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EDITORIAL

New Institutional Arrangements Discussed

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

The NASAP and INFCE studies are winding up. While discussion of these reports must await their publication, it is clear that safeguards will receive heavy emphasis and that much study and experimentation remain to be completed.

Assuming that once-through nuclear fuel cycles were more proliferation-resistant than fuel cycles which involve reprocessing, the U.S. had hoped to persuade other nations that reprocessing and fast breeder development could be postponed for a number of years. Other nations, however, have concluded that these activities should not be postponed, for a number of reasons. Consequently, it is necessary to consider safeguards, both domestic and international, for reprocessing, refabrication and fast breeder facilities.

As a follow-on to INFCE, some new institutional arrangements are being discussed, such as multinational spent fuel storage facilities, an international plutonium storage regime, and multinational nuclear fuel production facilities. Safeguards must be considered in any such discussions, and the form of any such multinational or international undertaking will affect the corresponding safeguards system design.

We must not underestimate the problems to be faced. There is a lack of agreement as to the objectives for either national or international safeguards systems. A national system designed to counter every threat that can be imagined would be very expensive, seriously hamper operations, and by its very size and complexity lacking in credibility. International safeguards, on the other hand, are applied to nuclear materials and facilities volunteered by national governments for application of such safeguards. Therefore, international safeguards must be acceptable to the nations concerned, while the internatonal system must accomplish objectives which clearly benefit these nations.

Safeguards involves a lot more than safeguards techniques and systems studies. It involves appreciation of the worries and the desires of the customers, and a clear understanding of the relative sensitivities of nuclear materials, facilities, and fuel cycles. It involves communication between the members of INMM and politicians and diplomats, on the one hand, and with the nuclear industry, on the other. It involves exploiting the contacts with our members in different countries, which our international organization offers.

Safeguards is here to stay. A lot of people are depending on us.

Dr. Higinbotham

Report on INMM Fall Executive Meeting in Denver

By Dr. G. Robert Keepin, Chairman
Institute of Nuclear Materials Management
Los Alamos, New Mexico
Mt. View, California

The Institute continues to grow with total membership now over 660, including three thriving Chapters with a combined membership of over 150, and the new Central Region Chapter about to be launched in early 1980. Likewise, operationally (and financially) the INMM has grown to a $150,000/year operation, with three workshops, two INMM co-sponsored topical meetings and at least three training courses scheduled for Fiscal Year 1980 — all in addition to our regular Annual INMM Meeting, to be held this year in Palm Beach, Florida.

Reports from the various standing committee chairmen at the INMM Executive Committee Meeting in Denver, November 