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Journal of the Institute of NUCLEAR MATERIALS MANAGEMENT

Feature Technical Articles

Table of Contents

REGULAR FEATURES

SPECIAL ARTICLES

ANNOUNCEMENTS AND NEWS

ADVERTISING INDEX

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EDITORIAL

The Beginning of the INMM Journal and Proceedings

By **Dr. William A. Higinbotham**
Brookhaven National Laboratory
Upton, New York

Proceedings of the Annual Meeting of the INMM have been published each year, starting in 1960. The first issue of the Journal was published in April of 1972.

During 1970-71, a very interesting and constructive study of safeguards was performed at the Kansas State University, Manhattan, Kansas, supported by a grant from the National Science Foundation, which involved participation of political and social scientists, as well as scientists and engineers. The project culminated with a symposium and the publication of a still useful book "Preventing Nuclear Theft: Guidelines for Industry and Government," edited by Robert Leachman and Philip Althoff.

Dr. Curtis G. Chezem, then head of the Nuclear Engineering Department of KSU, discovered Thomas A. Gerdis, who was doing editorial work for the University, and the two of them launched our Journal.

A couple of years later, I was persuaded to become the technical editor, by which time Tom Gerdis was doing everything else: collecting information on the Institute, hounding the officers for contributions, stimulating technical contributions, putting the pieces together and overseeing the publication and distribution. He also became responsible for designing and printing brochures, mailing out dues notices and assisting on public relations. Still, it was for him only a part time job.

In June, Tom found another challenging job which required him to give up the Journal assignment. Needless-to-say, this presents the Institute officers with a very difficult problem since Tom has been responsible for developing the Journal into a respected technical publication and a forum to coordinate safeguards activities, world-wide.

Ed Johnson and his colleagues at E.R. Johnson, Associates, have taken on the difficult task of managing and editing the Journal. It has taken time for us to pick-up the pieces and to get the publications back on schedule. We solicit your patient understanding.

My assignment, as technical editor, has been simply that. Tom, on the other hand, has kept track of everything and has been a continuing source of good ideas which have greatly improved the technical, as well as the other content. He is a great guy to work with. We all wish him well.

Higinbotham

CHAIRMAN'S COLUMN

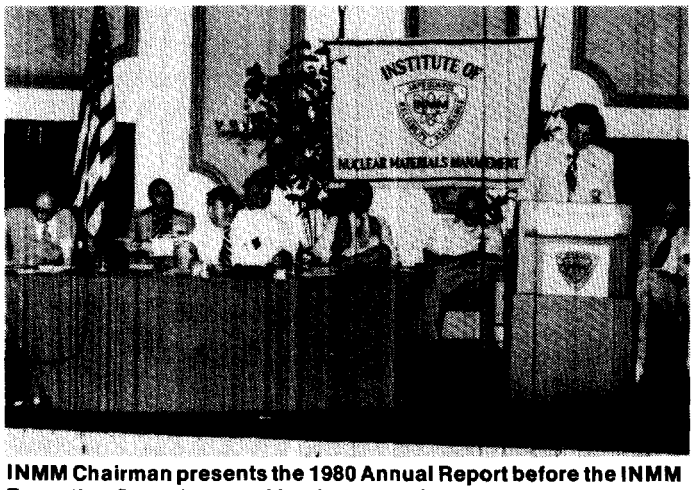
"The Changing of The Guard"

By **G. F. Molen,** Chairman
Institute of Nuclear Materials Management
Aiken, South Carolina

As of October first of this year we had a "changing of the guard". Bob Keepin, after two very successful years as Institute Chairman, has relinquished the reins to none other than yours truly. Bob has left some mighty big shoes to fill. In fact so big that I've chosen not to try to fill them. Bob's capabilities, talents and enthusiasm have meant so much to the Institute's growth that I plan to use Bob in several important and strategic roles (that is, if he is willing to continue to serve). To begin with, Bob will have oversight responsibilities for two of our most important standing committees, "Safeguards" and "Certification". Bob has long been a strong proponent of these efforts and I'm sure with his support and the fine leadership abilities of Bob Sorenson (Battelle Pacific Northwest Labs) for the Safeguards Committee and Fred Tingey (University of Idaho) for the Certification Committee that these two committees will make great strides in the next two years.

In addition, because of Bob's excellent professional reputation in congressional and political circles and because of his many and varied international contacts, I plan to call on him to represent the Institute in those endeavors which can best be pursued through political or international means. In this sense and from time to time Bob will be "our man in Washington" or "Vienna" or whatever the case may be. To me, Bob as the immediate Past Chairman has far too much experience, savvy, and common sense, as well as a good understanding of the desires of the Institute and its membership, not to be used to the fullest extent possible. I plan to do just that.

October first represented yet another milestone. Beginning on that date we welcomed two new members to the Executive Committee, Carleton Bingham of the New Brunswick Laboratory at Argonne, Illinois and Roy Crouch of DOE's Albuquerque Operations Office. (You may remember that Roy served as the Local Arrangements Chairman for the very successful 1979 Annual Meeting held at the Albuquerque Hilton.) These two gentlemen bring with them a wealth of valuable experience and we are looking forward to having them serve on the Executive Committee. Carleton will have oversight responsibilities for the N-15 Standards Committee and the Awards Committee. These two committees will continue to be chaired by Dennis Bishop (General Electric) and Ralph Lumb (NUSAC), respectively. Roy Crouch will have oversight responsibilities for the Education Committee chaired by Harley Toy (Battelle Columbus) and the Public Information Committee formerly chaired by Herman Miller (INET Corporation). I say formerly chaired because Herman has asked to be relieved of his responsibility since he will be serving as the Local Arrangements Chairman for the 1981 Annual Meeting at the Sheraton Palace in San Francisco. Accordingly, we (Roy and I) are looking for a willing and able-bodied volunteer. Any takers?



INMM Chairman presents the 1980 Annual Report before the INMM Executive Committee and Institute members in attendance at the 21st Annual INMM Business Meeting on Tuesday, July 1 in Palm Beach.

At the Goombay Buffet Dinner at the Breakers Beach Club on Tuesday evening, July 1, INMM Chairman Bob Keepin presents a plaque to former INMM Journal Editor, Tom Gerdis, in appreciation of Tom Gerdis' many years of dedicated service to the Institute.

The other members of the Executive Committee also have oversight responsibilities. John Jaech (Exxon Nuclear) as our new Vice-Chairman has responsibility for the Annual Meeting Committee. Serving him on this committee are Dick Chanda (Rockwell-Rocky Flats) as Program Chairman, Joe Stiegler (Sandia-Albuquerque) as Arrangements Chairman, and Ray Lang (DOE's Chicago Operations Office) as Site Selection and Future Arrangements Chairman. John is also responsible for Technical Working Groups. Tom Sellers (Sandia-Albuquerque) continues as Chairman of the Technical Working Group on Physical Protection. In addition, John has appointed Carl Bennett (Battelle Human Affairs Center) to chair the second technical working group which is to be called the Statistics Technical Working Group. Carl has an impressive precedent set by Tom Sellers and his group and we are anxious to see this new working group begin its activities. Good luck, Carl!

Vince DeVito (Goodyear Atomic) as our venerable Secretary has oversight responsibilities for Chapters both existing, newly formed, or emerging. Vince also monitors the activities of the Membership Committee under the new leadership of John Barry of Gulf States Utilities. Sam McDowell (DOE's Safeguards and Security Headquarters Office) has oversight responsibility and is Chairman of the ad hoc committee on Long Range Plans. This is probably one of the most vital committee appointments made in the Institute in recent years. The purpose of this committee is to lay out a plan, a road map if you will, for the long range future of the Institute. It is a very challenging task that Sam and his committee have undertaken. We wish them the very best in their deliberations and I urge you to offer your support of this effort in any way that you can.

And last, but certainly not least, is one of the hardest working members of the Executive Committee, Yvonne Ferris (Rockwell-Rocky Flats). Yvonne has oversight responsibilities for the By-Laws and Constitution Committee (Chairman of this committee is Roy Cardwell of Union Carbide-Nuclear Division) and the INMM Journal. This latter responsibility has taken

Past Chairmen of the INMM attending the 21st Annual Meeting in Palm Beach, Florida. Left to right are Harley Toy, Battelle, Columbus, Ralph Lumb, NUSAC, Bob Keepin, LASL, Roy Cardwell, ORNL, Ed Johnson of E. R. Johnson Associates, Inc. and Tom Bowie of Combustion Engineering.

At the Goombay Buffet Dinner on Tuesday evening, July 1, Chairman Bob Keepin presents a gift to Tom Sellers, Sandia Laboratories, in recognition of his energetic leadership as Chairman of the INMM Technical Working Group on Physical Security.

At a luncheon on Tuesday, July 1 hosted by the Department of Energy, Office of Safeguards and Security. L to R: Hugh Sturman, UK: Sergio Finzi, Italy; H. Gruemm, IAEA; Fred Brown, UK; W. Von Osten, FRG; George Weisz, OSS (luncheon host); Dipak Gupta, FRG; Bob Keepin, LASL; Bob Uhrig, F.P.&L.; and G. Jean Pierre, C.E.A. France.

"Charlie, I can tell you one thing for certain, it's not the burden of regulations but rather the burden of all this southern hospitality and good food which keeps you safeguards guys so heavily loaded". Left is Bob Burnett, USNRC and right is Charlie Vaughn, GE-WMD.

on a new dimension with the departure of our former Journal Editor Tom Gerdis (U.S. Ecology). Loss of the Editor this past summer necessitated some significant changes in the administration and operation of the Institute. After lengthy debate and discussion by the Executive Committee and after careful review of several proposals, E.R. Johnson Associates, Inc. (JAI) of Reston, Virginia was retained as the INMM Secretariat based on a signed "Agreement for Services" for the period July 1980 through September 1981. As the INMM Secretariat, JAI will supply the necessary personnel and facilities for the administration and operation of the Institute. Primarily this will involve publication of the INMM Journal, Annual Meeting Proceedings, and certain printing and publication services associated with the activities of the Annual Meeting Committee, the Education Committee, the N-15 Standards Committee, and other standing committees as appropriate.

Let me take this opportunity to personally commend Yvonne for the outstanding job she has done in making this transition as smooth as possible. She has served "above and beyond the call of duty" and her dedication has been unrelenting. We, the membership, and especially the Executive Committee, owe her a debt of gratitude for the fine job she has done.

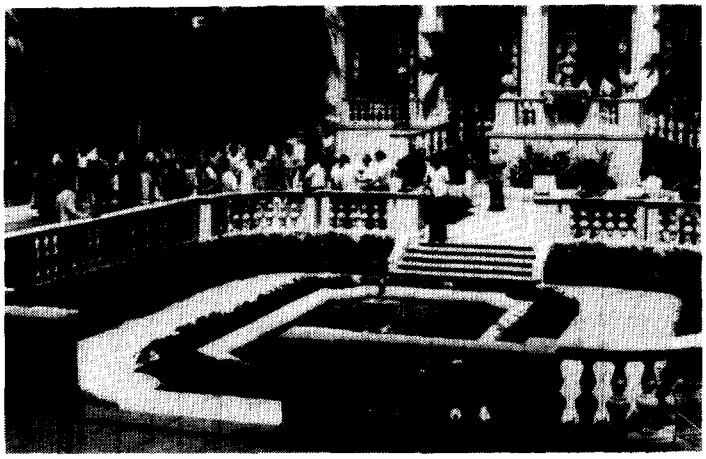
In closing let me say that the Institute is alive, well, and thriving. We are actively pursuing our certification program, particularly the legal liabilities of such a program. Our emphasis on education and training are continuing in that we have had numerous discussions on the possibility of presenting a second workshop on the impact of the US-IAEA agreement. Our standards committees are issuing standards and the Annual Meeting Committee is already well underway in preparing for the San Francisco meeting. Much is being done and there is plenty more to do. We need more volunteers, new ideas, different perspectives, and some fresh breaths of enthusiasm. Won't you join us? Contact me or any of the Committee Chairmen if you are interested.

Registration Committee of the 21st Annual Meeting in Palm Beach, Florida. Back Row (left to right) H. C. Austin, ORNL, P. M. Hennan SNL, O. L. Meadors, ILL, D. A. Dunn, Chairman, Rockwell. Front row (left to right) Fred Lyons, Rockwell, E. A. DeVer, Mound Labs, W. T. Dickenson, DuPont, SRL, M. M. Thorpe, LASL.

General discussion following the meeting of the IAEA International Working Group on Reprocessing Plant Safeguards. L to R: Hugh Sturman, UK; Bob Uhrig, Florida Power and Light; Charles Petrie, NBL; Howard Menlove, LASL; Jim Lovett, IAEA; and Wold Von Osten, FRG.

At the Goombay Buffet, members of the 1981 Executive Committee were introduced. L to R: Bob Keepin, LASL; John Jaech, Exxon; Gary Molen, SRL; Yvonne Ferris, RIRF; Vince DeVito, GAT; Ed Owings, Y-12. The three Executive Committee members not shown here are Carleton Bingham, NBL; Roy Crouch, ALOO; and Sam McDowell, DOE/OSS.

Part of the Tennessee delegation attending the 21st Annual Meeting gather at E. R. Johnson's "Watering Hole". Union Carbide Nuclear Division Personnel (standing, left to right, with Johnson) are Ed Owings, Enzo Ricci, Bill Wilson, Barbara and Roy Cardwell, and Mike Younkin. Seated are Jill Cooley, Lynn Owings, and Barbara Younkin.



The Terrace Garden in the Breakers provided a delightful setting for the morning and afternoon coffee breaks at the Palm Beach Meeting.

Dr. H. Gruemm, Deputy Director General, Department of Safequards of the International Atomic Energy Agency addressing the first session of the 21st Annual Meeting in Palm Beach, Florida.

Bob McBroom, General Atomic Company, chats with new INMM Chairman Gary Molen and his wife, Sara.

At the Chairman's reception on Sunday evening, June 29. Charles Beets, CEN/SCK Mol, Belgium, greets Madge and Bob Keepin.

Nominating Committee Solicits Input

The INMM nominating committee will soon begin to prepare an election slate FY 82 (10-1-81 to 9-30-82). Candidates for all four offices (Chairman, Vice-chairman, Secretary and Treasurer) and two Executive Committee-At-Large positions will be offered to the membership.

The committee solicits your suggestions and comments. The deadline for such information is March 15, 1981. Address G. Robert Keepin, Chairman, INMM Nominating Committee, Los Alamos Scientific Laboratory, MS#550, Los Alamos, New Mexico 87545.

VICE-CHAIRMAN'S COLUMN

Planning For San Francisco Meeting In Capable Hands

By **John L. Jaech,** Vice-Chairman
Institute of Nuclear Materials Management
Richland, Washington

As INMM Vice-Chairman, I am automatically designated to be the Annual Meeting Chairman in planning for the 22nd Annual Meeting to be held in San Francisco in July, 1981. This assignment is not as difficult as it may seem because of the experienced and capable committee chairmen that have agreed to continue their outstanding service to our organization during this next INMM year.

Specifically, I am speaking of Joe Stiegler, veteran Chairman of the Meeting Arrangements Committee and of Dick Chanda, an outstanding contributor to the Technical Program Committee for the past several years. Dick was Chairman of the Contributed Papers Subcommittee for the Albuquerque and Palm Beach Meetings, and has now agreed to serve as Technical Program Committee Chairman for the San Francisco meeting. I consider it an honor and a privilege to be associated with Joe and Dick in this capacity, and rely heavily on them and on members of their Committees. Their conscientious efforts are essential to the continued success of our annual meetings, and, I am sure, are appreciated by the membership.

In the Winter and Spring issues of this Journal, Joe and Dick will provide detailed information on plans for the upcoming meeting in their own respective columns. As of this point in time, let me assure you that planning is well underway for a truly outstanding meeting in a truly outstanding locale.

As Arrangements Chairman, Joe Stiegler is assisted by the following individuals:

Herman Miller - Local Arrangements Chairman
Duane Dunn - Registration Chairman
Mary Ellen Dodgen - Communications and Publicity Chairman
Tom McDaniel - Exhibits and Displays Chairman
Tony Kraft - Photography Chairman

In making a preliminary statement about the 1981 meeting, Joe writes, "The Committee had their first meeting at the Sheraton Palace Hotel in San Francisco in preparation for the 1981 Annual Meeting. The Sheraton Palace is a famous San Francisco hotel and is being beautifully remodeled and has ample facilities for our Annual Meeting. And, of course, San Francisco or Baghdad by the Bay has got to be one of the most unique cities in the world with hundreds of fine restaurants and much to see and do. So we have all the ingredients for another fine Annual Meeting with the large attendance that we have had the last two years."

Turning to the Technical Program Committee headed by Dick Chanda, he has appointed the following Subcommittee Chairmen:

John Glancy - Contributed Papers Chairman
George Huff - Invited Papers Chairman
Dick Chanda - Plenary Session Chairman (assisted by Dennis Wilson)

In his preliminary thoughts on the 1981 meeting, Dick writes, "Some new twists will be added to next year's meeting while retaining the basic format that has proven so successful the last two years. For example, a poster session is being considered and one or two invited paper sessions will utilize discussants or commentors.

Since the nuclear issue continues to be a controversial one in the media and government and, therefore, in the eyes of the public, a special session is being planned which will focus on the public's perceptions of nuclear power and safeguards and how we as professionals can and should respond. This will be a "mental workshop" for both speakers and audience, so come prepared to be challenged!"

I most certainly also want to acknowledge the very important role played the past few years by Ray Lang, Site Selection Chairman. Ray continues in this capacity this year. His experience and knowledge has served the INMM well in selecting hotels suited to our needs. We thank him for his major contributions to the success of our annual meetings.

Turning to another subject, under Gary Molen as past Vice-Chairman, the first Technical Group was created in 1979 under the very able leadership of Tom Sellers. This Group, on Physcical Protection, was formed somewhat as an experiment to determine the advantages of forming such groups. The report card is now in, and Tom's efforts in conducting two most successful workshops have earned him a rating of 10, making him a member of a rather elite group.

The success of this experiment has now led to the formation of our second Technical Group, one on Statistics. We are indeed fortunate to have as our initial Chairman of this group a distinguished long-time member of the Safeguards Community, and of the INMM, Carl Bennett. Because of heavy time commitments, Carl will be unable to devote effort to this assignment until January, 1981, but the wheels are in motion. We wish him success in this assignment.

John Jaech

AWARDS COMMITTEE REPORT

Student Award Announced

By **Dr. Ralph F. Lumb,** Chairman
Awards Committee
McLean, Virginia

Once again the INMM is sponsoring a student award for the best paper submitted by a student to the Institute for presentation at the Annual Meeting to be held in San Francisco on July 14-16, 1981. The award consists of a $500 honorarium, an opportunity to present the paper at the Annual Meeting with all travel and subsistence paid by the Institute, and a complimentary membership in the INMM.

Announcement of the student award program has been mailed to engineering departments of colleges and universities throughout the U.S., to the IAEA and Euratom, and to INMM chapters in Japan and Vienna, Austria. Papers have been requested by March 1, 1981; it is planned to announce the winning student during April. A copy of the announcement of the program with details of the requirements to qualify is reproduced elsewhere in this issue.

The Institute will also be presenting a Distinguished Service Award to one of its members who has served Nuclear Materials Management and the Institute with distinction through the years. The Awards Committee will be evaluating nominations in March; hence, all nominations for candidates for the Distinguished Service Award should be forwarded to the Chairman of the Awards Committee by March 1, 1981. The details regarding the Award can be found elsewhere in this issue of the Journal.

The Awards Committee also considers various meritorious awards for special recognition of services to the Institute. The membership is urged to call to the attention of any member of the Committee (B. Gessiness, W. Higinbotham, R. Lumb) special circumstances which warrant recognition in the form of an award. These will be considered carefully and appropriate awards made at the Annual Meeting.

Each member can contribute to one or more of these programs. Please sit down today and write to the Committee with your suggestions and nominations.

Third Annual Student Award being presented to Mohammad Sharafi of MIT by Dr. Ralph Lumb at the 21st Annual Meeting in Palm Beach, Florida.

INMM Annual Distinguished Service Award

To be presented
July 1981
at the
Twenty-second Annual Meeting
San Francisco, California

It is the intent of the Institute to present its Annual Distinguished Service Award to a deserving individual during its 22nd Annual Meeting. Nominations will be accepted until March 1, 1981.

Selection will be based upon dedication and contributions to the field of safeguards and nuclear material management. Nominees need not be members of the INMM.

Nominations should include a biographical sketch and supporting information.

Submit nominations to:
Ralph F. Lumb
Chairman, Awards Committee
c/o NUSAC, Incorporated
7926 Jones Branch Drive
McLean, Virginia 22102

More Applicants Take Certification Examination

By **Dr. Fred H. Tingey**
University of Idaho
Idaho Falls, Idaho

The Certification Program got off to a flying start at the annual meeting in Palm Beach with four applicants taking the certification examination. As a result of the examination and the prerequisite qualifications, all four applicants were certified as Safeguards Interns.

The operation of the Certification Board is governed by a set of bylaws and procedures including an application form considered and approved by the Executive Committee.

Subsequent to the Palm Beach meeting certain questions relative to certification were raised by a legal firm retained by the Institute. The questions were of a nature as to result in the program being placed on "hold" until such time as the Executive Committee can meet and resolve them.

In the meantime assignments were made within the existing Board membership to update and supplement the examination library and to determine what action might be taken to stimulate individuals to become certified. Pending a resolution of the legal questions to the satisfaction of the Executive Committee, an aggressive program will be implemented to provide opportunity for examination to all those that desire certification.

It is anticipated that Certification Examinations, in addition to being available at the annual meeting, will be organized and administered regionally. This will come about through the execution of an application form by the interested party which will identify the time period of availability and regional preference. The applications will then be organized and the examinations given by a member of the Certification Board.

Application forms will be available from the Chairman of the Certification Board on request. They also will be included in subsequent publications of the Journal. The question of proper training prior to certification is one of continuing concern to the Certification Board. Consequently the short courses being sponsored by the Institute are highly encouraged.

The Certification Board met on November 4 in conjunction with the meeting of the Executive Committee. The agenda included bylaws revisions, changes in wording in the application form, review of supplemental material for the examination library, security of the examination library, certification standards, training incidental to certification, examination frequency and locations, advertising, certification plaques and awards, certification procedures, and the annual budget.

Tingey

Education Committee Formulates Plans For 1981

By **Harley Toy,** Chairman
Education Committee
Columbus, Ohio

As we start to wind down activities for the year the Education Committee is looking to 1981. Our initial plan is to continue formal course offerings in Statistics and Accounting in the coming year. We are also proposing to expand course offerings to include nuclear materials measurement technology. Such a course offering in measurements would compliment DOE's LASL Safeguards Technology Program. We will look to Past Chairman Keepin for guidance in this endeavor. Our educational program for 1981 will be submitted to the Executive Committee for their approval and guidance.

A review of educational activities during the past few months reveals:

- John Jaech's statistics courses, Introductory and Selected Topics were presented in Columbus during September. The two courses were given back-to-back on September 10-12 and September 15-19, 1980. The courses attracted some eighteen (18) attendees representing government agencies and the industrial sector. Present plans call for presenting the courses again during the second quarter of 1981. Feed-back on the courses continues to be excellent.
- The Short Course in Accounting and Auditing for Nuclear Material was given on November 18-21, 1980, at Richland, Washington. The course was coordinated by Bob Sorenson. Shelly Kops was lead instructor, assisted by Cal Solem and Paul Korstad.
- Liaison was continued with NRC regarding the presentation of formal courses at NRC Headquarters. We anticipate that plans will be confirmed for the presentation of John Jaech's statistical courses at NRC Headquarters in the first quarter of 1981.
- The Education Committee continued its ongoing activity in responding to requests for information in the Safeguards area. We have experienced a steady flow of requests from high school and college students regarding the U.S. Safeguards Program.

Returning to proposed plans for calendar 1981, we will continue to pursue the presentation of educational programs on a regional basis. Discussions are still underway with Roy Cardwell concerning presentations of the statistics and accounting courses in the Oak Ridge area.

The Education Committee solicits and welcomes input and comments from the general membership concerning current educational activities.

Upcoming conferences, workshops, and meetings which may be of interest are presented below.

AMERICAN NUCLEAR SOCIETY

- ANS - EXECUTIVE CONFERENCE ON HUMAN FACTORS
  February 8-11, 1981
  Monterey, CA

- ANS - NUCLEAR POWER ASSEMBLY
  May 19-20, 1981
  Washington, DC

- ANS ANNUAL MEETING
  June 7-12, 1981
  Miami Beach, FL

- ANS WINTER MEETING
  November 29 - December 4, 1981
  San Francisco, CA

U.S. DEPARTMENT OF ENERGY SAFEGUARDS TECHNOLOGY TRAINING PROGRAM

- ADVANCED INSTRUMENTATION BASED ON NEUTRON DETECTION METHODS
  (To be presented in early 1981)
  Contact:
  Karen Humphrey
  USDOE Safeguards Technology Training
  Los Alamos Scientific Laboratory
  P.O. Box 1663
  Los Alamos, NM 87545
  505-677-6394 or FTS 843-6394

INTERNATIONAL ATOMIC ENERGY AGENCY

- REGIONAL SEMINAR ON FUNCTIONS AND ORGANIZATION OF SECONDARY STANDARDS DOSIMETRY LABORATORIES WITHIN THE IAEA/WHO NETWORK OF SSDLs FOR DEVELOPING COUNTRIES IN AFRICA
  Location and dates to be announced later
  Contact:
  International Atomic Energy Agency
  Wagramerstrasse 5
  P. O. Box 100, A-1400
  Vienna, Austria

ATOMIC INDUSTRIAL FORUM

- INFO '81
  February 22-25, 1981
  Adams Hotel
  Phoenix, AZ
- FUEL CYCLE CONFERENCE '81
  March 15-18, 1981
  Century Plaza
  Los Angeles, CA
- WORKSHOP ON REACTOR LICENSING AND SAFETY
  April 12-15, 1981
  Royal Sonesta
  New Orleans, LA
- FINANCE CONFERENCE
  May 3-6, 1981
  New York Hilton
  New York, NY

Contact:
Conference Office
Atomic Industrial Forum, Inc.
7101 Wisconsin Avenue
Washington, D. C. 20014
TWX 7108249602 Atomic for DC

UNIVERSITY OF ARIZONA

- FUNDAMENTALS OF INDUSTRIAL HYGIENE
  (Recognition, Evaluation and Control of Occupational Health Hazards) This course is designed for the non-industrial hygienist.
  March 9, 1981
  Tucson, AZ

Contact:
Herschella L. Horton, R.N.
University of Arizona
Health Sciences Center
Tucson, Arizona 85724
(602) 626-6835

SELECTED TOPICS IN STATISTICAL METHODS FOR SPECIAL NUCLEAR MATERIAL CONTROL
September 15-19, 1980 Columbus, Ohio

Standing (L to R): William Walsh, Neil Harms, John Adams, Robert Kinnison, Richard Bardo, Leslie Davenport, John Chinault, Billy Sansom, Lavella Adkins, Harley Toy.

Seated (L to R): Richard Peavy, Martin Messinger, John Jaech, Janet Pindak, Bruce Erkkila, Werner Bahn.
Not Pictured: Brett Gallatin, Mark Laidlow, Ken Long, and Matthew Suwala.

INMM Workshop Held on Guard Training

By **Dr. L. P. Robertson,** Workshop Coordinator
Sandia National Laboratories
Albuquerque, New Mexico

T. A. Sellers, Chairman of the INMM Technical Group on Physical Protection, welcomed over 60 participants to the Workshop on Guard Training held August 27-29, 1980, at the Sheraton Hotel in Gatlinburg, Tennessee. This is the second workshop which has been sponsored by the Technical Group on Physical Protection (the first was on Intrusion Detection Systems as reported in Nuclear Materials Management, Spring 1980, pp. 28-29). Special thanks go to **William Knauf,** DOE-Office of Safeguards & Security, who gave an excellent keynote address and to **Gary Molen,** DuPont, who reviewed the current activities of INMM for the participants. Each of the small group session moderators also did an outstanding job in making major contributions to the success of the workshop.

The workshop began on the evening of August 27 with a registration and a "get acquainted" cocktail party. Participants represented a wide range of organizations including private utilities, commercial security organizations, engineering and consulting firms, and governmental agencies.

Following the moderator's breakfast on August 28, all participants met in a general workshop orientation meeting where Bill Knauf gave a talk stressing the critical role played by the human element of our physical protection systems and the extreme importance of training in that role. Following the general meeting, the participants separated into seven separate small session workshops for the remainder of the day and then into another four sessions the next morning. The small group sessions were conducted by individual volunteer moderators.

Prior to the meeting each attendee had been asked to rank order their preference of topics from a broader list than those actually covered at the workshop. The preference list was used by the Program Committee to select the preferred topics, select the session moderators, and to separate the sessions for minimum conflict of interest areas. Eleven separate topics were covered during the workshop, and were attended by 12 to 20 persons.

Session I, moderated by W. G. Floyd, Nuclear Regulatory Commission, involved discussions and interchange of information on the mission of the security force. It was concluded by the group that the best that security organizations could do in relation to the protection of assets and in view of the current restrictions placed upon security actions, would be to minimize threats.

Session II, moderated by W. D. Telfair, Professional Management Associates, covered the physical and medical standards for security personnel. Various operating physical training programs were discussed. A summary was given of the development work in setting physical standards being funded by DOE.

Session III involved tactical training techniques and was moderated by Douglas R. Cavileer, NUSAC. The realism of training was stressed both in terms of objectives and training experiences. MILES devices were seen as having excellent realism.

Session IV covered special guard equipment and was moderated by E. L. Musselwhite, Allied General Nuclear Services. Participants expressed displeasure with currently used equipment and felt that more

Typical small group workshop session

Participants being entertained by local musicians at banquet

developmental work should be done. It was felt that equipment should be based upon approved contingency plans and not upon general DOE or NRC regulations.

Contingency plans were discussed in Session V, moderated by M. T. Ridge, Dupont-Savannah River. Realistic, well-tested contingency planning was felt to be a necessary part of guard training. Management support of these plans was seen as essential.

Session VI, communications, was moderated by Elgin J. Arave, DOE-Dayton Area Office. Problems concerning radio communications including procedures, discipline, security, and equipment were discussed. The participants stressed the complexity of emergency communications and the need for much more attention to this critical part of physical protection systems.

Session VII, moderated by Manfred Von Ehrenfried, International Energy Associates Limited, discussed command post and control room operations. Participants felt that few stations are human engineered or were of current technology. This complicates the training required for operators and decision makers. Improvements are needed was the conclusion.

Session VIII covered special situations training and was moderated by R. E. Myers, Florida Power & Light Co. Proper contingency plans will include the many situations other than violent attempts at theft or sabotage which may confront guards. From these plans the training plans can be developed. The session focused upon the special situation involving hostages and demonstrations.

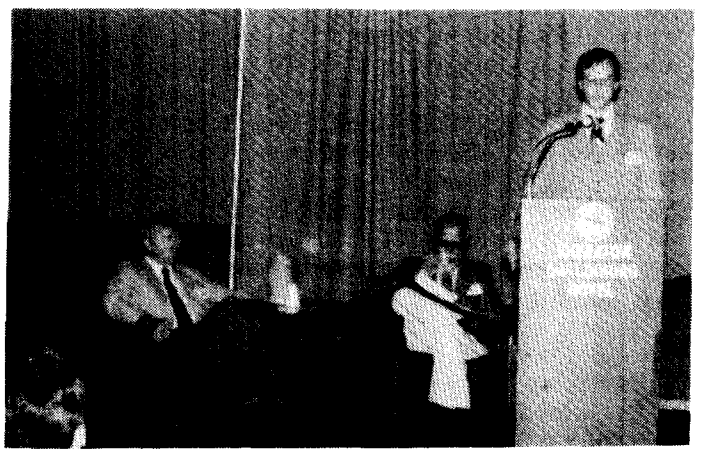
Larry R. Moore, Union Carbide-Oak Ridge, moderated Session IX which covered overcoming guard complacency. Realistic and compatible organizational and individual objectives coupled with training and job experiences were viewed as excellent methods of reducing guard complacency.

Session X, moderated by Janet V. McGee, Duquesne Light Co., discussed performance-oriented training procedures. The need for thorough job or task analyses prior to the development of training programs was stressed. Testing was seen to be directly related to the individual's actual job and based upon the task or job analysis.

Session XI covered the legal constraints and legal obligations and was moderated by J. J. Cadwell, Brookhaven National Laboratory. The legal problems were highlighted which result when a guard or guards are placed in a position to intercept, delay entry, or arrest an intruder. It was concluded that the guard had to act in a **reasonable** manner in determining the level of threat and in responding to an intrusion. Forcing a guard to act in this way in the face of possible sabotage or theft is a difficult requirement and is much the same as that imposed upon police officers who are also often in life-or-death situations.

A summary session for all participants concluded the workshop. Each moderator presented the highlights of the items discussed in their particular small group session. Proceedings of the workshop consisting of summaries of the small-group sessions have been prepared and distributed to all participants. Copies are available from the Chairman of the INMM Technical Group on Physical Protection (T. A. Sellers, (505)-844-4472).

Judging the verbal responses from the participants, the workshop was indeed a complete success. The majority of the participants felt that another workshop on guard training should be held within a year and with even greater concentration on the ever present problems encountered when conducting guard training. It is the intention of the Technical Group to plan another workshop in this area within the coming calendar year.



Opening address by Bill Knauf, DOE (On stage is T. A. Sellers & L. P. Robertson)

Briefing on INMM Activities by Gary Molen at Banquet

Institute of Nuclear Materials Management

TECHNICAL WORKSHOP ON PHYSICAL PROTECTION

Sheraton Charleston Hotel, Charleston, S. C.

March 9-12, 1981

THE PURPOSE OF THIS WORKSHOP WILL BE TO DISCUSS SPECIFIC TECHNICAL AND OPERATIONAL PROBLEMS RELATED TO PHYSICAL PLANT SECURITY, PRIMARILY EXTERIOR INTRUSION DETECTION SYSTEMS. THIS WORKSHOP IS A MUST FOR ANY INVOLVED IN THE ENGINEERING, OPERATIONS AND MAINTENANCE OF PHYSICAL PLANT SECURITY.

FOR MORE INFORMATION PLEASE CONTACT:

D. A. McDaniel (302) 429-5259
Columbia LNG Corporation
20 Montchanin Road
Wilmington, Delaware 19807

MEMBERSHIP COMMITTEE REPORT

INMM Membership Is Growing

By **John E. Barry,** Membership Chairman
Gulf State Utilities Company
Beaumont, Texas

Coincidental as the U.S. Senate consent and the Presidential final ratification of the United States - IAEA Safeguards Treaty were to my first month's tenure as INMM Membership Committee Chairman, those events, I feel, emphasize how totally involved the U.S. nuclear industry has become in broad, international issues, like it or not, from industry or government points of view!

The importance and effectiveness of the Institute of Nuclear Materials Management in professionally promoting cooperative and constructive actions in the international safeguards arena will be proportional to our membership strength, its makeup and the activism, technically and otherwise, of individual members. I believe the INMM, through professional endeavors, can, and indeed must, help ensure beneficial and greatly expanded nuclear power development worldwide in this era of global concern and tension over petroleum logistics — and therefore peace and economic progress for all.

INMM is continuing to grow with membership now over 725. By the next issue we hope to detail how this committee will seek to better serve you on a regional basis. As you know discount membership packages were distributed at the Annual Meeting and remnants, while they lasted, have been mailed to prospective members. In all about fifty invitations to join the INMM were mailed during the period between the Annual Meeting and September 30, 1980, many at the recommendation of present members. I ask you to continue to forward the names of your qualified friends and colleagues to me.

The following fifty-four individuals have been accepted for INMM membership during the period March 1, 1980 to September 30, 1980. To each, the INMM Executive Committee extends its welcome and congratulations. New members not mentioned in this issue will be listed in the Winter 1980/1981 (Volume IX, No. 4) issue:

Institute of Nuclear Materials Management New Members

Dr. Rudolf Bodege, Deutsche Gesellschaft fur, Wiederaufarbeitung von, Kern Brennstoffen NBH, Postfach #1407, 300 Hannover 1 FRG, 011 69511 3990420.

Duane R. Bradley, Management Engineer, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL 60439, 312-972-7308.

Clarence P. Breskovic, Safeguards Technician, International Atomic Energy Agnecy, Vienna International Center, P.O. Box 100, A-1400 Vienna, Austria, 23-60-1889.

Thomas R. Canada, Assistant Group Leader, Los Alamos Scientific Laboratory, MS 539, Los Alamos, NM 87545, 505-667-6779.

Joel A. Carter, Section Head, Union Carbide, ORNL, P.O. Box Y, Bldg. 9735, Oak Ridge TN, 37830, 615-574-2447.

Harvey T. Cohen, Supervisor, Combustion Engineering, 1000 Prospect Hill Rd., Windsor, CT 06095, 203-688-1911.

Robert S. Craig, Nuclear Fuel Engineer, Florida Power & Light, P.O. Box 529100, Miami, FL 33152, 305-552-4067.

Rosemary G. Dalton, Qualtiy Control Engineer, Westinghouse, NFD, P.O. Drawer R, Columbia, SC 29209, 803-776-2610.

Ronald G. Dennys, International Atomic Energy Agency, P.O. Box 100, A-1400, Vienna, Austria, 2360-1857.

Peter P. DeRegge, Section Head, SCK-CEN, Boeretang, 200, Mol B-2400 Belgium.

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Larry V. East, Applications Eng. Manager, Canberra Industries, Inc., 45 Gracey Ave., Meriden, CT 06450, 203-238-2351.

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John H. Ellis, Manager, Nuclear Materials Control, Allied General Nuclear Services, P.O. Box 847, Barnwell, SC 29812, 803-259-1711.

David M. Ericson, Jr., Member Technical Staff, Sandia National Laboratories, Division 4414, P.O. Box 5800, Albuquerque, NM 87185, 505-844-3402.

Leslie G. Fishbone, Associate Scientist, Brookhaven National Laboratory, Building 197C, Upton, NY 11973, 516-345-2942.

Owen H. Gailar, Associate Professor, Purdue University, W. Lafayette, Indiana 47907, 749-2675.

Robert F. Gronemeyer, Assistant Special Material Rep., Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, Illinois 60439, 312-972-7390.

Hans Gruemm, Dep. Dir. General, International Atomic Energy Agency, Wagramerstr. 5, P.O. Box 100, A-1400 Vienna, Austria, 2360-1800.

Richard C. Hagenauer, Chemist, New Brunswick Lab., Dept. of Energy, 9800 S. Cass Avenue, Argonne, IL, 312-972-2460.

Donald A. Hamilton, Nuclear Fuel Inspector, Commonwealth Edison, One First National Plaza, P.O. Box 767, Chicago, IL, 60690, 312-294-8088.

John B. Jennings, Sectional Engineer, Mason & Hanger - Silas Mason Co., P.O. Box 30020, Amarillo, TX 79177, 806-335-1581, ext. 2135.

Clifford E. Johnson, Program Manager, Exxon Nuclear Idaho, CPP-637, P.O. Box 2800, Idaho Falls, ID, 83401, 526-2281.

Charles Joseph, Specialist, Nuclear Materials Controls, Allied General Nuclear Services, P.O. Box 847, Barnwell, SC 29812, 803-259-1711.

Bruce R. Judd, Principal, Applied Decision Analysis, Inc. 300 Sand Hill Road, Menlo Park, CA 94025, 415-854-7101.

Stephen Kaiser, Administrator, Euratom Safeguards Directorate, Batiment Jean Monnet, BP1907, Luxembourg, LUX 4301-3073.

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Martin Messinger, Operations Research Analyst, USNRC, Washington, D.C. 20555, 301-427-4024.

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Mark F. Mullen, Senior Research Scientist, Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352, 509-942-4369.

Carolyn R. Mullendore, Technical Specialist, U.S. DOE, DSS, Century 21 Bldg., Germantown, MD, 301-353-5673.

Kaoru Naito, Professional Staff, International Atomic Energy Agency, Wagramerstrasse 5, P.O. Box 200, A-1400-Vienna, Austria, 2360-1861.

Patrick B. O'Callaghan, Technical Programmer, Westinghouse Hanford, P.O. Box 1970, Richland, WA 99352, 509-376-5823.

John A. O'Malley, 507 55th Street, W. Palm Beach, FL 33407.

Long "Cookie" D.Y. Ong, 754 Princeton Place, Rockville, MD, 20850.

Marvin W. Oonk, Consultant, 284 Transylvania Road, Woodbury, CN 06798, 203-263-2860.

Michael G. O'Rear, Chemical Engineer, U.S. Doe, P.O. Box A, Aiken, SC 29801, 803-725-3777.

Kenneth W. Poupa, Accountability Control Manager, Argonne National Lab., 9700 S. Cass Ave., Argonne, ILL 60439, 312-972-6782.

John C. Pratt, Staff Member, Los Alamos Scientific Laboratory, Box 1663, Los Alamos, NM, 87545, 505-667-5066.

Syed Y. Raza, Asst. Engineer, Pakistan Atomic Energy Commission, P.O. Box 114, Islamabad, Pakistan 25579.

Eugene W. Richard, Operations Research Analyst, U.S. NRC, Washington, D.C. 20555, 301-427-4387.

Mohammad Sharafi, Student, MIT, 77 Mass Ave., Nuclear Engineering, Dept. MIT, Cambridge, Mass. 02139, 617-253-3211.

Charlotte M. Sholeen, Engineer, Argonne National Lab., 9700 S. Cass Avenue, Argonne, ILL 60439, 312-972-3432.

Brian W. Smith, Engineer, Battelle-Northwest, P.O. Box 999, Richland, Wa 99352, 509-942-4425.

Alfren C. Sugarman, Staff Scientist, Science Applications, Inc., 5 Palo Alto Sq., Palo Alto, CA 94304, 415-493-4326.

Richard H. Sutton, Senior Consultant, International Energy Assoc. Ltd. 600 New Hampshire Ave., NW, Washington, D.C. 20037, 202-338-8230.

Joyce M. Taylert, Inventory Management Specialist, Exxon Nuclear Idaho Co., Inc., P.O. Box 2800, Idaho Falls, ID 83401, 208-526-2114.

Harold von Werner, Chief, MC&A Branch, USNRC, Office of Inspection & Enforcement, Washington, D.C. 20555, 301-443-5873.

Leon West, Manager, Nuclear Power Business Element, Canberra Industries, Inc., 45 Gracey Ave., Meriden, CN 06450, 203-238-2351.

Martin S. Zucker, Brookhaven National Laboratory, TSO Bldg. 197, Upton, L.I., N.Y 11973, 516-345-2929.

Address changes

Mr. Gary P. Kodman
International Atomic Energy Agency
P. O. Box 200
A-1400 Vienna, Austria

Mr. Gary Kodman is currently on a two year assignment with the IAEA Division of Operations. Prior to accepting this position, Gary was the Manager of Safeguards and Inventory Management at the Idaho Chemical Processing Plant which is operated for DOE by Exxon Nuclear Idaho Co. Inc. Gary also worked as a statistician for the Nuclear Materials Division of Babcock and Wilcox in Apollo, Pennsylvania. He will be in Vienna until October 1982.

Mr. William F. Lindsay
Science Applications, Inc.
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Albuquerque, New Mexico 87102

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Sarasota, Florida 33577

Mr. Ray Mulkin
108 Grand Canyon
Los Alamos, New Mexico 87544

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Albuquerque, New Mexico 87185

Robert A. Kramer
910 South Ridge Street
Crown Point, Indiana 46307

Barry

Assuming Technology Will Prevail

By **Dennis M. Bishop**
General Electric Co.
San Jose, Calif.

Being the INMM-N15 Standards Committee Chairman has a lot of disadvantage. Like your local minister, or building fund representative or tax collector, you sometimes get the feeling that people are avoiding you because they're afraid you'll remember the promises they made to have things done several months before.

In this regard, the operation of N15 Standards Committee is theoretically quite simple. It consists of two primary functions: (1) Organization and (2) Execution and follow-through. It is the later topic which I want to address in this N15 column.

Clearly these are difficult days for the nuclear business. Anti-nuclear extremists have attacked the very existence of the industry. The resulting uncertainty has brought into question the societal benefit of nuclear energy in general, and the effectiveness of ancillary issues such as safeguards in particular. Although it may be said that nuclear advocacy is on the upsurge, it is all still relative. As they say, when your up to your &!x?X in alligators, it is sometimes hard to see any change in trend, let alone an improvement. The point is that some have likened working on INMM N15 Standards to rearranging deck chairs on the Titanic. I wholeheartedly disagree for a variety of technical and professional reasons which are explained in the following discussion. It is all a matter of perspective.

Stage one: The thrill of Technology

During the decades of the 50's and 60's, those of us who had the opportunity to be involved in the nuclear industry were privileged to be part of an idealic industry. The commercial use of nuclear power was made a reality. The vision of unlimited and economical energy seemed to be within grasp. Centuries of technical and societal limits were on the verge of extinction as this literal quantum jump in energy expectation was made. I call this state in the development and application of any new concept the "Thrill of Technology". Although exilarating, and still potentially achievable for nuclear power, this vision has proven premature. Such an experience is not uncommon in other industries, in other histories and perhaps in human nature. In this respect we as an industry may be at fault for not having expected it to occur, and been properly prepared.

As scientists it is almost always more fun to develop a concept than to hassle through applying it. Academa is repleat with example where the value of a theory was overestimated, and the costs and difficulty of implementation was underestimated.

Stage Two: The Agony of Application

In this regard, at least three things are certain in life:
(1) Death
(2) Taxes, and
(3) the Thrill of Technology is followed by the Agony of Application

Concepts must be applied, and when and where this happens, more often than not they are challenged, and learning and improvements occur. Quite obviously the nuclear industry is currently going through this

FIGURE 1. INMM — N15 STANDARDS COMMITTEE ORGANIZATION

SUBCOMMITTEE	TITLE	CHAIRMAN	AFFILIATION	PHONE
—	N15 Chairman	Dennis Bishop	General Electric Co.	(408) 925-6614
—	N15 Secretary	Robert Kramer	Northern Indiana Public Service Company	(219) 787-8531
—	N15-NSMB Representative	Lou Doher	Rockwell International	(303) 497-2575
—	ANSI Staff Representative	Mary Crehan-Vaca	ANSI	(212) 354-3360
INMM-1	Accountability	Howard Menke	Westinghouse	(412) 373-4511
INMM-2	Material Classification	Whitey Thorpe	LASL	(505) 667-5886
INMM-3	Statistics	Frank Wimpey	Science Applications	(703) 821-4429
INMM-5	Measurement Controls	Yvonne Ferris	Rockwell International	(303) 497-4441
INMM-6	Inventory Techniques	Frank Roberts	Battelle — PNL	(509) 375-2606
INMM-7	Audit, Records and Reporting Techniques	Marv Schnaible	Exxon	(509) 375-8153
INMM-8	Calibration	Syl Suda	Brookhaven National Laboratory	(516) 345-2925
INMM-9	Nondestructive Assay	Darryl Smith	LASL	(505) 667-6514
INMM-10	Physical Security	John Darby	Sandia Labs	(505) 844-8977
INMM-11	Training and Certification	Fred Tingey	University of Idaho	(208) 526-9637
INMM-12	Site Response Planning	Ed Young	Rockwell International	(303) 497-2518
INMM-14	International Safeguards	Neil Harms	Battelle — PNL	(509) 376-4437

**Currently under review by an N15 Advisory Group to evaluate scope and feasibility.*

"agony" phase. We were shocked and perhaps insulted at the start, but this was the wrong perspective. Besides, its not as if we have a choice now. Like people, really practical technical solutions seem to make it through close scrutiny and are better for the experience. The point is **technology will prevail,** as it has for centuries. If our society is to continue to thrive it must grow. To grow it must have technical solutions to current energy problems. I firmly believe that these technical solutions will be based extensively on nuclear power. However, in the near term we have much to do.

Assuming that technology prevails, adequate nuclear materials safeguards will continue to be a primary prerequisite for the social acceptance of nuclear power. The products of the N15 Standards Committee will continue to be a cornerstone of the INMM Safeguards Program, as they have been in the past.What can you and I do to aid the nuclear re-emergence? The first and most important thing is to not lose sight of the original vision. Clearly, we can play many roles based on our various talents. Some are technical, some are social, and some are political. For those whose talents are in the technical area, what we can do is make sure our own house is in order. One vehicle for achieving this is through INMM N15 Standards Committee. In our twelfth year of existence, we have grown with the world-wide safeguards program to become the single most effective contributor of standards per capita member in the ANSI organization. We consist of twelve subcommittees and twenty-four writing groups addressing each major technical area which makes up this surrogate profession called safeguards. A listing of key people in each technical area is provided in the attached figure.

The challenge is yours. Whether it be through the N15 Standards Committee or another INMM committee function, please take this opportunity to get involved in the new wave of Institute activity. We ask no more from any individual than he do his part. In N15, this typically involves making relatively modest personal time commitments on specific technical tasks, and sticking to them. Remember, if techology is to prevail it can only be if people like you and I do our parts.

Bishop

Great Session at 1980 Annual Meeting

By **Herman Miller,** Chairman
Public Information Committee
Mountain View, California

Activities of the Public Information Committee culminated in a rich harvest at the 1980 Annual INMM Meeting in Palm Beach.

Excellent coverage was obtained from the press, radio and TV. Overall, the reports were fair and contributed to public understanding of nuclear power and the activities of the Institute.

My greatest personal satisfaction came from the enthusiastic and most favorable reception of our Public Information session. This was the first such session by the Institute. A capacity audience showed their interest and appreciation by good questions and unfailing attention to the speakers and the TV training. This session was taped and copies are available on loan or on sale for use by interested individuals or groups by contacting me. Our thanks to Florida Power and Light and the participants for their help in this session.

The theme of our annual meeting was Safeguards, but the bottom line is really energy and our lifestyle. Adequate energy is vital to maintain our lifestyle and help the less well endowed achieve their well being.

A primary goal of the INMM PIC program is providing technical and other factual information to the public and public representatives so they can make informed decisions on energy. Our first PIC session involved more INMM members in this noble effort.

Introduction of every new energy source has been faced with many of the same problems and concerns. In the 1700's forecasters in Britain predicted an **unbridgeable** energy gap as wood ran out! Other similar projections have been made as shortages appeared for other energy sources.

The energy problem is not new. What is new is our lack of resolve and direction to solve it.

Sufficient energy **potential** exists for us never to have to constrain our lifestyles. That is not in doubt. The question is how we can harness that energy to safely fulfill our needs.

We have the technical expertise.

We have the resources.

Unfortunately, organized opinion rarely seems in favor of development, mostly against. We resist change!

In democratic societies, we pursue goals based on regard for all factors and interests. This is why our energy policy is primarily an intensely political matter!

This is why we had the Public Information session.

Success in this program will be in direct proportion to the support of the INMM members. If we can tap the enthusiasm shown at the meeting, the INMM can meet its objectives.

A final note: My two year term as Chairman, PIC, is now complete. As this assignment is passed on to the next Chairman, I wish him well and thank all those who helped me during my term.

Herman Miller, right, and Chairman Gary Molen discuss how well the Public Information part of the 21st Annual Meeting Program turned out.

JAPAN CHAPTER REPORT

Two Executive Committee meetings were held on June 18 and August 15 respectively. The vote for the new Executive Committee members of Japan Chapter was made in May and election of the following new members were reported and confirmed at the executive committee meeting in June:

Chairman .....Yoshio Kawashima
Vice-chairman .....Ryohei Kiyose
Secretary .....Mitsuho Hirata
Treasurer .....Reinosuke Hara
Directors .....Kentaro Nakajima
Ryukichi Imai
Tooru Haginoya
Haruo Natsume

Mr. R. Imai has recently become Japanese Ambassador to Kuwait. His successor on the executive committee is not yet appointed.

In accordance with the revision of the INMM Constitution and Bylaws, the subject relating to the amendment of the Constitution and Bylaws of Japan Chapter was discussed at the August Executive Committee meeting, but final conclusion was not reached. The subject is currently under review.

It was agreed at the meetings that the Japan Chapter should encourage its members to contribute an article to the INMM Journal, so that at least one article from the Japan Chapter might appear in each issue of the Journal.

The present membership of the Japan Chapter, including those who are applying for membership, include fifty four members and the effort is being made to increase its membership.

It was discussed at the June Executive Committee meeting to hold an annual meeting of the Japan Chapter on October 20 and the following program was approved at the August meeting.

Opening Remarks by M. Hirata.
Address by Chairman Y. Kawashima.
Report of the 21st INMM Annual Meeting by K. Higuchi of PNC.
Safeguard activities of IAEA for EURATOM by T. Haginoya of Mitsubishi Metal Co.
Commercial R&D and Product Development by U.S. Companies in the Security Field by F. Prokoski of U. S. Arms Control and Disarmament Agency.
Safeguard Program at the Enrichment Plant by Tamai of PNC.
Safeguard Programs at the Chemical Reprocessing Facilities by T. Koizumi of PNC.
U. S. Department of Energy - Sponsored R&D in the Area of Physical Security by G. Weisz of U. S. Department of Energy.
Report of the Activities of the Japan Chapter by M. Hirata.
Closing Address by R. Kiyose.

Mr. Katsuji Higuchi of Nuclear Material Control Center who had been with the Japan Chapter in charge of administrative matters, reassumed his duty with the Power Reactor and Nuclear Fuel Development Corporation, thus he was replaced by his successor Mr. Ken-ichi Tsutsumi of Nuclear Material Control Center.

Mr. George Welsz of DOE-OSS and Mr. Katsuji Higuchi of the Nuclear Material Control Center in Tokyo, Japan discuss the program of the 21st Annual Meeting in Palm Beach, Florida.

LETTER FROM VIENNA

Our chapter enters upon its second year with enthusiasm undiminished, with the new officers and committee determined to pursue a vigorous policy. Our annual general meeting was held in June at — you've guessed it — a 'Heurige' in — you won't guess this — Paradisgasse! The main business was the installation of the new officers and committee. Les Thorne, Head of the Far East Operations Section, takes over as Chairman, Don Terrey of Safeguards Evaluation Section continues as Vice-Chairman, Tom Shea of System Studies Section is Secretary and Djali Ahimsa of Standardization and Administrative Support Section is Treasurer. Committee members are Tom Beetle of Data Evaluation Section, Joe Nardi, Head of Data Processing Development Section and, of course, our former chairman, Carlos Buechler.

A membership drive during August and September produced a crop of new members which has almost offset the number leaving to return to their home countries. At the time of counting (beginning of October), Chapter membership stands at 39 but recruits are still coming in.

In September, a successful evening meeting was held (at a 'Heurige', of course) at which our speaker was Institute Secretary Vince DeVito. Vince struck a good balance between information and entertainment, telling us about INMM activities in the U.S. and Japan, current anti-nuclear activities in the U.S. and measures being taken to counter them, and plans for the centrifuge enrichment plant to be built at Portsmouth. Willie Higinbotham, who is currently in Vienna on a safeguards consultation assignment, then entertained with his accordion in his well known breezy style.

Early October saw the first luncheon meeting of the new season, at which the speaker was M. Andre Petit, representative of France in the IAEA's Standing Advisory Group on Safeguards Implementation. M. Petit is a most articulate spokesman and provided us with a thought-provoking commentary on the contrasts between national and international safeguards systems as seen from the standpoint of one nation with a highly developed nuclear industry.

Future plans include a half-day symposium to be held early in 1981. Tom Beetle is Programme Chairman for this and hopes to assemble an interesting group of technical papers. We shall also continue with our luncheon and evening meetings, whenever we can persuade a visiting (or resident) celebrity to speak to us.

BOOK REVIEW

Energy in America's Future. The Choices Before Us.

Sam H. Schurr, Joel Darmstadter, Harry Perry, William Ramsay, and Milton Russell (A Resources for the Future Study), The Johns Hopkins University Press, Baltimore, 1979, xxviii, 556 pp., illus. Cloth, $30, paper, $10.95.

Energy Strategies. Toward a Solar Future.

Henry W. Kendall and Steven J. Nadis, editors (A Report of the Union of Concerned Scientists), Ballinger, Cambridge, Mass., 1980, xxii, 320 pp., illus. Cloth, $16.50.

> "Detente in the multifaceted conflict over energy policy might be achieved through an approach that meets the minimum requirements for acceptability by all important groups, and thus creates an overall energy strategy which, while not the preferred path for any of them, is judged superior to some plausible outcomes by all of them."

This paragraph presents the central theme of a voluminous, balanced study by staff members of Resources for the Future (RFF). They believe that the main goals of both economic "expansionists" and of those who counsel limited growth can be met through a reasoned decision-making procedure and through several sets of technical and policy measures for dealing with energy needs.

In contrast to the RFF method-oriented theme is the goal-oriented theme of an energy study prepared by the Union of Concerned Scientists (UCS); its authors believe that presently available information dictates a choice to proceed to an energy system in the year 2050 based largely upon solar energy:

> "We conclude that carefully selected solar energy collection, storage, distribution, and conversion technologies can be integrated into a workable system able to meet the diverse scope of energy needs of the United States in the future. A solar power strategy capable of satisfying these stringent requirements appears to be technically and economically feasible, environmentally and socially desirable, and compatible with healthy economic growth, reduced unemployment, and a high standard of living for all citizens."

The RFF study was supported by a grant from the Andrew W. Mellon Foundation. RFF itself is a nonprofit organization established in 1952 with the cooperation of the Ford Foundation; its aims are "research and education in the development, conservation, and use of natural resources and the improvement of the quality of the environment." Funds for the UCS study came from the Bydale Foundation, the Catherine Davis Trust, the Ottinger Foundation, the Rockefeller Brothers Fund, the Stern Foundation, and the national UCS sponsors; UCS is itself a "nonprofit organization concerned about the impact of advanced technology on society."

Both studies are the well-written products of long collaborative projects to survey the United States energy situation now and in the future. They are both studies of studies, with the UCS one more heavily documented; the reason is that many sections of the RFF study have been or will be published separately with extensive citations. Following overview chapters, each book presents a description of energy demands in the future and then an assessment of supply possibilities.

The dilemma for the United States has been obvious since 1973: a complex of policy measures has put the nation into a dependent situation because of its disproportionate reliance on imported energy resources. Adjustments have occurred slowly since then, but the UCS and RFF studies confirm that the United States does not really have a problem regarding long-term energy resources. Abundant coal and uranium can supply the nation's needs far into the future if the environmental and safety questions attendant upon the use of those resources do not become unmanageable.

Both sets of authors aver that with the application of existing techniques and new policies for improving the efficiency of energy utilization, primary energy levels need grow very little to support a vibrant economy. Indeed, the RFF authors produce interesting historical evidence that economic and energy growth certainly can occur with variable ratios. This is suggestive that an energy-conserving society need not be an economically contracting one and partly substantiates both sets of authors' remarks concerning efficiency.

Though the UCS study is aimed primarily at an energy future for the year 2050, its authors present energy figures for the year 2000 too, thereby permitting a comparison with the RFF study. The authors of the latter take 115 quads (a quad is 10^{15} BTU) as a **mid-range** projection for required primary energy (the fossil-fuel equivalent energy needed to supply the energy system before any processing); the actual figure for 1976 was 74 quads. This represents 1.8 percent annual energy growth and could realistically be accompanied by 3.2 percent annual economic growth. This RFF energy projection is based upon a population of 260 million people and upon a sector-by-sector analysis of that population's energy needs and takes account of many energy-efficiency improvements. A

requirement of 115 quads is also the **highest** of the many considered in the UCS study for the same population. Assumptions there are only moderate efficiency improvements (a 15 percent reduction from current needs for primary energy to provide services) and a large (55 percent) increase in per capita energy use so that everyone will consume energy as do upper income people today. Given efficiency improvements of 30 percent from current practice and the current per capita energy-use distribution, the UCS study shows a primary energy need of 66 quads.

For the year 2050, the UCS study gives primary energy needs of 114 quads and 53 quads respectively for the two sets of assumptions just described but with a population of 315 million. Other sets of assumptions yield intermediate figures, and it is the goal of the USC authors to show how needs closer to the 53 quad figure can be met almost entirely by renewable energy technologies.

In my view, the central difficulty of the UCS study is the assertion of the adequacy of, say, 60 quads of primary energy in meeting energy service needs and the practical ability of renewable technologies and resources to supply nearly 60 quads — even as late as 2050. (Up to 28 quads of renewable energy are posited for the year 2000.)

Much detail appears in the RFF study concerning the energy-conservation potential available from improvements in home heating and automobiles and in the widespread adoption of cogeneration of electricity and heat. Home-heating energy needs would be decreased, for example, by the introduction of passive solar techniques and by building houses with fewer air leaks. A 50% reduction from 1976 (non-solar) energy needs is plausible with all such methods. Cars can be made lighter to achieve a doubling of fuel efficiency from 1976 levels to 37 miles per gallon. Finally, needs for industrial process heat can be met by generating electricity too, saving 134 gigawatts of central-station capacity or 3.5 quads of primary energy annually. In less detail, these and other methods for saving large amounts of energy are also presented in the UCS study.

A strong point of the RFF analysis is the authors' realization of the importance of cost effectiveness for these conservation technologies. It is cost-effective now to implement the techniques and practices just mentioned, i.e., investments now produce greater fuel savings in a short time. Why haven't these techniques and practices been implemented previously?

First and foremost, price signaling for energy in our market economy has been inadequate. The artificial setting of price levels for petroleum, for example, postponed the time when purchasers of automobiles would demand fuel efficiency. To rectify the problem the U.S. Government imposed standards of fuel efficiency. These are only two offsetting examples of intervention that distorts the marketplace. The RFF authors argue forcefully for freeing all energy prices and using direct policy measures to correct any attendant equity or welfare problems. For regulated utilities, they also suggest the replacement of average generation costs for increased electricity usage by the costs for new capacity — so-called marginal pricing.

Other barriers to energy savings have included conservation in the home-building industry; the preference of mortgage institutions and therefore home buyers to focus upon first costs, not lifecycle costs; and the laws concerning and practices of electrical utilities that effectively discouraged industrial process-heat users from generating electricity too and selling unneeded amounts of it to the utilities for distribution.

It is, ironically, the embryonic solar and conservation enterprises which have suffered the most from the historical, controlled methods of energy pricing. They might have been part of a thriving industry by now had their products been in demand sooner. Exploration for increasingly rare conventional resources and the exploitation of known, unconventional forms of those resources suffer too, but these activities are carried out in part by substantial, mature firms which can give limited support to risky activities as part of their otherwise healthy businesses.

A large section of the UCS study is devoted to a detailed exposition of the supply potential and costs of renewable technologies and resources. Specifically, they give resource estimates of 20 to 200 quads annually for direct solar energy and 10 to 40 quads for wind energy. They do not neglect the storage needs, diurnal and seasonal, that solar heating and wind-generated electricity would create. The authors fairly represent the present cost-ineffectiveness of photovoltaic cells for general usage. They argue, however, that photovoltaic cells will eventually become cost effective. By positing their renewable resource system for the year 2050, they at least allow sufficient time for the massive technological change they suggest.

In general, the UCS authors counsel a policy direction largely dependent upon cost-ineffective methods when law and behavior dictate cost-effective methods. Their motive is to have a system without the potential for catastrophe. But what investment decisions are needed to get from where we are to there? Is this direction a realistic one?

Of particular interest in this journal are the findings and opinions by the two studies' sets of authors relating to nuclear energy. (Both studies, by the way, were published sufficiently recently to allow some consideration of the Three Mile accident.)Both recognize that orders for nuclear power plants have declined in part because of declines in projected energy demand and because of licensing delays. With ever increasing demand for limited fossil resources, I believe that these factors by themselves would ultimately not forestall continued nuclear implementation unless renewable techniques turn out to be more cost-effective. The key questions are not economic though.

The UCS authors have already reached a conclusion. They feel that "unresolved problems relating to reactor safety, radioactive waste disposal, and nuclear weapons proliferation make an increased dependence upon nuclear energy technology an imprudent course for the United States at the present time." In addition, they seriously question whether solar technologies, devoid of these problems, and the breeder reactor can form a feasible investment portfolio together. Is there enough money? Realize that an exclusive investment

focus mandates severe repercussions in case the original decision is wrong.

The RFF authors proceed differently. In presenting alternative energy policies, they discuss several prudent measures to implement were the United States to reaffirm its traditional support of nuclear energy because of continued economic and resource attractiveness. First, they feel that a decision on using breeder reactors is not required soon so that the possible linkage between breeders and nuclear-weapons proliferation need not be an issue requiring imminent resolution. Basic research should continue, but probably not "investigation of breeder technology". (This strikes me as an unwise point of view given required development time. If appropriate, we should be able to make a political or economic decision against something even if it is technically feasible. This, after all, happened with the supersonic transport plane.) Second, radioactive waste disposal should be carried to completion in a convincing technical, economic, and political fashion. Finally (in my view, most importantly) the safety question must be resolutely addressed. Remote siting of plants is essential; operating plants too close to population centers might be closed to emphasize "renewed dedication to maximum safety in the nuclear enterprise". Additionally, the defense-in-depth philosophy might be strengthened or reactor sizes diminished to handle better or forestall meltdown accidents. Regulatory measures could be strengthened to make penalties for unsafe operation more severe than they are now are. Keep in mind that these proposals are designed to make the nuclear enterprise safer and to enhance its public acceptability.

Largely absent from the UCS study are discussions of how the United States energy situation relates to that of the rest of the world. Relevant questions are these: Can or should the United States forego breeder technology in a world which regards it as essential — even at the research stage? Should the United States become an energy resource exporter if coal becomes the resource of choice? What should we advise developing countries to do in the energy field?

An important inconsistency in the RFF study is the recommendation in one place for reversing the policy of separating promotional and regulatory functions of government agencies because separation engenders delay. Elsewhere is the proposal for "changes in regulatory systems to increase incentives to assure safe operation" of nuclear plants. Safety promotion requires independence which should certainly prevail in this case.

One utterly fatuous statement appears in the RFF study, namely, that electrical utilities could serve 90 percent of the remaining electrical load during the fifteen days immediately after a nuclear attack. The statement is based upon a 1964 U.S. Government analysis. In light of the number, power, and accuracy of present-day nuclear weapons, the assertion is certainly wrong if the electricity-generating stations themselves are targets (less than one thousand units generating one gigawatt each could serve the United States) or vacuous if no load is left to serve.

In spite of these problems the RFF study is an extremely rewarding document because of its keen insights into economic theory, the way our society acts with respect to energy policy, and the way it might act to enhance new policy directions. I recommend **Energy in America's Future** unreservedly.

The UCS study is in essence a visionary answer to the question: How would we power our society if nuclear fission or fusion could not controllably produce energy and if fossil resources faced imminent exhaustion (or were reserved for petrochemical usage)? **Energy Strategies** is worth reading because of this question which the authors attempt to answer.

by Leslie G. Fishbone
Brookhaven National Laboratory

BOOK REVIEW

Nuclear Proliferation and Civilian Nuclear Power

DOE/NE-0001, "Nuclear Proliferation and Civilian Nuclear Power — Report of the Nonproliferation Alternative Systems Assessment Program," U.S. Department of Energy, Washington, D.C., June, 1980, Superintendent of Documents, U.S. Government Printing Office, $55.25

The stated goal of the NASAP study which serves as the basis for this report is "to provide recommendations for the development and possible deployment of more proliferation-resistant civilian nuclear power systems and institutions in light of nuclear energy needs." Some $23 million and almost three years later, the report, consisting of an Executive Summary and nine Volumes, has been issued.

Considering that the report is based on the results of over 50 studies performed by seven national laboratories, 13 independent research organizations, 10 companies from the nuclear industry, five universities, and consultations with many industry leaders and other organizations, it clearly represents the informed views of a very authorative group in the nuclear energy field. The nine individual volumes were based on contributions from studies performed by as few as two contributing organizations and as many as thirteen. In addition to the Executive Summary, the report allots a volume to each of the following topics:

- Program Summary
- Proliferation Resistance
- Resources and Fuel Cycle Facilities
- Commercial Potential
- Economics and Systems Analysis
- Safety and Environmental Considerations for Licensing
- International Perspectives
- Advanced Concepts
- Reactor and Fuel Cycle Descriptions

The above volumes represent studies of a broad spectrum of the fuel cycle as it is impacted by various proliferation-resistant systems. The report, as might be expected, comes out strongly behind the furtherance of light-water reactors dedicated to a single pass of their fuel. This is referred to as a "Stow-away once-through" cycle, but really amounts to a "throw-away" cycle for the nuclear fuel. This position, to many foreign governments, is not dissimilar to disposing of an automobile because it needs a new battery.

To whom was the report addressed? The report itself is silent on this point; however, its very diversification of content (and cost) ensures a relatively small audience for its full scope. Those members of Congress who are concerned with nuclear energy will find it an excellent reference for this Administration's approach to proliferation concerns of the nuclear industry in the United States. Members of the DOE and NRC who are responsible for proliferation policy and the development of the nuclear fuel cycle should have the report available for tracking future program changes. And finally, government members in the international community with significant nuclear programs may benefit from the consolidation of so many studies on the subject of proliferation of nuclear materials.

As so often happens, most readers will not go beyond the Executive Summary initially, and the writers must have recognized this possibility, for the Summary, brief as it is, is a compact encapsulation of the nine volumes that make up the report. A more expansive coverage of the report is contained in Volume I: Program Summary. In this Volume, the scope of the proliferation problem is identified, and in turn, the thrust of the studies, and the resultant findings upon which the remaining eight volumes are based, is summarized.

Volume II may be taken as an example of the report's approach. At the outset an explanation is given for the abbreviations and acronyms used in the Volume. This is followed by an overview of the problem, the assessment approach and procedure, and finally, a summary of assesments and recommendations.

The first chapter examines the proliferation problem, which is really the IAEA's problem, since the U.S.already has nuclear weapons; but this does not come through with any clarity. As a result, we find that the proliferation resistance measures which follow are presented as measures which should be undertaken by the U.S. nuclear industry. Unfortunately there are many in the Administration who seem to consider the U.S. nuclear industry as the Government's research and development pool, to be maneuvered, modified, and inhibited in whatever manner they wish to test or exhibit next. The chapter concludes with a presentation of the assessment approach and the procedure which is used as the basis for the studies upon which Volume II is based.

Chapter Two covers the assessment of civilian nuclear systems. The once-through systems of light-water reactors are reviewed. Both the present systems and the envisioned future modifications to them are evaluated for safeguards. Of all the systems that are covered by the report, the once-through type gets the greatest support in terms of acceptability.

The closed fuel cycle is assessed based on several systems. The most straightforward approach would involve the addition of an irradiated fuel reprocessing capability to the present light-water reactor cycle. This of course opens the door to the problems associated with large quantities of separated plutonium as a result

of the reprocessing. The prospect of having so much plutonium sitting around without a use or purpose has presented the largest obstacle to proliferation resistance. The available "fixes" are explained, but most are really not practical or effective. And it is in this area that the intended readership of the report must be envisioned with considerable latitude. The U.S. nuclear industry and the federal agencies responsible for implementing safeguards have had over thirty years of successful experience in safeguarding substantial quantities of plutonium. This fact is given so little recognition that it would appear that the report is discounting it very substantially.

Since this chapter also considers the mixed oxide fuel system and the breeder system and identifies them as strong candidates for the future, it might have been more reassuring if our experience to date could have been put in a more positive light. If indeed the assurances do not exist in the United States for such systems, it is imperative that they be developed and made known to the public well ahead of any pilot plant or commercial development of the concepts.

The last categories of reactor systems assessed by the studies were the research reactors and critical facilities. While these do represent potential areas of proliferation, the studies indicated that it would be difficult to obtain sufficient amounts or weapons-usable material without serious disruption of the research programs. The studies also concluded that the few critical facilities that possess fuel that would be attractive for proliferation purposes could be modified to substantially reduce their proliferation potential.

The third chapter of Volume II centers around the assessment of the materials and facilities that complement the reactors in a fuel cycle. At the front end of the cycle are the enrichment facilities. The chapter discusses the proliferation problems associated with eight different systems. Three of these systems, gaseous diffusion, centrifuge and aerodynamic (Becker nozzle), are with us now; one, the calutron, was active in the 1940's; and the remaining four are in various stages of research and development. Contrary to the approach for evaluating reactors, in which a basic premise seemed to be one of accepting subnational diversion as a scenario to be addressed, the authors considered there to be a small likelihood of subnational diversion from uranium enrichment facilities. Accordingly, the report largely addresses what the IAEA must do to reduce proliferation at this stage of the cycle.

The down-stream side of reactors contains large quantities of irradiated spent fuel. The proliferation problems for such fuel are considered to be at the national level since extensive remote handling capabilities are necessary to even store such fuel. The chapter does express concern for diversion of spent fuel both in storage and in transit, but again the high radiation levels and handling problems associated with such fuel focus any proliferation efforts at the national levels. Once more it must be assumed that the prime beneficiary of the studies is the IAEA and those responsible for guiding its safeguards efforts.

The chapter's approach to reprocessing facilities evidences a considerable concern for this step in the fuel cycle. A number of reprocessing methods are discussed and evaluated and the relative attractiveness of the contained plutonium at various stages of the fuel cycle are assessed. Recognizing that reprocessing is a national level of effort task if proliferation is to be resisted, the report then discusses in considerable detail the characteristics and capabilities of nationally dedicated facilities established for proliferation purposes. Such facilities could process spent fuel, fresh fuel, or intermediate materials and the reported studies give considerable detail as to how such diversions could be accomplished.

The fourth, and concluding chapter of Volume II, addresses the subject of fuel cycle safeguards from both IAEA and national perspectives. A substantial part of the chapter is devoted to what the IAEA safeguards are for the various types of facilities in the fuel cycle. This presentation is expanded upon further by a number of proposals for possible strengthening of the IAEA's safeguards capabilities. Regrettably, two features which would provide immediate strengthening are not mentioned: more freedom of access for safeguards inspectors, and more safeguards inspectors. Both of the above points must be recognized in any future plans for adequate IAEA safeguards.

Coverage of national safeguards systems appears to be strongly based on what the U.S. nuclear industry is required to do in fulfillment of Nuclear Regulatory Commission licensing requirements. The report describes the NRC's safeguards requirements and indicates that Department of Energy facilities operate under "equivalent" safeguards. Nothing is said about other national systems: are they better than those in the U.S.: are they worse; or doesn't anyone except the IAEA know? To the extent that responsible officials in the Administration and members of Congress could benefit from an awareness of the comparative adequacy of other national systems, the report seems to miss an opportunity to keep them informed.

The balance of the report, Volumes III through IX, examines an array of topics that relate to the nuclear fuel cycle and identifies the impact on proliferation resistance of each. Volume III, for example, covers resources and fuel cycle facilities, and reaches the conclusion that the supply of uranium, as well as the demand for it, is still subject to broad ranges of estimates. This Volume also reviews the relationship between what is called "resource extension options," such as lower enrichment tails and fast breeder reactors, and the goal of increased proliferation resistance of the fuel cycle.

The artificial constraints that the report writers were under comes through quite clearly in Volume IV. A conclusion is presented that no reactor or fuel cycle is commercially viable unless it is licensable for operation by the Nuclear Regulatory Commission. There is a substantial number of those concerned with our domestic fuel cycle that are of the opinion that the fast breeder is commercially viable in the U.S., and there is strong evidence that a number of foreign countries are moving in that direction without the benefit of the NRC's blessing. In fact, this Volume goes on to identify several areas of commercially potential increases in efficiency of operation. In addition to such steps as

improving the present LWR capabilities and lowering the enrichment of tails, it identifies the development of the fast breeder reactors.

As mentioned at the outset, the report is an ambitious undertaking, and the efforts to relate all that it presents to proliferation resistance is a task unto itself. Individual volumes will have varying degrees of acceptance and interest by the nuclear community in the United States, but the report may find its greatest demand in the international community, for who else but the U.S. could afford to spend $23 million for such studies?

By
Russell E. Weber
NUSAC, Incorporated
McLean, Virginia

BOOK REVIEW

Los Alamos Science Premiere

Our hats are off to the editors and publishers of **Los Alamos Science.** This is a new quarterly publication composed by the staff of Los Alamos Scientific Laboratory and dedicated to informing the scientific community about studies in the Laboratory.

The premier issue, published in Summer 1980, is a slick magazine filled with several short technical papers and a feature package on one major Laboratory program — nuclear safeguards. It finishes with a superb memorial to a brilliant and gracious man, Professor William H. Zachariasen, formerly of the University of Chicago. Altogether, its 152 pages of manuscript, explanatory figures and photographs are artfully designed and written to draw and hold attention.

To the readers of **Nuclear Materials Management,** we unhesitatingly endorse this issue. We do so for the technical stories (which have been written to attract a spectrum of readers broader than that who would read papers on these subjects when published in disciplinary journals) but especially for the four papers which were contributed for the feature package. In the latter, Dr. G. Robert Keepin, former Chairman of INMM, presents a historical perspective on safeguards issues and his view of LASL's contributions. Keepin's article is followed by two excellent technical discussions; one, an in-depth review of nondestructive measurement technology and its use, by Drs. Roddy B. Walton and Howard O. Menlove and the other, the technology of designing a materials accounting system to deter and detect diversion by a knowledgeable insider, by Drs. Darryl B. Smith, Dante Stirpe and James P. Shipley. To complete this package, LASL's Director, Don Kerr, reviews the current safeguards issues and argues the need for continued research and development of advanced technology in this field.

We are told that future issues are planned to be comparable in content and composition to this first. The senior editor, Dr. Neccia Grant Cooper, has stated, "We hope to provide a forum for scientists and engineers at LASL to present their work to each other and to the wider community in a fashion that promotes understanding." We submit that Dr. Cooper and staff successfully met their first test. We extend our wishes to them to continue their good work.

Review by L. K. Hurst
of the INMM Secretariat

Nuclear Safeguards; An Updated Analysis of the Concept of Safeguards as a National and International Institution by Dr. Frederick Forscher was published by the U.S. Government Printing Office in June 1980. Dr. Forscher has provided the Journal with the following highlights of this report:

1. Safeguards is a necessary and protective institution of society in the nuclear age.

2. The institution of safeguards is essential, regardless of what is decided about the future of nuclear power, and it should be nurtured in all its aspects.

3. It is important to distinguish between safeguards and non-proliferation measures. Briefly, non-proliferation aims to deter, detect, and delay any and all capabilities to make and deliver a nuclear explosive device. Safeguards, on the other hand, aims to deter, detect and delay the diversion of special nuclear materials. Safeguards is a necessary but not sufficient condition for non-proliferation.

4. The effectiveness of the institution of safeguards is usually judged in terms of detectability of postulated threats. The threats to be countered are embodied in the design bases (DB-safeguards threats). DB-safeguards threats are usually site-specific and facility-specific and should not become public knowledge.

5. The effectiveness of non-proliferation measures is more difficult to judge. The most serious threat is overt seizure by governments of facilities, manpower, and materials that can be used to produce a nuclear explosive device. For states that have signed the Non-Proliferation Treaty, the threat of seizure is referred to as the abrogation scenario.

6. To counteract the threat of seizure, on a worldwide basis, and still reap the benefits of nuclear power, will require consideration of multi-national fuel cycle centers in non-weapons states, or national centers, in weapons states. The United States has done little to encourage such centers, although the Nuclear Non-Proliferation Act points in this direction.

7. An unexpected benefit of a viable international institution of safeguards could be its effect on currency stabilization. Fissile isotopes (primary plutonium) owned and controlled by an international fissile material bank, could well become the next internationally accepted basis to which all national currencies can be pegged.

8. The institution of safeguards is in a developmental stage, both nationally and internationally. Science and technology, economics and trade, military and foreign affairs, all have an impact on this developing institution.

9. Two U.S. cabinet departments have substantial interests in safeguards - the Departments of State and of Energy, while two more have notable interests -- the Departments of Commerce and of Defense. In addition, the Arms Control and Disarmament Agency (ACDA) also has an active safeguards program, and the independent Nuclear Regulatory Commission has notable safeguards-related responsibilities.

10. In the White House, safeguards issues are of concern to the National Security Council, the Domestic Policy Council, the Council of Economic Advisors, and the new Office of Science and Technology Policy. Urgently needed is an answer to the question: Who coordinates safeguards policy, and how is this done?

11. Public acceptability of safeguards depends on its effectiveness to deter, detect and delay diversion and proliferation. Acceptability implies that the perceived effectiveness of the institution of safeguards outweighs the perceived risks of diversion and proliferation.

12. The institution of safeguards can be no better than the individuals in industry and government who staff this institution. Their performance will reflect their competence, motivation and loyalty to the institution and is the key to safeguards effectiveness. Yet, the concept of a profession of safeguards is only now beginning to appear, despite its importance to every nation and to the world community.

13. Another essential feature of a viable institution of safeguards is the ability to determine accurately and rapidly the amount of fissionable materials, wherever they may be found in the fuel cycle. A good beginning has been made by cooperation among IAEA, national laboratories of some member states, and the U.S. National Bureau of Standards.

14. The eventual structure, domestic and worldwide, of the institution of safeguards will have to be able to accommodate changing internal and external factors by a process of feedback adjustment. For example, the 1974 explosion of a nuclear device by India is still not fully accommodated by international safeguards.

15. The Three Mile Island accident will have a long-lasting effect on the question of acceptability of nuclear power, but little on the public perception of safeguards (in contrast to safety). If nothing else, this signifies a separation of two issues: the need for safeguards as a necessary protective institution, and the need for nuclear power as a necessary source of electricity. The interconnection of these two issues rests on the availability and control of fissile isotopes, primarily in the backend of the fuel cycle including the breeder cycle.

16. The TMI accident could provide a valuable lesson for the planning stage of the institution of safeguards. Investigation of this accident may yet conclude that the people were closer to a panic than the reactor was to a meltdown. The challenge for safeguards organization is how to prevent a panic when a credible threat of diversion and blackmail becomes known. This is one more aspect in favor of placing the backend of the fuel cycle (and breeders) into nuclear fuel cycle centers. Such national or multi-national centers can be hardened against all threats.

Copies of this committee print can be obtained from the U.S. Government Printing Office, Washington, D.C., 20402. For identification the following information, in addition to the title, may be needed: Report prepared for the Subcommittee on Energy Research and Production of the Committee on Science and Technology, U.S. House of Representatives, 96th Congress, by the Congressional Research Service, Library of Congress.

Announcement

The proceedings of the American Nuclear Society Topical Meeting held at Kiawah Island, South Carolina, November 26-30, 1979, have been published and are available from the U.S. National Bureau of Standards, as Special Publication 582. The title is "Measurement Technology for Safeguards and Materials Control". The report was edited by Thomas R. Canada, Los Alamos, and B. Stephen Carpenter, N.B.S.

SPECIAL ARTICLES

Report on US DOE-IAEA International Training Course on Materials Accountability and Control For Safeguards Purposes

May 27-June 6, 1980
Santa Fe, New Mexico

Course Staff
E. A. Hakkila, C. Hatcher, G. R. Keepin,
B. Pontes, T. D. Reilly, and J. Shipley
International Atomic Energy Agency
Vienna, Austria
and
Los Alamos Scientific Laboratory
Los Alamos, New Mexico*

An International Training Course on nuclear materials accountability and control for safeguards purposes was held May 27 - June 6, 1980 at Bishop's Lodge near Santa Fe, New Mexico. The course, authorized by the US Nuclear Nonproliferation Act and sponsored by the US Department of Energy in cooperation with the International Atomic Energy Agency, was developed "to provide practical training in the design, implementation, and operation of a national system of nuclear material accountability and control that satisfies both national and IAEA international safeguards objectives."

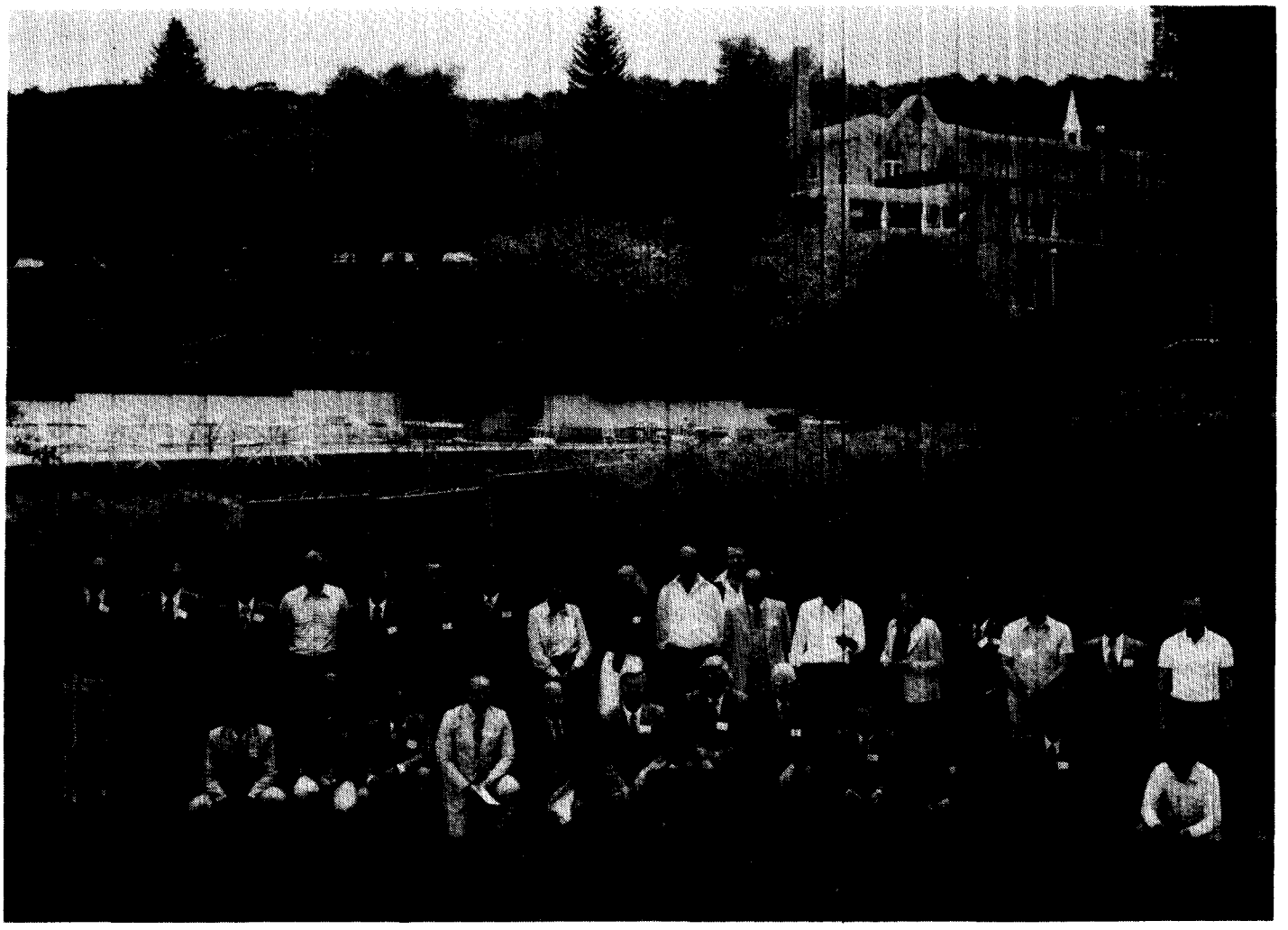
The course was conducted by the University of California's Los Alamos Scientific Laboratory (LASL) under the leadership of G. Robert Keepin, Course Director, and Charles R. Hatcher and T. Douglas Reilly, Course Coordinators. Bernardino Pontes, Head of Training Section, IAEA Department of Safeguards, was the official IAEA adviser to the Training Course.

A total of some 70 participants (including course attendees and lecturers) from 23 nations took part. Nations represented included Brazil, Canada, Chile, Denmark, Egypt, the Federal Republic of Germany, the German Democratic Republic, Greece, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Kenya, Korea, Pakistan, Philippines, Portugal, Taiwan, Turkey, and the United States. Participants also came from the cosponsoring organization, the IAEA in Vienna, Austria, and the EURATOM organization of the Commission of the European Communities in Luxembourg. The course emphasized safequards requirements, necessary resources, and implementation as applied to power reactor/spent fuel storage and research reactor facilities. At the opening session of the course on Tuesday morning, May 27, George Weisz, Director of the DOE Office of Safeguards and Security, said, "We regard our program of international training in safeguards as a major vehicle for strengthening international collaboration in safeguards."

Adolf von Baeckmann, Director of the Division of

Representatives of organizations responsible for planning and sponsoring the international training course include (left to right) G. Robert Keepin, Course Director; George Weisz, Director, DOE Office of Safeguards and Security; Adolf von Baeckmann, Director, IAEA Division of Development and Technical Support; and Don Kerr, Director, Los Alamos Scientific Laboratory.

Mr. Carlos Buechler of IAEA Department of Safeguards was the first of three IAEA lecturers who spoke on international safeguards.



Course Participants - Opening Day, May 27, 1980

Left to right, back row: Shafi Ahman, Pakistan; Tamas Biro, Hungary; Yusuf Raza, Pakistan; Martin Littlejohn, Euratom; Chung-Lu Lo, Taiwan; Shimon Malkiely, Israel; Nimrod Tole, Kenya; Isabel Torres, Portugal; Marita Stute, Federal Republic of Germany; David Bacon, Euratom; Paulo Cruz, Chile; Gilberto Andrade, Brazil; Adel Tolba, Egypt; Aysun Anacon, Turkey; Arumugan Palamalai, India; Flavio Argentisi, Italy; Satoshi Nishizawa, Japan; and Jan Bogaards, Canada.

Front row: Hudihastowo Poesposoetardjo, Indonesia; Yi-Ching Yang, Taiwan; Edwardo Melo, Brazil; (the next five people were course lecturers) Bernardino Pontes, IAEA; George Weisz, DOE/OSS; G. R. Keepin, LASL; Adolf von Baeckmann, IAEA; Gerald Tape, Associated Universities; Hafiz Higgy, Egypt; Jong-Lai Kim, Korea; Nand Kishore, India; and Ji-Bok Lee, Korea. Maria Luz Ascano of the Philippines arrived later. The Bishop's Lodge can be seen in the background

Development and Technical Support in the IAEA's Department of Safeguards, told course participants that the IAEA promotes the peaceful uses of atomic energy while at the same time providing assurances that nuclear materials are not subverted for non-peaceful purposes. He said the IAEA-sponsored courses are designed to standardize materials accountability and control in nuclear facilities while also allowing access to these facilities by IAEA safeguards inspectors.

LASL Director Donald M. Kerr welcomed participants to New Mexico by saying that LASL is making significant contributions to all three of the major problems facing the nuclear industry: assured nuclear safety, acceptable waste disposal, and effective safeguards. He noted that of these three, "nuclear safeguards may well prove to be the most pressing requirement" and pointed out that LASL has developed a wide range of instrumentation for nondestructive assay of nuclear materials, allowing measurements at all stages of the fuel cycle.

Kerr said that the Los Alamos Scientific Laboratory, as the DOE lead laboratory in R&D related to nuclear materials accountability and control, has a major responsibility for transferring this technology to various types of nuclear facilities. "In this role the Laboratory has for many years conducted an extensive program of training courses and technical consultation, as well as technical support programs in conjunction with the IAEA," Kerr said.

G. Robert Keepin, LASL's Program Manager for Safeguards Affairs, and the Training Course Director, detailed the structure and content of the Safeguards Training Course. He told participants the course would cover all elements of nuclear safeguards ranging from historical background to legal requirements and advanced state-of-the-art technological developments.

As attested by the Schedule of Sessions and invited lecturers shown in Tables I and II, a truly outstanding course instructional staff was assembled from among leading safeguards and materials management experts in national laboratories, government, and private

industry, from both the United States and abroad.

The first week of the course (see Table I) covered the general principles and practice of safeguards - its evolution, basic elements, and current application of materials accountability and control, inspection and verification on the national and international level, as well as current practice in specific types of nuclear facilities. The first week then concluded with a preview of the workshop in facility safeguards system design that was to follow during the latter part of the course.

The second week of the course (see Table II) involved more detail on the instrumentation and technology required to implement modern safeguards systems. The lecture material was correlated with, and supported by, tours and demonstrations (at the Los Alamos Safeguards R&D Laboratories) of state-of-the-art instrumentation and equipment. Detailed descriptions were given of current safeguards practice and actual operating experience in existing power reactor and research reactor facilities. The principles and practical application of safeguards system design were then presented and the resources required for their implementation were surveyed. The second week of the course culminated in the "product" of the course, i.e., the workshop in facility safeguards systems design in which each course attendee participated as a member of a designated design subgroup. The course concluded with individual design subgroup reports and an evaluation of the workshop results, as well as a detailed overall evaluation of the entire course.

The occasional differences in viewpoint and approach to safeguards issues and problems taken by different lecturers was cited as part of the reality of safeguards today, underscoring the great need for consensus, international cooperation, and standardization in the implementation of equitable, effective safeguards on both the national and international level. It was further noted that this need is an important underlying factor in the basic thrust and overall purpose of the NNPA-authorized International Training Course.

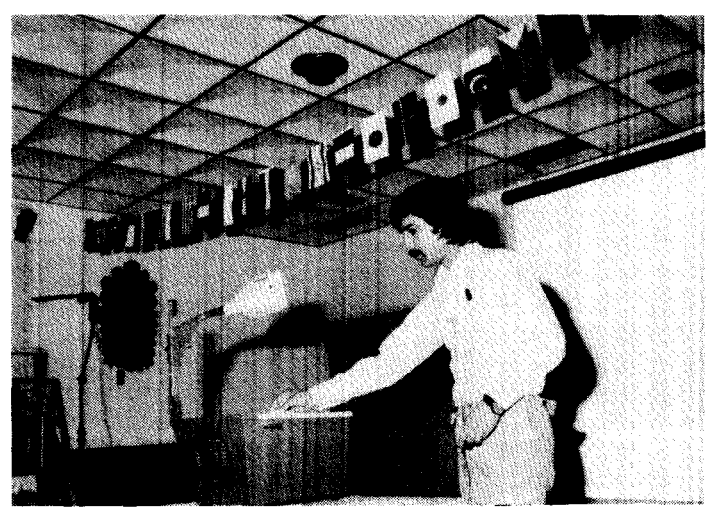
At the concluding session of the course, it was emphasized that each of the countries represented has its own characteristic set of energy problems with correspondingly unique national concerns and approaches to the difficult, and sometimes controversial, issues posed by nuclear energy. Nevertheless, it was recognized by all that a common concern and professional commitment to effective safeguarding of nuclear energy was the common factor that had brought all participants together for the safeguards Training Course in Santa Fe.

Many participants expressed the belief that the overall thrust of the course, including the lectures, the workshop, and the opportunity for direct interactions with safeguards colleagues from around the world, would contribute to better communication and understanding, and thereby to the implementation of more effective safeguards, not only in the different countries they represented, but throughout the worldwide nuclear community.

The published proceedings of the course, including the full text of all presentations, will be available from the Department of Energy, Office of Safeguards and Security, and the Los Alamos Scientific Laboratory. All lectures were video taped for review by participants during the course and for use as training aids in the future.

* Mr. Bernardino Pontes heads the Safeguards Training Unit, International Atomic Energy Agency, Vienna, Austria. All other authors are with the Safeguards Program Staff, Los Alamos Scientific Laboratory, Los Alamos, N.M.

Mr. Ferruz Cruz, Mr. Poesposoetardjo, and Mr. Palamalai in the foreground inspect nondestructive assay equipment during a tour of LASL safeguards laboratories.



Mr. Yusuf Raza of Pakistan reports on the safeguards system design workshop during the final day of the course. The flags of nations represented were prominently displayed.

Congratulations and diploma are presented to Mr. Satoshi Nishizawa by Course Director Bob Keepin as IAEA Adviser Bernardino Pontes looks on during banquet honoring course participants.

An evening at Casa del Mirador overlooking the Rio Grande with hosts Bob and Madge Keepin provides time for relaxing and enjoying a New Mexico sunset.

TABLE I
US DOE/IAEA INTERNATIONAL TRAINING COURSE
SCHEDULE OF SESSIONS
First Week

#1: Welcome
D. M. Kerr, Lasl; G. Weisz, DOE; A. Von Baeckmann, IAEA

#2: Introduction to Training Course
G. Weisz, DOE; A. Von Baeckmann, IAEA; G. R. Keepin, LASL

#3: Historical and Political Framework of Safeguards
G. F. Tape, AUI

#4: Description of a State System and Its Requirements
James Partlow, NRC

#5: Domestic Safeguards: Threat Analysis and Response Capabilities — Brian Jenkins, RAND Corp.

#6: Domestic Accountability and Control Features
Ralph Lumb, NUSAC, Inc.

#7: EURATOM Safeguards as a Multinational System
Ugo Miranda, EURATOM

#8: IAEA International Safeguards (3 lectures)
C. Buechler, IAEA; L Thorne, IAEA; and G. Hough, IAEA

#9: Introduction to Nuclear Fuel Cycles
Ronald Knief, UNM

#10: Elements of Nuclear Material Accounting
Ralph Lumb, NUSAC, Inc.

#11: Nuclear Material Control
Christopher Olson, Sandia Laboratories

#12: Survey of Statistical Methods in Nuclear Material Accounting and Control - John Jaech, Exxon

#13: Advanced SNM Accounting and Control Systems for Bulk Processing Facilities - W. A. Higinbotham, BNL; John Malanify, LASL

#14: Nuclear Materials Accounting and Control in Power Reactor Facilities
John Foley, LASL; W.A. Higinbotham, BNL

#15: Safeguarding of Nuclear Research Facilities
E. R. Johnson, E. R. Johnson Assoc.

#16: Inspection of Reactor and Spent Fuel Storage Facilities
Les Thorne, IAEA

#17 Preworkshop Session (and Review)
James Shipley, A. Hakkila, IAEA and LASL Staff

TABLE II
US DOE/IAEA INTERNATIONAL TRAINING COURSE
SCHEDULE OF SESSIONS
Second Week

#18: Elements of Chemical and Bulk Measurement Technology
Carleton D. Bingham, DOE/NBL

#19: Elements of Nondestructive Assay (NDA) Technology
Hastings Smith and Thomas Canada, LASL

#20: National System of Measurement Standards
Thomas Yolken, NBS

#21: Assay/Verification of Fresh and Spent Fuel
David Lee, LASL

#22: Lecture/Tour of Safeguards Research Facilities and Demonstration of Instrumentation (LASL Safeguards R&D)
Hastings Smith, Nick Nicholson, T. Douglas Reilly, LASL

#23: An LWR Power Reactor Facility
Cordell Reed, Commonwealth Edison

#24: A CANDU Power Reactor Facility
David B. Sinden, Atomic Energy Control Board of Canada

#25: A Research Reactor Facility
Fred H. Tingey, University of Idaho

#26: Safeguards System Design and Applications
Donald Cobb, LASL

#27: Design Features Relevant to Improved Safequards Implementation (Federal Republic of Germany)
Dipak Gupta, Gessellschaft Fur Kernforschung MBH

#28: Example of an Operating State System (German Democratic Republic)
Walter Roehnsch, National Board for Atomic Safety

#29: Example of an Operating State System (Japan)
H. Kurihara, Embassy of Japan: Takeshi Osabe, Japan Nuclear Fuel Co., Ltd.

#30: Implementation of the Facility Safeguards System
James A. Powers, Tenknekron

#31: Workshop in Facility Safeguards System Design
James Shipley, Coordinator; A. Hakkila, D. Cobb, J. Foley, D. Reilly, LASL; C. Olson, SLA; D. Perricos, B. Pontes, IAEA; L. Wirfs, NRC

#32: Plenary Session and Wrap-up of Safeguards System Design Workshop - All Participants

Cruise Was An "Emerald" Event

By **Roy Cardwell**
Oak Ridge, Tennessee

The SS Emerald Seas sailed from Miami for Nassau on Friday, July 4, with 38 INMM post-convention "sailors" aboard. Those of us who had doubts about our sea legs soon cast them aside when we found we had to go look out a porthole to tell if we were moving. The weather was remarkable and the Caribbean waters were a little less than a mirror

Food and first class entertainment were rampant and continuous throughout the trip. There was no doubt that the chef on this ship had been shanghaied from Paris and never left his kitchen during the entire voyage. The three bands aboard provided a constant melody of one rhythm or another and the several evening shows were as good as anything I have seen in a Las Vegas lounge. A large casino was open for those who had money to burn and (to the delight of most of the INMM group) there was a bar open every few yards.

Nassau is a quaint town of old buildings divided into many shops. It is obvious that the main industry is tourism and nothing more. Some of the early colonial government buildings still stand and are used as government offices. Plenty of cabs are waiting at the dock to whisk you away through the islands (the fares are not cheap by any means) but most chose to stroll up through the straw market immediately adjacent to the dock area and nearly everyone came away with a hand made hat to keep off the heavy Nassau sunshine. Barbara and I, due to our nature, found the only sale on the island where I purchased a set of bongo drums as my only souvenir of the trip, besides the hat of course (my display of bongo drumming was not as well received aboard ship as I would have anticipated, however).

Bob and Carolyn Brooksbank, Oak Ridge, chat with friends at the travel service party.

Herman and JoAnne Miller, San Fransisco, winners of another Nassau cruise.

Madge (Mrs. Robert) Keepin chats with Phyllis and Herb Harrison, Oklahoma.

Our always congenial Chairman Bob Keepin was "put up" by his colleagues in the belly dancing contest .... and won!

About a dozen of our number opted for the Saturday evening nightclub tour. This started in someplace called Ronnie's Rebel Room where we had to threaten the waiters before we got our paid for drinks and had about given up on the entertainment until the very last act. Billed as the inventor of the steel drum (but who was obviously not old enough) he was most certainly the world's champion! Twenty minutes of solid concert . . . classical, pop, rock, and John Phillip Sousa . . . completely obliterated our first impressions and made the stopover worthwhile. I am sorry to say that Barbara and I missed the show that an artist, named Bonaparte, gave on board our ship next afternoon because we were out seeing the sights. The second nightclub stop was over the bridge to the Treasure Island Casino where we were treated to a super show to end the evening.

Ahmed Kabani, from the Universal Express Travel Service, and his lovely wife sailed with us and were most congenial hosts solving all of our small problems and treating us to a most enjoyable champagne cocktail party attended by the ship's Captain. The travel service gave out a door prize of another Nassau cruise and were we were pleased that Captain Danelle drew the names of our own Herman and JoAnne Miller as winners.

Our thanks many times over to Jim and Janet Lee for not only arranging this elaborate and entertaining "Nassau run" but also for the many, many things they did to make our convention so enjoyable and worthwhile.

INMM "Officials" aboard the Emerald Seas on the post-convention cruise to Nassau. (Left to right) Herman and JoAnne Miller, Yvonne and Livingston Ferris, and Roy and Barbara Cardwell. The occasion was the Captain's Party.

Joe and Diana Stiegler, Albuquerque (foreground) flanked by Florida hosts Jim and Janet Lee with Chuck and Marion Mayer, Joplin, Mo.

Dee McCord, Bellevue, Washington with our ships waiters have found someone with a "Happy Birthday."

CORRECTION

In the Summer 1980 Issue of the Journal, the Editors made an unintentional error in the Public Information Committee Report. In that report we printed the title of an article "Is Nuclear Power the Only Choice for the Future?" written by Judith Viorst and printed in the February 1980 issue of Redbook, but the text that we printed was not that article but rather, a letter from Mr. Robert Sorenson and Mr. Robert Clark of the INMM Pacific Northwest Chapter to Redbook commenting on the article. Our most profound apologies to Ms. Viorst, Mr. Sorenson, Mr. Clark and Redbook for this most regrettable error. In order to set the record straight we have reprinted the letters in their correctly identified form on the following pages.

INMM Editors

INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT

PACIFIC NORTHWEST CHAPTER

March 21, 1980

Letters to the Editor
Redbook Magazine
230 Park Avenue
New York, NY 10017

Dear Sir:

Subject: "IS NUCLEAR POWER THE 'ONLY CHOICE' FOR THE FUTURE?"
Between Us, Judith Viorst, Redbook, February 1980

One of the very serious questions of the day is the continuously declining availability and increasing cost of energy. The times call for the very best in analyzing and discussing our restricted energy options and the effects they have on the American public. Therefore, the public needs the most responsible and the highest quality of journalism possible from the media. In our opinion the article by Mrs. Viorst doesn't measure up.

It is difficult for us to understand how Redbook, and what we perceive as a responsible person such as the author, could publish this article. It is a smorgasbord of facts woven into a story which supports the author's preconceived notions and emotions about nuclear power. There are also a number of points which are not true, and there are some omissions which we think will result in your integrity being questioned by your readers. The article develops little if any real or new perspective on the subject of nuclear power or the energy crisis. It simply perpetuates and appeals to fear, largely what seems to be the fear of technology. These fears are understandable if they are based on the misinformation the article repeats. Because of this we feel compelled to respond with this letter.

Research Effort

First, we question the quality of the research that went into the article. The author stated, "I decided that I would try to become informed." Then she says she found the answers to her questions "... in pamphlets, newspapers, magazines and interviews." We would not be able to write an accurate and factual article from those sources either. What has become so disturbing to us is that one incorrect media story breeds other incorrect media stories.

Throughout the article the references and quotes are vague and limited. None of the sources are listed. For example, we know of no knowledgable, responsible engineer who would say that they almost lost Detroit. The truth of this statement has been refuted.[1] The other accidents the author notes were all related to the defense nuclear program, but the author would have us believe that these are from or are typical of the commercial power industry. We believe that a responsible journalist would keep a clear distinction between defense nuclear programs and the commercial sector. By analogy one could easily prove that commercial aviation is unacceptably risky by citing the incidence of F-111 crashes. To put the accidents in perspective, the author could ask what other industry has a safety record comparable to the commercial nuclear industry. This omission leaves us to question the actual intent of the writer. Incidentally, there have been accidents in the defense nuclear program other than those quoted in the article that more accurately demonstrate the lethal effects of high-level radiation exposure.

The writer quotes an out-of-date Atomic Energy Commission study (apparently WASH-740, 1967)[2] that is a partial consequence analysis of reactors. The part of the analysis that the author neglected to include was the probability of the event, which is sufficiently remote to eliminate the event from further consideration. This study has been superseded by others (e.g., WASH-1400, 1975)[3] which have been critiqued by the technical community of this nation, including some of those most critical of the nuclear option, and found to be a highly credible study[4] on the risk of nuclear reactors.

The risk of death to an individual in this country from the nuclear option is far more remote than being struck by lightning. Yet some people are killed by lightning, and someday some person (probably not a member of the public but a nuclear powerplant worker) will be killed at a nuclear facilty. And someday there will be a partial fuel meltdown at a reactor; in fact, about once every 17 years (assuming 100 reactors are in service) is forecasted by the WASH-1400 study.[5] However, this is a partial meltdown and the public is not expected to be exposed. The Kemeny Commission, for example, concluded that even had the core at the Three Mile Island reactor melted, the public exposure would have been slight. The cost of replacement power can be a real impact, however, in such an accident. This is an issue that needs careful consideration.

Radiation

Woven throughout the article are words and expressions that engender a fear of radiation. None of the benefits of radiation are ever mentioned to put the subject in some reasonable perspective. The author's use of the expression "... life-destroying radioactive materials" leads the reader to overlook the life-saving virtues of radiation as constantly used in both medical treatment and diagnostics.

The fact that we have always lived in an environment of low-level radiation is never mentioned. Because of Denver's elevation and geology, every citizen receives more radiation in a year than the hypothetical person standing continuously at the fence of Three Mile Island during the March 1979 incident. Such data is apparently not presented because it does not contribute to the intended hysteria over radiation.

Radioactive Waste

The disposal of radioactive wastes is the most difficult issue to discuss. That's because most of us in the industry believe that from a technical point of view it has been solved for a long time. Most of what we see are the social and political issues around the question of waste--the location, medium, management, etc. The recent temporary closing of the U.S. low-level depositories highlighted the fact that nuclear waste from the medical community became the first pinch point. The public has just forgotten that the medical profession, in saving and extending life, is creating some of the waste.

We are again disturbed about the actual motives of the author when she says, "Thousands and thousands of tons of this waste must be safely stored for millieniums" and "... virtually every storage facility that our government has started has already suffered from radioactive leaks!" It has been demonstrated that high-level radioactive wastes can be managed, i.e., isolated from the biosphere. Further, the currently estimated times for isolation of high-level wastes are closer to 1,000 years. From then on they are of less risk than the ore bodies from which they originated.

As the effectiveness of the mechanical stabilization achieved with these wastes is realized, perhaps someday they will be utilized as energy sources and not buried. They can now be converted to a glass that is less soluble than Pyrex cookware; they are then double encapsulated in metal cans. There would only be enough of this high-level waste by the year 2000, if all electrical energy came from nuclear plants in this country, to fill a repository whose surface area would be about 3.5 square miles and the underground area no larger. Certainly with quantities of material no more voluminous than this the country has the capability to manage the waste with an effort that is small when compared to other industrial activities now routinely undertaken.

Proliferation

The reference to India's source of plutonium for exploding an atomic bomb is in error. Also, the statement "Peaceful reactors already have helped to build bombs" is incorrect. India's weapons material did not come from their power reactors. They have four light water power reactors and four more power reactors under construction. India used heavy water provided by Canada in a "test" reactor to produce weapons material. The commercial nuclear power program in India did not produce weapons material. Further, we are not aware of any commercial nuclear power reactor program that was used to develop nuclear weapon capability. There are a number of good reasons for this, including economics. This country has reportedly demonstrated (exploded) a device assembled from reactor grade material, i.e., plutonium from a power reactor, instead of weapons grade material from a weapons reactor. However, it is much cheaper, quicker and more efficient (better weapons) not to involve commercial power reactors. Attempting to develop a weapons capability from a power reactor program is a costly and tedious process that has never been done to our knowledge except for the experiment by the United States mentioned above, long after we had nuclear weapons.

The article presents only one side of the proliferation concern. Nuclear technology is the proliferation issue, and considerable nuclear technology is indeed acquired by adopting energy production with nuclear reactors. But the genie is out of the bottle, and wishful thinking will not cast this capability out of the storehouse of human knowledge. Further, the article does not discuss the Nonproliferation Treaty and the International Atomic Energy Agency, and the prospects, hopes and definite limitations of these international programs in addressing proliferation. These are the real issues.

Conservation and Solar

What the writer implies about conservation and solar energy is greatly oversimplified. All of us support both the continued emphasis on conservation and the vigorous development of solar energy. From our point of view you don't have to argue the case, just present it fairly. Even though we support the development of solar energy, we clearly recognize that it has environmental consequences.[6] But then we also recognize that the American public must come to terms with the fact that there is no free lunch.

The author does not identify the impacts, including costs and some disbenefits, of the various energy-saving and energy-producing alternatives. Many do have value, but her analyses are far too trivial (by omitting any concerns for the accompanying impacts) to assist in decision making. Her analysis of alternatives is simply a "wish" list.

Nuclear Option

No one who supports nuclear energy ever claimed that "nuclear power, ... is our painful but only real answer to the energy crisis." However, most of us believe that the inverse of the writer's statement is catastrophe. By closing the door on the nuclear option we are creating an energy crisis that will whiplash into every aspect of our lives--health, jobs, standard of living, economic and political stability--by adding to our shortfalls in energy sources.

We believe that we need all of our options, including nuclear energy. We can't afford to close the door on any of our alternatives. We need to be aggressive on all fronts.

Conclusions

We can understand the author's honest, gut reactions and concerns with nuclear power. We are, however, surprised and dismayed that the author and the editors of Redbook would include this article as a serious journalistic effort in these days when rational discussions with perspective are so important to the American people. There are so many ways to get information, and to have articles reviewed prior to publication, that what you have done, in our opinion, is not a service to your readers.

Sincerely,

Robert J. Sorenson

Robert G. Clark

REFERENCES

1. E.M. Page, We Did Not Almost Lose Detroit. Detroit Edison Company, May 1976.

2. Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants, WASH-740. U.S. Atomic Energy Commission, March 1957.

3. Reactor Safety Study, WASH-1400 (NUREG-75/014). U.S. Nuclear Regulatory Commission, October 1975.

4. Testimony of H.W. Lewis Before the Subcommittee on Energy and the Environment of the House Committee on Interior and Insular Affairs, February 26, 1979. Congressional Record, February 26, 1979.

5. Reactor Safety Study, WASH-1400.

6. Herbert Inhaber, Risk of Energy Production, AECB-1119, Rev. 2. Atomic Energy Control Board, P.O. Box 1046, Ottawa, Canada, KP 5S9. November 1978.

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INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT

PACIFIC NORTHWEST CHAPTER

March 31, 1980

Letters to the Editor
Redbook Magazine
230 Park Avenue
New York, NY 10017

Dear Sir:

Subject: "IS NUCLEAR POWER THE 'ONLY CHOICE' FOR THE FUTURE?"
Reference: Our letter to you dated March 21, 1980

After sending you our letter last week, we noticed two points that need clarification. First, in the middle of the second page we imply something about deaths at commercial nuclear power plants which is not quite true. There have been industrial accidents resulting in deaths at operating nuclear plants. They were caused by such things as high pressure steam and falls. We are aware of more than two such accidents. However, most people limit these types of comparisons to accidents involving some radioactive aspect of the operating plant. That is what we were doing. That may not be a completely fair comparison.

Secondly, we noticed that our professional society stationery has no return address. That was an oversight on our part. We were not attempting to remain anonymous. Our addresses are:

Robert J. Sorenson
361 Breakwater Court
Richland, WA 99352

Robert G. Clark
1618 W. Clearwater
Kennewick, WA 99336

Sincerely,

Robert J. Sorenson

Robert G. Clark

REDBOOK

230 Park Avenue, New York, New York 10017
(212) 983-3200

June 5, 1980

Mr. Robert J. Sorenson
Mr. Robert G. Clark
Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington 99352

Dear Mr. Sorenson and Mr. Clark:

Thank you for your very thorough and intelligent response to Judith Viorst's article on nuclear energy. The issue is a difficult one and we've received many letters from readers expressing a wide variety of viewpoints.

Please know that we will keep your comments in mind as we plan for future issues of Redbook.

Sincerely,

Cathy Cavender
Editorial Assistant

A MEMBER OF THE CHARTER PUBLISHING COMPANY GROUP

LETTERS

September 18, 1980

INMM Executive Committee
Standing Committee Chairmen
INMM Chapter Chairmen

Dear INMM Colleague:

As the end of my term as INMM Chairman approaches, I want to take this opportunity to express my personal thanks, and "by proxy" the thanks of the entire Institute membership, for your direct, personal contribution to the growth and progress of the Institute.

We clearly had another winner this year at Palm Beach, and the comments and feedback on our 1980 Annual Meeting, as well as our press coverage, have been most gratifying as many of you are well aware.

Our continuing growth, as well as the Institute's expanding professional services and programs have placed an increasingly heavy burden on volunteer workers, and the need for a fulltime executive director, business manager, or administrative officer has become apparent to all of us. I believe we have achieved in the Institute's new contract with Johnson Associates, Inc., a good, workable solution to our "intermediate-term" problem. This should then give us the time needed to evaluate and address the options and challenge before us with regard to our "long-term" problem, including the necessary expansion of our operational and financial base in order to adequately fund a national headquarters with an executive director, or business manager, etc.

The Institute has indeed made remarkable progress in recent years, thanks to the hard work of so many of our dedicated Committee Chairmen, Committee Members, and volunteer workers. By the same token, it is abundantly clear that much remains to be done in the challenging months and years ahead. Together we can now look forward to continued Institute growth and progress under the very able leadership of Gary Molen, John Jaech, and the new 1981 Executive Committee.

As I look back on my years of service with the Institute, including the past two years as Chairman, one of the greatest rewards of Institute work for me has been, and continues to be, the professional and perscnal association with dedicated INMM colleagues and friends. I look forward to serving on the INMM Executive Committee during the coming two years and to continued close association with all of you in Institute affairs.

With best regards,
G. Robert Keepin

GRK/gm
xc: INMM File

September 8, 1980

Editor
Nuclear Materials Management
Reston, Virginia

I have been disturbed by a recent rumor circulating among the membership that INMM is planning to merge with ANS.

This has been discussed only two or three times in Executive Committee over the past twenty years, and each time the idea has been strongly rejected. On one occasion in 1978, we discussed contracting with ANS for administrative services. This, too, was rejected, and since the resignation of Tom Gerdis a new Secretariat has been created to perform this function.

ANS is a fine organization for which I have the utmost respect. There are many ways which our two societies should work together, but merger is in no way one of them.

This rumor should be put to rest once and for all!

Very truly yours,

Roy G. Cardwell
Past Chairman

Nuclear Material Control Center

Akasaka Park bldg.
2-3-4, Akasaka, Minato-ku,
Tokyo

Tel. 03-583-5355
Telex 0242-4535
CA NUCLEARCENTER

Sep. 30, 1980

Mr. G. Robert Keepin
Office of the Chairman, INMM
Nuclear Safeguards Program Director
Los Alamos Scientific Laboratory
Los Alamos, New Mexico 87545
U.S.A.

Dear Mr. Keepin;

Thank you very much for your letter of September 18th. On behalf of Japan chapter of INMM I should like to express my thanks to you for what you have done during the past two years as the Chairman of the INMM. Under your powerful leadership the activities of INMM have expanded not only in terms of quantity but also of quality. In addition to the Japan Chapter, establishment of which you contributed a great deal, the new two chapters, including Vienna Chapter, were set up during the period. Two annual meetings, which were held in 1979 and 1980, coincided with the rising currents of non-prolifiration policy in the world, particularly of safeguards, and attracted attention of the people in various sections of society. Revision of the INMM Constitution reflected the growing importance of safeguards in the nuclear field. I highly appreciate your efforts for making the activities of INMM more attractive and wish to congratulate you on your marvellous achievements as the Chairman of INMM.

Sincerely yours,

Y. Kawashima

Yoshio Kawashima

NEWS AND ANNOUNCEMENTS

New Appointment Announced by Union Carbide Nuclear Division

James A. Parsons will be responsible for an expanded process engineering division. He has been a member of INMM since the early 1960s. He is a co-author of **Nuclear Materials Management,** the first complete book published on the subject.

Parsons, a native of Hand County, S.C., received his BS in chemical engineering from the South Dakota School of Mines and Technology in 1944. He joined Union Carbide the same year, when he became associated with a group at Columbia University working on development of the gaseous diffusion process for uranium enrichment.

He came to Oak Ridge later that year and was involved in startup operations at ORGDP. His professional career has included superintendent of the Process Division, superintendent of Process Engineering at ORGDP, and Manager of General Engineering for the three Oak Ridge Facilities Union Carbide operates for the Department of Energy. In 1975, he was appointed to his present position as Process Engineering Manager for the three Oak Ridge facilities.

Parsons is a registered professional engineer in Tennessee and a certified nuclear materials manager in the Institute of Nuclear Materials Management.

Active in community affairs, he has served as engineering representative on the Oak Ridge Civic Center Building Commission, Chairman of the Oak Ridge Environmental Quality Advisory Board, and for many years was Vice Chairman of the Oak Ridge Board of Zoning Appeals.

Parsons is married to the former Harriett Suddarth, Gallatin, Tenn. They live at Route 4, Wild Acres, Clinton. The couple has two sons.

Parsons

NUSAC Announces Appointments

Mr. Loren J. Evenson has recently joined NUSAC, Incorporated as a Senior Technical Associate, Security Programs Division. His services are being used by NUSAC's physical security clients to formulate security plans, devise guard training programs, conduct security audits, and perform other security support functions.

Mr. Evenson comes to NUSAC with a background in military investigations and private security. As a Special Agent for the Air Force Office of Special Investigations for ten years, he gained experience not only in all types and phases of investigative work, but also in document and information security, protection of privacy, and formulation of policy and procedures. In private industry, he has completed security projects for the U.S. Nuclear Regulatory Commission, private nuclear industry, and commercial businesses.

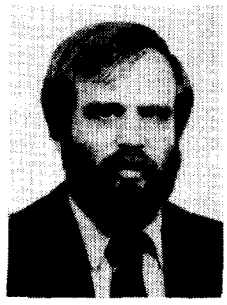
He holds a Juris Doctor degree in law and is a member of the Idaho State Bar. He holds the rating of Certified Protection Professional from the American Society of Industrial Security.

Mr. Louis T. DeStefano has recently joined NUSAC, Incorporated as its Senior Systems Engineer. Under his direction, NUSAC continues to offer a wide variety of technical specification development and system troubleshooting services to government and industry.

Mr. DeStefano comes to NUSAC from the Bechtel Power Corporation, where he was responsible for providing technical security consulting to the nuclear industry. His responsibilities at Bechtel, as they are now for NUSAC, include security system design and specification development, technical procedure writing, system related audits and security program design. Previous employment includes the Military Police Corps., Aberdeen Proving Grounds, Maryland, where he served as Post Security Officer and the architect/engineer firm of Sysha and Henessy, Inc., New York, New York, where he was responsible for providing security consulting services to museums, office buildings, hospitals and government complexes.

He holds a Masters of Science Degree in Electrical Engineering from the Polytechnic Institute of Brooklyn, where he also received his Bachelors Degree. Mr. DeStefano is currently an active member of the National Society of Professional Engineers, the Institute of Electrical and Electronics Engineers, Tau Beta Pi and Sigma Xi.

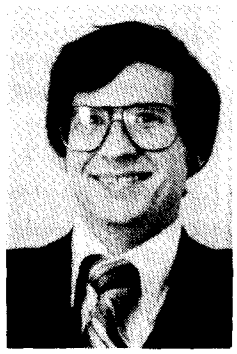
Evenson



DeStefano

E.R. Johnson Associates, Inc. Announces New Staff Appointments

E. R. Johnson Associates, Inc. of Reston, Virginia announced the addition of two new members to its technical staff. **Mr. D. J. Spak,** a biologist and graduate of Florida Southern College, will be concerned with environmental impact analysis activities with the company. **Mr. James Kapsales,** a physicist and graduate of Syracuse University, will be concerned with the design of fuel cycle facilities with particular emphasis on spent fuel storage, reprocessing and waste disposal facilities; he will also be involved in the company's training activities. Mr. Kapsales has been an instructor in reactor physics at the Naval Nuclear Power School in Orlando, Florida for the last four years.



Spak

Kapsales

Tape Honored

Gerald F. Tape, former President of AUI, recently received two awards. Presented to him at the Very Large Array dedication in New Mexico was the Distinguished Public Service Award of the National Science Foundation. Tape received a medal and a certificate "for his contribution to the management of science through firm and steady leadership in the fields of radio astronomy, atomic energy and high energy physics."

At the Lawrence Award ceremony in Washington, D.C., the U.S. Department of Energy's Distinguished Associate Award was "conferred upon Tape for his exceptional contributions to the development and civilian use of atomic energy; for his astute stewardship over the evolution of Brookhaven National Laboratory into one of the leading research centers of the world; and for his outstanding statesmanship on behalf of the United States in bringing about increased international understanding and cooperation in the development and control of nuclear energy."

Gerald Smith Resigns

Gerald C. Smith resigned on November 4, 1980 (Election Day) as the U.S. Ambassador-At-Large for non-proliferation matters.

AIF Files Amicus Curlae Brief in California Nuclear Law Litigation

The Atomic Industrial Forum (AIF) filed an amicus curiae brief in August 1980 in the appellate proceeding contesting the validity of California's restrictive nuclear laws. This proceeding, in the U.S. Court of Appeals for the Ninth Circuit, is an appeal by the State Energy Resources Conservation and Development Commission (California), the Natural Resourced Defense Council, Inc. and others of a ruling of the U.S. District Court for the Eastern District of California in which the latter court found that the California statutes in question were preempted by federal law and posed a direct obstacle to the accomplishment of the policies and objectives of Congress. The main thrust of the AIF's position is that the lower court's correctly determined that the challenged California Statutes were constitutionally invalid.

Transition Team

Shortly after the November 4 elections the Reagan Administration set up a series of transition teams to make recommendations for nominations to various positions. Some of those key transition team members in areas which may affect nuclear policy are set forth below:

Resources and Development Group

- Richard Fairbanks — Director
- Glenn Schleede — Assistant Director
- Michel Halbouty — Department of Energy
- Richard Kennedy — Nuclear Regulatory Commission
- Norman Livermore — Environmental Protection Agency
- Richard Richards — Department of Interior

National Security Group

- David Abshire — Director
- Robert Neumann — State Department
- William Van Cleave — Department of Defense
- James Malone — Arms Control and Disarmament Agency

THE ROLE OF THE INMM IN REMOTE FUEL FABRICATION

By **Roy G. Cardwell***
Union Carbide Corp. — Nuclear Division
Oak Ridge, Tennessee

ABSTRACT

The general role of the Institute of Nuclear Materials Management (INMM) is the same as that of any technical society — to provide a forum for the communication of information between members and to promote the profession. The Institute is unique, however, in that it is the only professional society dedicated exclusively to the field of safeguards and nuclear materials management. It is international in scope, having both chartered a Japanese chapter and accepted the petition for a chapter in Europe last year.

Specifically, the INMM defines nuclear materials management as an interrelated operation of material control, accountability, and security. It includes safeguards, but as a much more encompassing term, since it also strives for conservatism and efficiency in the use of the materials and the quality of the nuclear product as well as in protection from unauthorized diversion.

The primary role of the INMM in remote fabrication is synonomous with its role in any process of the fuel cycle, that is, to determine through the collective expertise and experience of members the best management methods and approaches to apply to each process segment to achieve the desired management goals and conform to the regulations. This is pursued by the communication techniques of the annual technical meetings, various special workshops, and our quarterly technical journal. Two additional major activities of INMM that contribute strongly to remote fuel fabrication standards and certification are also discussed.

INTRODUCTION

I will briefly describe the activities of the Institute of Nuclear Materials Management (INMM) relative to the remote fabrication of nuclear fuel. Discussing this work is somewhat difficult because it is so geographically diversified and much of it is intangible. However, the INMM has brought much of the diversification together in its excellent technical journal, and the society's intangibles continue to take form through an increasing number of published reports and standards.

The INMM is a nonprofit organization of individuals working in government, industry, and academic institutions wherever nuclear materials are utilized. Since its creation in 1958, it has been the only professional organization devoted exclusively to safeguards and nuclear materials management. It is international in scope, having chartered both Japanese and European chapters in the past two years.

Its basic objectives are to further the advancement of nuclear materials management in (1) the application of principles of accounting,

*Past Chairman, Institute of Nuclear Materials Management.

auditing, engineering, mathematics, physics, statistics, and physical security for the safeguarding of nuclear facilities and materials in facilities and in transit to those facilities; (2) the promotion of research in the field of nuclear materials management; (3) the encouragement, development, and preparation of American National Standards Institute (ANSI) standards consistent with existing professional and regulatory requirements; (4) the promotion of international cooperation in nuclear materials management; and (5) the continued development of the qualifications and usefulness of those individuals engaged in nuclear materials management as a profession. The INMM is dedicated to total management and control of our valuable nuclear materials by the development and selection of reliable accounting and control methods that will assure both the intended quantity and quality of the nuclear products as well as prevent their diversion as they move through the fuel cycle.

Specifically, the INMM defines nuclear materials management as an interrelated operation of material control, accountability, and security.

Material control is a broad classification including not only material location but also product quality, that is, assurance that the product falls within proper limits for each individual specification. Indeed, our technical sessions feature more papers and discussion on measurement equipment and technology and statistical evaluation than either of the other two elements. In remote fabrication, material control procedures take on a complexity not found in the processing of "cold" materials. A heavier reliance on instrumented measurement equipment and statistical evaluation becomes necessary because we are prevented from using most of the ordinary mechanical methods.

Accountability is the series of specialized accounting techniques used to quantitatively track the materials through the process, to calculate any losses, and to locate where such losses probably occur. With the possible exception of the receiving and shipping steps, accountability is generally based on the material control process data and is therefore heavily dependent on, and only as good as, its measurements. In remote fabrication this dependence may be heavier because the receiving and shipping steps are included as a part of the remote process.

Security takes on a more critical importance in the refabrication operation because of the attractiveness of the process materials. Not only is the intrinsic value much greater than the low-enriched uranium of the light-water reactors (LWRs), but the weapons potential is an added factor. The best available techniques, equipment, and procedures are required to protect the materials during remote fabrication.

REMOTE FUEL FABRICATION

The primary role of INMM in remote fuel fabrication is synonomous with its role in any process of the fuel cycle, that is, to utilize collective expertise and experience in the field for determining the best nuclear materials management approaches and solutions to our common problems. However, it differs from other technical societies in that it unites a contingent of engineers, physicists, chemists, mathematicians, and statisticians into an uncommon bond with an additional contingent of accountants, auditors, and physical security specialists. The nuclear materials managers must have an understanding of all these disciplines and of the relationship of each to the control and management of nuclear materials — not an easy spectrum to assimilate. Furthermore, they must have the additional wisdom to deal properly with an ever increasing bureaucratic structure — a monumental accomplishment in itself.

The INMM has many active programs. I have selected three major areas that contribute strongly to remote fuel fabrication: communication and interaction, ANSI Standards, and professional certification.

COMMUNICATION AND INTERACTION

A constant communication between the members is maintained through the annual meeting, special workshops, and the quarterly technical journal. Innovation and development are particularly encouraged as means of enhancing our combined professional contribution as individuals and as a society. In 1979 our annual meeting offered 82 technical papers in 11 sessions on several of the complex operations and problems within the fields of safeguards and nuclear materials management. These sessions and the number of papers in each were:

Session	Papers
Safeguards in ESARDA (International)	6
Human Factors in Safeguards	8
Nondestructive Measurements in Safeguards	8
Safeguards Concerns of Utilities	4
Process Monitoring and Dynamic Materials Control (MCA)	8
International Safeguards — Performance Assessment and Spent Fuel Measurements	8
Safeguards Measurements and Technology	8
Statistical and Decision Analyses (MCA)	8
Estimation and Control of Measurement Errors	8
Safeguards Methology Applications	8
International Safeguards — Containment and Surveillance and Timely Accounting	8

ANSI STANDARDS

The INMM has been the society designate for ANSI Standards for Methods for Nuclear Materials Control (N-15) since 1968. Our effort has grown with the United States Safeguards Program to become the single most effective contributor of standards per capita member in the ANSI organization. Specifically, the effects of ANSI Nuclear Standards can and do have a strong influence over all fabrication of fuel.

Within ANSI, the Nuclear Technical Advisory Board (NTAB) is assigned responsibility for developing standards relating to design, construction, and safe and reliable operation of nuclear facilities. Under this broad charter NTAB invites various technical societies to coordinate standards development activities on specific nuclear topics within their principal area of expertise. Sixteen such standards committees currently exist under NTAB, and the INMM is responsible for the N-15 Standards Committee dealing with methods for nuclear materials control. This effort is briefly outlined and described in Fig. 1.

The subcommittees listed in Fig. 1 are further subdivided into over 20 individual writing groups consisting of approximately 5 to 10 contributors. Thus, the INMM N-15 Standards Commmittee currently represents a significant resource of nearly 200 dedicated engineers and scientists from all segments of the U.S. nuclear community. This broad-based participation has been the key to the high rate of acceptance and implementation of the N-15 standard.

Following the resolution of internal comments, ANSI Board of Standards Review (BSR) and public comment reviews are initiated. All negative comments resulting from these reviews are reconciled in writing or incorporated into the standard before submitting the final standard to ANSI for approval and issuance. Throughout its life, at a minimum of every five years, each ANSI standard is reviewed, reaffirmed, and if necessary revised or withdrawn. The result is a dynamic set of guidelines

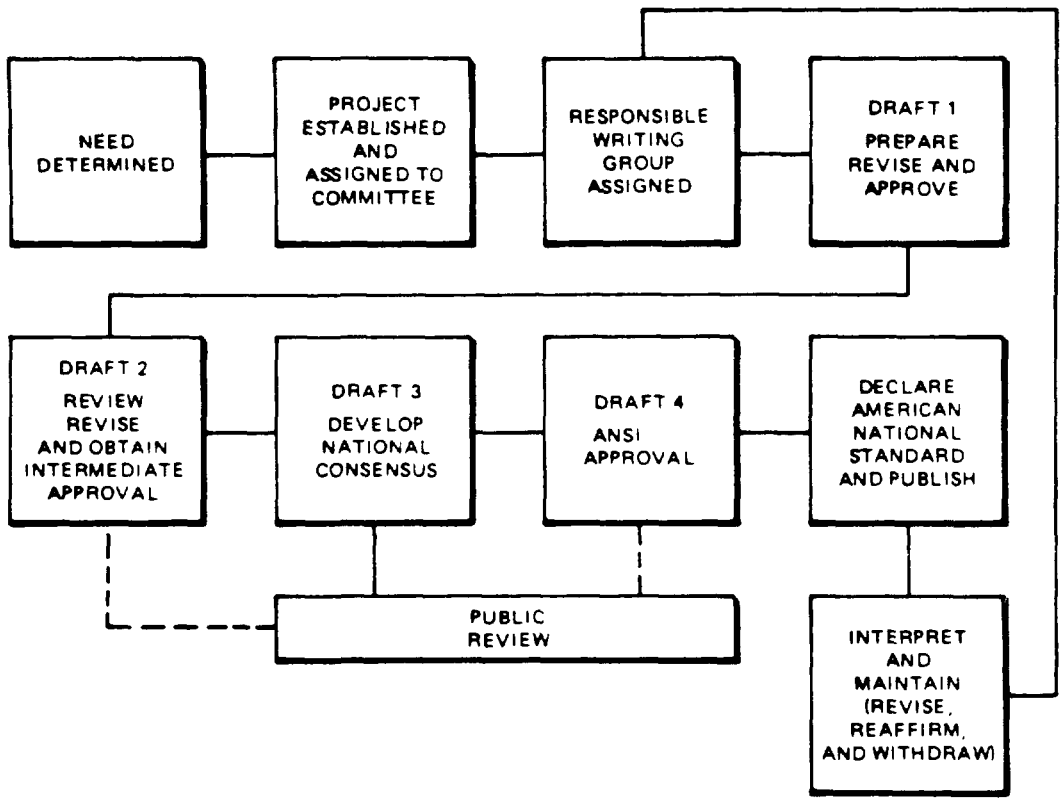


Fig. 1. Process for an ANSI Standard. Standards Committee N-15 operates under a charter of "Standards for the protection, control, and accounting of special materials in all phases of the nuclear fuel cycle, including analytical procedures where necessary and special to this purpose, except the physical protection of special nuclear material within nuclear power plants."

or recommended practices for the industry, which are established and maintained by a panel of experts to assure timeliness and technical accuracy. A current list of N-15 standards, both published and in process of publication, is given in the Appendix to this report.

Because of the increasing international emphasis on both conventional and breeder reactors as power producers, the INMM is extremely interested and is working toward expanding its international effort on standards, including remote fuel fabrication. The current chanel for international communication in safeguards standardizationn is based on the International Standards Organization (ISO), and the INMM is keenly interested in stimulating increased communication and cooperation with them. Such efforts can become a vehicle for improving the effectiveness of current safeguard systems and assuring coordination as international requirements become effective. The exact mechanism for initiating this international cooperation is currently somewhat vague and has not been well exercised in safeguards, but avenues that we feel should be stimulated include:

- formulation of international integration advisory groups;
- formation of international standardization writing groups;
- cooperation at the draft and peer-review stages as standards are developed at the national level;
- international compatibility reviews of existing, issued national standards; and
- development of intercomparison programs involving physical standards (round robins).

Each of these areas is being evaluated to establish the most time- and cost-effective mechanism for satisfying today's rapidly changing international safeguards requirements.

CERTIFICATION

Since nuclear materials management is a relatively new area, professional recognition of those in the field is strongly needed. Although the INMM has conducted a certification program for over ten years, the program was recently suspended for complete redesign and upgrading with the goal of attaining recognition on a par with other professional certificates. The new program will include extensive written testing and will be a two-step process.

The first step would lead to certification as a Safeguards Intern (CSI). After three years of applicable professional experience, the candidate would be eligible to apply for certification as a Safeguards Specialist (CSS) in any one of three specialties — Materials Accounting, Materials Control, or Physical Protection/Security. The actual test procedure, cost, and administration is still in development. For the CSI the current thinking assumes a test-question pool of about 200 questions from each of the specialties, of which some designated percentage should be answered correctly. The examination for the CSS would contain a larger selection of questions from all three categories but would concentrate on the candidate's particular specialty.

Figure 2 presents a complete outline of the second step requirements. Parts A (Accounting) and C (Security) will be relatively unaffected by whether the specialist is engaged in direct or remote fabrication of fuel.

Fig. 2. Outline of Pertinent Subject Matter in the examination for Certified Safeguards Specialist

A. Material Accounting	B. Material Control	C. Physical Protection/ Security, at fixed sites and in transportation
1. **Measurements** Bulk (mass, volume) Chemical NDA Treatment of data and uncertainty	1. **Process Control** Process streams and flow Process measurement Indicators Packaging Sampling Preparation for shipment	1. **Deterrence** Laws and regulations Signs Personnel clearances Procedures, operating Physical characteristics Seals
2. **Records** Internal MBA records Facility records Transfer documents Book inventory	2. **MBA System** Item identification (serialization) Physical inventory Custodian/responsibility	2. **Detection/Assessment** Access/Egress Control Sensors and alarms Surveillance Operating procedures
3. **Reports** International requirements National requirements Facility management	3. **Quality Control** Reference materials (physical standards) Standards Traceability Sampling	3. **Communication** Modes Communications Security Redundancy Network
4. **Data Analysis** Statistics Errors, bias treatment Inventory difference Limit of Error Shipper/receiver dif	4. **Laboratory Qualification** Sample exchange Referee/verification	4. **Delay** Physical barriers, passive and active Remote response mechanism
5. **Data Processing Technique** Licensee State System IAEA	5. **System Auditing** Sampling	5. **Response** Reaction time Guard force Backup forces
6. **Audits** System audits Sampling		6. **Audits** 7. **Transport**

*Compiled by the Institute of Nuclear Materials Management, Certification Test Formulators, 19 January 1979

Fig. 2. Outline of pertinent subject matter in the examination for Certified Safeguards Specialist.

However, we would expect that Part B (Control) would be significantly affected by this factor, as much more complexity is involved in the remote process. It is quite possible that the certification board will want to enhance the certification of those in the remote fabrication specialty by some additional subclassification of their certificate.

SUMMARY

The general role of the INMM is the same as that of any technical society — to provide a forum for the communication of information between members and to promote the profession. The Institute is unique in that it is the only professional society dedicated exclusively to the field of safeguards and nuclear materials management.

The society can contribute significantly to remote fuel fabrication through all its programs but particularly through its programs of peer interaction, ANSI Standards, and certification. With the increasing international emphasis on nuclear power, particularly the breeder reactor, the INMM will be pursuing a greater international role. It is expected that much of its attention in this area will be directed toward remote fuel fabrication.

APPENDIX

CURRENT N-15 PUBLISHED STANDARDS

N15.1-1970	CLASSIFICATION OF UNIRRADIATED URANIUM SCRAP
N15.2-1971	RECORD AND REPORTING UNITS FOR NUCLEAR MATERIALS CONTROL
N15.3-1972	PHYSICAL INVENTORIES OF NUCLEAR MATERIALS
N15.4-1971	GUIDE TO PRACTICES, NUCLEAR MATERIAL CONTROL SYSTEMS FOR CONVERSION FACILITIES
N15.5-1972	STATISTICAL TERMINOLOGY AND NOTATION
N15.8-1974	NUCLEAR MATERIAL CONTROL SYSTEMS FOR NUCLEAR POWER REACTORS
N15.9-1975	NUCLEAR MATERIALS CONTROL SYSTEMS FOR FUEL FABRICATION PLANTS
N15.10-1972	CLASSIFICATION OF UNIRRADIATED PLUTONIUM SCRAP
N15.11-1973	AUDITING NUCLEAR MATERIAL STATEMENTS
N15.13-1974	NUCLEAR MATERIAL CONTROL SYSTEMS FOR FUEL PROCESSING FACILITIES (A GUIDE TO PRACTICE)
N15.15-1974	ASSESSMENT OF THE ASSUMPTION OF NORMALITY (EMPLOYING INDIVIDUAL OBSERVED VALUES)
N15.16-1974	LIMIT OF ERROR CONCEPTS AND PRINCIPLES OF CALCULATION IN NUCLEAR MATERIALS CONTROL
N15.17-1975	CONCEPTS AND PRINCIPLES FOR THE STATISTICAL EVALUATION OF SHIPPER-RECEIVER DIFFERENCES IN THE TRANSFER OF SNM
N15.18-1975	MASS CALIBRATION TECHNIQUES FOR NUCLEAR MATERIALS CONTROL
N15.19-1975	VOLUME CALIBRATION TECHNIQUES FOR NUCLEAR MATERIALS CONTROL
N15.20-1975	RADIOMETRIC CALIBRATION TECHNIQUES
N15.22-1975	CALIBRATION TECHNIQUES FOR THE CALORIMETRIC ASSAY OF PLUTONIUM BEARING SOLIDS APPLIED TO NUCLEAR MATERIALS CONTROL
N15.23-1979	NONDESTRUCTIVE ASSAY OF THE FISSILE CONTENT OF UNPOISONED LOW-ENRICHED URANIUM FUEL RODS

N-15 STANDARDS IN PROCESS

N15.33	CATEGORIZATION OF SPECIAL NUCLEAR MATERIAL FOR NONDESTRUCTIVE ASSAY
N15.34	STANDARDIZED CONTAINERS FOR NONDESTRUCTIVE ASSAY
N15.35	NONDESTRUCTIVE ASSAY PHYSICAL STANDARDS
N15.36	NONDESTRUCTIVE ASSAY MEASUREMENT CONTROL AND ASSURANCE

N15.37	AUTOMATED NONDESTRUCTIVE ASSAY DATA ACQUISITION AND ANALYSIS
N15.38	A GENERIC GUIDE FOR AUDITING NUCLEAR MATERIALS SAFEGUARDS SYSTEM
N15.39	NONDESTRUCTIVE ASSAY OF IN PROCESS LOW-ENRICHED URANIUM FUEL MATERIAL
N15.40	DEFINITION OF TERMS AND SYMBOLS ASSOCIATED WITH THE PHYSICAL PROTECTION OF NUCLEAR MATERIALS AND FACILITIES

N-15 STANDARDS UNDER CONSIDERATION

N15.12	NUCLEAR MATERIAL CONTROL SYSTEMS FOR ENRICHMENT PLANTS, A GUIDE TO PRACTICE
N15.14	NUCLEAR MATERIAL CONTROL SYSTEMS FOR COLD SCRAP PROCESSING PLANTS, A GUIDE TO PRACTICE
N15.24	STANDARD FOR THE RECORDKEEPING AND REPORTING OF LICENSEE INVENTORY DATA
N15.25	STANDARD FOR MEASURING MATERIAL IN PROCESS EQUIPMENT
N15.29	PROCEDURES FOR CORRECTING MEASUREMENT DATA FOR BIAS
N15.30	SAMPLE SIZE CONSIDERATIONS IN THE ESTIMATION OF VARIANCE
N15.31	COMBINING SETS OF DATA
N15.32	PROCEDURES FOR RESOLVING SHIPPER-RECEIVER DIFFERENCES

Editor's Note: Invited paper, presented at the 25th Annual Meeting of the American Nuclear Society, Atlanta, Georgia, June 6, 1979.

Measurements for Certification of Reference Materials and for Characterization of Materials to be Used in Interlaboratory Evaluation Programs

By **Nancy M. Trahey**
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ABSTRACT

Programs designed to evaluate the accuracy of interlaboratory measurements as performed on selected materials require that values be assigned to the materials which are compatible with an accepted reference base. The experimental design of a material characterization program or of a material certification program must consider the measurement process. Examples will be given which are taken from the SALE and/or GAE Programs at the New Brunswick Laboratory.

INTRODUCTION

Reference materials are defined as "substances having one or more (physical/chemical) properties which are sufficiently well established to be used for the calibration of an apparatus (instrument) or for the verification of a measurement method". According to this definition, accepted by both the International Standards Organization (ISO) and the U. S. Nuclear Regulatory Commission (NRC), reference samples used in interlaboratory measurement evaluation programs can therefore be classed reference materials. In point of fact, the same rigorous certification criteria are applied, without distinction, to New Brunswick Laboratory (NBL) reference materials as well as reference samples used in the NBL-administered General Analytical Evaluation (GAE) and Safeguards Analytical Laboratory Evaluation (SALE) Programs. For purposes of this discussion, then, use of the term "reference material" will also infer the term "measurement evaluation reference sample".

PREPARATION AND CHARACTERIZATION OF A REFERENCE MATERIAL

Certification of a reference material must be preceded by a properly defined preparation and characterization protocol or plan. First, the need for a particular reference material must be clearly established, with major consideration given to its intended end-use. Second, an appropriate starting material should be prepared or located and evaluated for its physical and chemical properties. This preliminary examination is especially critical for a material taken from some intermediate step in the fuel production process where form, composition, and purity were originally specified for purposes unrelated to reference material usage. Thus, impurity contents, particle sizes, dissolution peculiarities, etc., of the material must be checked before formal characterization begins.

Once the material has been deemed acceptable for use as a reference material, it is packaged in a manner appropriate to its physical, chemical, and

hazardous properties. Stable substances, such as uranium metal, uranium trioxide (UO_3), triuranium octoxide (U_3O_8), pitchblende ore, and uranium-thorium carbide can be safely packaged in plastic vials or borosilicate glass jars without compromising their subsequent certifications. Conversely, materials, such as uranium dioxide (UO_2), uranium hexafluoride (UF_6), uranyl and plutonium nitrate solutions, plutonium metal, and plutonium dioxide (PuO_2) require special types of containment - according to their particular chemical and radiological properties - in order to preserve their chemical integrities and reduce the danger to personnel transporting and handling them.

After the "new" reference material has been packaged, details of the measurement phase of the characterization are specified on both chemical and statistical bases. Analytical procedures to be applied, measurement uncertainties tolerated, population sampling statistics required, type(s) and number of standards (nationally accepted reference materials) needed, etc., are carefully reviewed. When each parameter has been determined, a measurement outline is prepared, defining each step in the process. Typical sample and analysis schemes from an outline are shown in Figures 1 and 2. The material under consideration is uranium dioxide (UO_2); the properties to be certified are its uranium and uranium-235 contents; the analytical procedures to be used are a high precision titrimetric method, a gravimetric method, a thermal ionization mass spectrometric method and an emission spectrographic and/or atomic absorption spectrometric method.

As can be seen in Figure 1, two (2) independent uranium assay analytical methods are selected for the characterization. The reasons for doing so are (1) each is an assay technique widely accepted throughout the nuclear industry, (2) each is capable of providing accurate and precise (better than $\pm$ 0.01% absolute) measurements, and (3) each has few potential measurement errors in common. In preference to consensus certification, use of these two independent techniques furnishes the information necessary to assure an unbiased assay characterization, though only the titrimetric method can be validated directly with a uranium metal standard (NBS SRM or NBL RM).

For mass spectrometric analysis, a scheme similar to that shown in Figure 2 for the titrimetric measurements is followed on a day-to-day basis. In this case, the reference materials used are uranium isotopic standards (NBS SRMs) selected to bracket the uranium-235 content of the sample.

Gravimetric analysis is not amenable to the scheme in Figure 2 for the ignition of the uranium dioxide (UO_2) to triuranium octoxide (U_3O_8). However, every effort is made to concurrently ignite the same numbered subsamples from each sample under conditions where temperature, time of ignition, and time of cooling are precisely controlled. Also, there are no reference materials available to assure that oxide stoichiometry has, in fact, been achieved; however, triple ignitions insure that the oxide has reached a constant weight.

Once the ignitions are complete, portions of two subsamples are analyzed by emission spectrography and/or atomic absorption spectrometry for impurity oxide contents. These measurements are performed using a triuranium octoxide (U_3O_8) impurity standard (NBL RM) for validation.

Assay of several of the ignited subsamples is also performed by the high precision titrimetric method. There are advantages to doing these additional measurements, one being that direct verification to nationally accepted reference materials can be accomplished; another being that problems in dissolving certain uranium dioxide (UO_2) samples in phosphoric acid (such as high-fired powder or ground-up sintered pellets) are reduced or eliminated entirely.

When all the measurements have been completed, statistical evaluation of the data is begun. A variety of tests are performed to determine whether or not significant differences or biases exist between samples, within samples, between methods, and within methods. The results of these tests are then reviewed and compared to the objectives set forth in the characterization plan. Based on this final evaluation, a certified value, traceable to the National Measurement System, is established for each property of the material characterized.

USE OF REFERENCE MATERIALS IN THE GAE AND SALE PROGRAMS

At the present time, there are four (4) types of materials in the SALE Program and four (4) types in the GAE Program being used as measurement evaluation reference materials. Table 1 lists these materials, the quantity of each type characterized in Fiscal Year 1980, the property or properties for which they are certified and the specific program to which they apply. (It should be noted here that some of the materials listed are characterized for their uranium or plutonium contents by a single assay method. In these cases, population sampling of the materials is increased so that any deleterious measurement effects can be evaluated over a longer period of time. This latter process is not the most desirable for assay characterization; however, it is better than attempting to correlate measurement data from two independent assay techniques for which the material is not equally suitable.)

Measurement data on the materials listed in Table 1 are submitted by program participants according to a time cycle established for the particular program. SALE program measurements are required on a bimonthly basis; GAE on a monthly basis. Documentation of the data generated in each program are provided in reports issued by cycle as well as annually. The annual reports provide additional statistical information and a broader overall perspective of the measurement of these materials with respect to time.

CONCLUSION

The GAE and SALE Programs for measurement of special nuclear materials for quality assurance and nuclear safeguards purposes have three (3) major goals. These goals are (1) to assess current state-of-the-art measurements, (2) to sustain the quality of measurements performed, and (3) to improve, where necessary, the level of measurement performance. With properly prepared and characterized certified reference materials as their foundation, the goals of these two programs have been and will continue to be realized.

REFERENCES

1. ISO Guide 6-1977(E), "Mention of Reference Materials in International Standards", section 2.2.

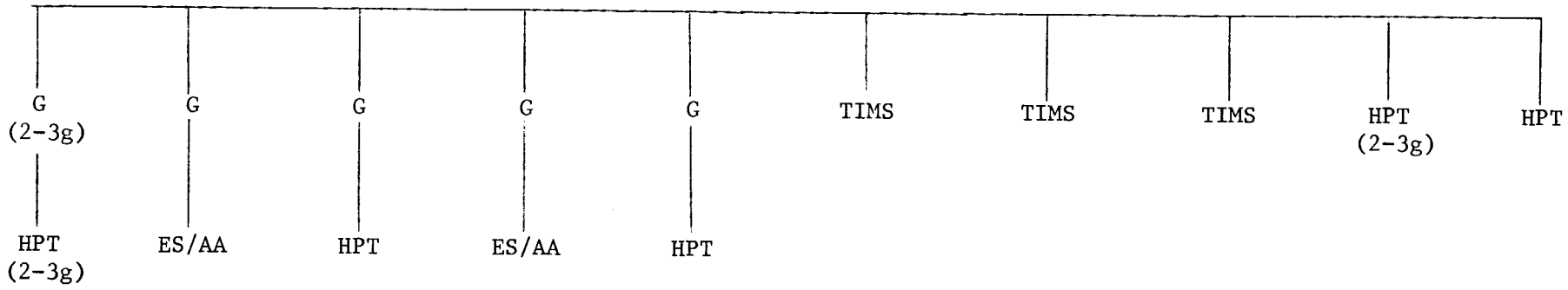
2. USNRC Regulatory Guide 5.58, "Considerations for Establishing Traceability of Special Nuclear Material Accounting Measurements", February 1980.

3. NBL-286, "Summary of the Results of the General Analytical Evaluation Program - March 1976 through February 1977".

4. NBL-295, "Safeguards Analytical Laboratory Evaluation (SALE) 1979 Annual Report", July 1980.

Figure 1

Typical Sampling Scheme for Characterization of Uranium Dioxide (UO_2)



ES/AA = emission spectrography/atomic absorption spectrometry
G = gravimetry
HPT = high precision titrimetry
TIMS = thermal ionization mass spectrometry

Figure 2

Typical Titrimetric Analysis Scheme for Characterization of Uranium Dioxide (UO_2)

Measurement Schedule & Sequence		
Day 1	Day 2	Day n
S-1	S-5	S-x
HPT-1-1	HPT-1-2	HPT-1-y
S-2	S-6	S-(x+1)
HPT-2-1	HPT-2-2	HPT-2-y
S-3	S-7	S-(x+2)
HPT-3-1	HPT-3-2	HPT-3-y
S-4	S-8	S-(x+3)

S = certified reference material

Table 1

Reference Materials Prepared and Characterized in FY 1980 for NBL Evaluation Programs - GAE & SALE

Material Type (Composition)	Number of Materials Characterized	Property(ies) Characterized	Evaluation Program
Uranium Dioxide - UO_2 (powder)	1	U, ^{235}U	SALE
Triuranium Octoxide U_3O_8 (powder)	6	metallic	GAE
Uranyl Nitrate (solution)	4	U, ^{235}U	SALE
Uranium Nitrate (solution)	2*	U, ^{235}U	GAE
Uranium-Niobium (1%) (solution)	1	U, ^{235}U	GAE
Uranium-Chromium (10%) (solution)	1	U, ^{235}U	GAE
Plutonium-Dioxide - PuO_2 (powder)	1	Pu, $^{238-242}Pu$	SALE
Uranium-Plutonium Dioxide - $(U-Pu)O_2$ (pellet)	3	U, ^{235}U, Pu $^{238-242}Pu$	SALE

*One (1) process dissolver solution (no characterization)

A Socratic Approach To Independent Verification

By **C. R. Hatcher**
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Los Alamos, New Mexico

I. INTRODUCTION

In carrying out its inspection and verification responsibilities, the International Atomic Energy Agency (IAEA) performs a variety of chemical analyses and nondestructive assays (NDA) of various nuclear materials. Most of the IAEA's NDA measurements for materials accountability purposes are made in operating facilities using portable or transportable instruments. This approach has several advantages, including the prevention of tampering with the instrument by a potential diverter, since the instrument remains in the custody of the inspector. Recent interest in the possible use of NDA instruments that would not be in the direct custody of the inspector is due to two factors:

1) Greater use is being made of in-plant NDA instruments by facility operators for both process control and materials accountability. In many instances, these instruments provide data that would be useful to international inspectors.
2) There is a need for near-real-time accounting of material in certain types of facilities, obtainable only with in-plant measurement systems that cannot be easily moved.

From these considerations, the question naturally arises as to how the IAEA might independently verify measurements made with an instrument that is in the custody of a facility operator.

Although various people have examined the problem of independent verification for a specific NDA instrument monitoring a specific process, it appeared worthwhile to see if the problem could be approached in a more general way. In thinking about how actual tampering with an NDA instrument to conceal a diversion might be falsely interpreted by an inspector as being a routine measurement error, we posed the following (Socratic) questions:

1) Is one type of measurement error more likely than another?
2) Is one type of diversion attempt more likely than another?
3) Why do safeguards personnel normally test for measurement errors before exploring diversion possibilities?
4) What should be the difference in approach when testing for measurement errors vs testing for diversion?

This technical note is intended to help address these questions in a qualitative way. Although the present treatment is rather elementary, it may provide slightly different insight into some of the problems of independent verification, and perhaps stimulate further thought in an area of increasing importance to international safeguards.

II. DISCUSSION OF PROBABILITY FUNCTIONS

A. The Probability of a Diversion Attempt With Planned Cover-Up Activity S(s)

We consider a variable s that is defined as the complexity of a diversion scenario.

$s = s$ (cost, number of people involved, number of operational steps, time required, number of parameters affected, etc.)

The ease of concealing a diversion as a function of s will be an increasing function, and the ease of implementing a diversion as a function of s will be a decreasing function, as shown in Fig. 1.

The probability of a diversion with planned cover-up activity S(s) is assumed to be proportional to the product of the two functions plotted in Fig. 1. Figure 2, showing S(s), would imply that if diversion with cover-up activity takes place, it is unlikely that the associated complexity of the scenario will be either very low or very high, and most likely that the complexity will fall in some middle range.

B. Diversion With No Cover-Up Activity U(s)

In addition to diversion with planned cover-up activity, there may be diversions in which no

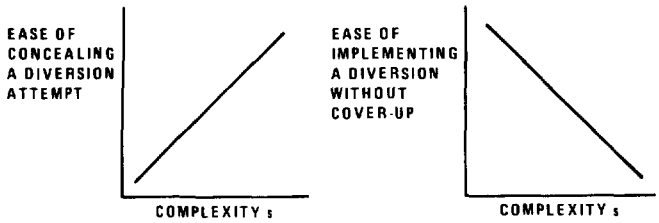

Fig. 1. Ease of concealing a diversion and ease of implementing a diversion plotted as a function of complexity of the scenario.

cover-up activity is planned. We assume that the probability of such a diversion is a decreasing function of complexity (Fig. 3).

C. Total Probability of Diversion D(s)

The probability D(s) of there being some kind of diversion, either with or without planned cover-up activity, can be written in terms of S and U.

$$D(s) = 1 - (1-S)(1-U) = S + U - SU \quad . \qquad (1)$$

Since the cross term is small,

$$D(s) \cong S + U \qquad (2)$$

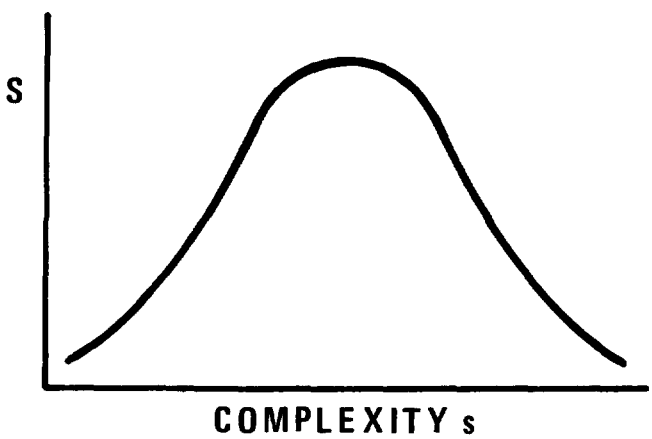

Fig. 2. Probability of a diversion with planned cover-up S plotted vs complexity.

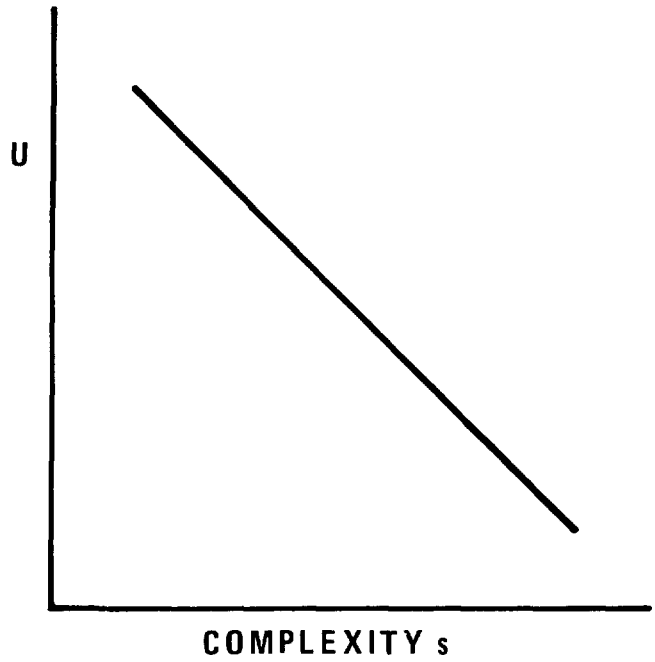

Fig. 3. Probability of a diversion in which no cover-up activity is planned U plotted vs complexity.

In the region where $s < s_m$, U is decreasing, and S is increasing, as shown in Fig. 4. Because U and S describe similar kinds of activity, we expect them to be of the same magnitude in this region, and so we assume that $D(s) = U + S$ is constant for $s < s_m$. For $s > s_m$, D(s) drops off rapidly, and for for $s > s_0$, D(s) is negligibly small. For planning a verification strategy, we might therefore assume that D(s) is as shown in Fig. 5.

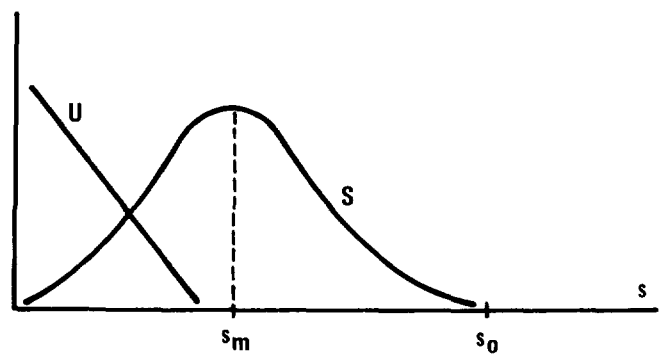

Fig. 4. Probability of a diversion with no cover-up activity U and probability of a diversion with planned cover-up activity S, both plotted vs complexity.

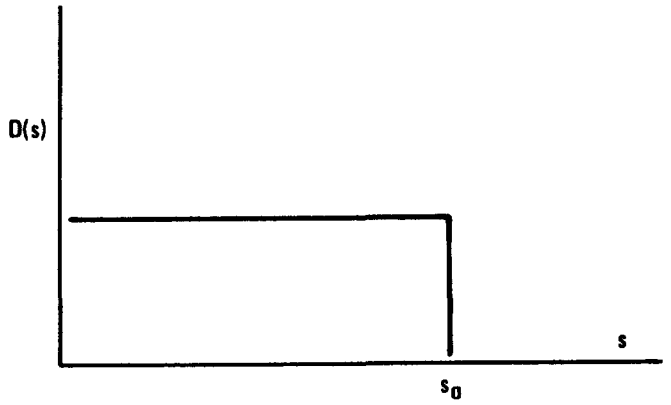

Fig. 5. Assumed form for total probability of diversion D(s) vs complexity of scenario.

D. Probability of Measurement Error M(s)

By measurement errors, we mean all activities, other than intentional tampering, that can lead to an in-plant instrument giving an erroneous result, including statistical counting uncertainties, sampling problems, human errors, and hardware or software failures. If we broaden the definition of complexity to include measurement error parameters as well as diversion scenario parameters, we can then plot the probability of measurement errors M(s) vs complexity. We assume that M(s) is a decreasing function of s, i.e. that a measurement error is more likely to be due to something simple than due to something complex. We also assume that $M(s) \to 0$ for some value of $s < s_0$. For convenience, both M(s) and D(s) are shown in Fig. 6.

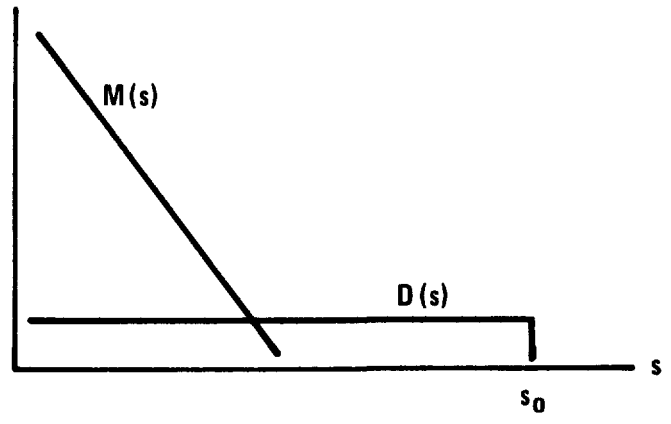

Fig. 6. Probability of measurement error M(s) and probability of diversion D(s) plotted vs complexity.

For a typical facility,

$$\int_S M(s)\, ds >> \int_S D(s) ds \qquad (3)$$

because measurement errors are statistically much more probable than diversion attempts. However, for a given facility and a given in-plant instrument, this inequality may not always be valid.

III. IMPLICATIONS FOR STRATEGY

A. Optimum Strategy for Detecting Measurement Error M(s)

For detecting measurement errors with maximum efficiency, one should test for low-complexity scenarios first, since these have the highest probability and generally require the simplest test procedures. The fact that no collusion is involved

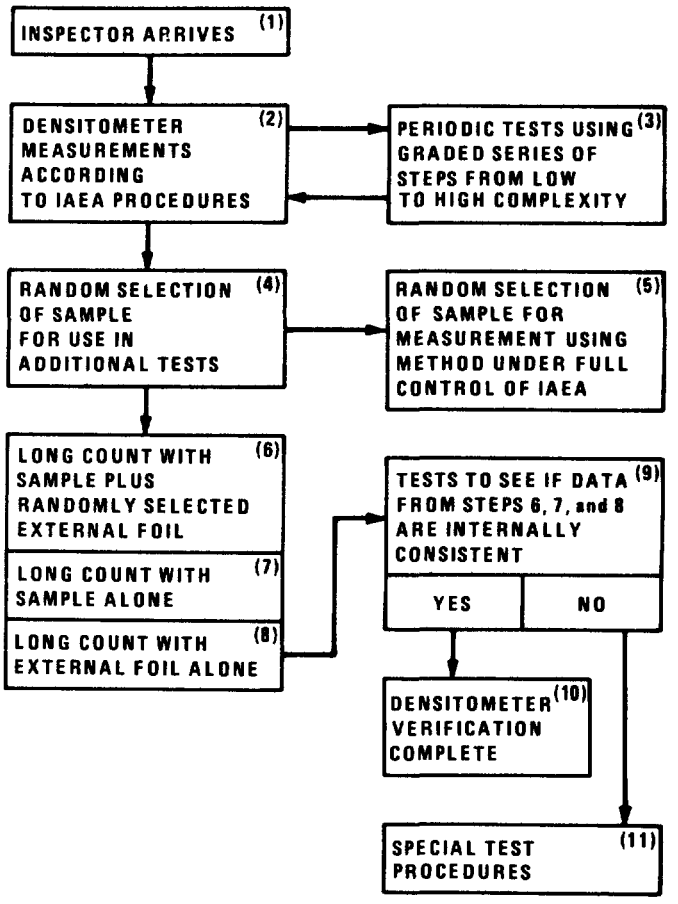

Fig. 7. Block diagram of possible independent verification procedures for K-edge densitometer.

means that regularly scheduled tests can be instituted, and one can follow a series of steps going from simple scenarios to more complex scenarios with the simpler tests occuring more frequently.

B. Optimum Strategy for Detecting Diversion D(s)

For detecting diversion efficiently, one should choose a value of complexity s_0, above which one is sure that D(s) can be safely neglected. The search for diversion should then give approximately equal weight to all diversion scenarios with $s < s_0$, independent of the value of s. For detecting diversion, a test of low-complexity scenarios is of limited value, and one is better off to plan more involved tests that will cover a wider range of diversion possibilities, from the simplest to the most complex. Also, since cover-up activity may be involved, it is desirable that the tests for diversion be made on a random basis and that the facility operator not know what the correct answer to a test is before the result is obtained.

When measurements indicate that a diversion may have taken place, there is a "natural" tendency to doubt the validity of the measurements and to work frantically trying to find the measurement error. This reaction is logical (if misguided) because, in general, measurement errors are more probable than diversions. A well-designed independent verification procedure should include rigorous steps to follow when measurements indicate a diversion has taken place, so that one is forced to look not just for what is most probable (i.e., a measurement error) but also for what is less probable but more important (i.e., a diversion).

III. APPLICATION OF GENERAL STRATEGY

Figure 7 shows an example of how the above strategy could, in principle, be applied by the IAEA to independent verification of measurements made with an in-plant x-ray densitometer. Each numbered block in Fig. 7 will be briefly discussed.

1) The inspector arrives and asks facility operator personnel to begin measurements under the inspector's observation. We assume that prior to this time the densitometer has been under operator control.
2) Densitometry measurements are made by facility personnel according to IAEA procedures. These procedures include additions to the procedures normally used by the plant operator and will require loading of the IAEA's program disk.
3) On a regular basis, tests are made to establish that the densitometer system is intact and is capable of working properly. The procedure consists of a graded series of steps, starting with tests for the simplest scenarios and going toward more complex scenarios. The inspector would be given the option of terminating the procedure at any point, and tests for simple scenarios would be made more frequently than tests for more complex scenarios. The procedure would involve such steps as:
   a) Visual checks of hardware, including seals.
   b) Monitoring of detector output.
   c) Monitoring of ac power input.
   d) Verification of program disk.
   e) Printout of measurement parameters.
   f) Measurement of standard foils.
   g) Measurement of sample in IAEA cell.
   h) Statistical analysis of gamma-ray spectra from a series of repeated runs.
   i) Detailed hardware inspection.

   Typically, steps a), b), and c) might be performed once or twice per shift, steps d), e), f), and g) might be performed once per day, and steps h) and i) might be performed once per week or once per campaign.
4) On a random basis, the inspector selects a sample to be used in tests for measurement errors and diversion scenarios covering a wide range of complexities.
5) Some of these randomly selected samples would be verified using "external" methods under full IAEA control, such as those at the IAEA's Seibersdorf Analytical Laboratory.

6,7,8) First, the randomly selected sample and a randomly selected foil (inserted in a slot external to the glovebox) are measured simultaneously. Second, the external foil is removed and the sample alone is measured without being moved. Third, the sample is removed and the same foil used previously is replaced in the

external slot and measured separately.* The identity of the foil is not disclosed to the operator until after measurements are completed, and steps are taken so that the operator cannot determine the identity of the foil or estimate its density from the simultaneous measurement of foil and sample. External foils left at the facility are protected with seals when not in use.

9) Statistical methods are used to determine the probability that the difference between the simultaneous and separate measurements of the sample and foil is due to statistical counting errors.

10) If the measurement results are internally consistent, the verification is considered complete.

11) If the measurement results are not consistent, then one goes to a set of special test procedures that should be clearly defined in advance. We have not developed these procedures in detail, but feel that there should be several steps, most of which are designed to focus on the possibility of a diversion rather than on the possibility of a measurement error. Examples of steps being considered for special test procedures are as follows:

a) Request of operator additional information, including process data, material characteristics, sampling details, etc.

b) Correlate data from different instruments and different measurement points, and attempt to close material balance.

c) Make detailed check of instrument hardware and software with emphasis on detecting tampering.

d) Repeat steps 6), 7), 8), and 9) using same sample and foil and different sample and foil.

e) Increase the number of measurements under complete IAEA control.

* The use of separate and simultaneous measurements of sample and foil was suggested by S.-T. Hsue and Phyllis Russo of LASL.

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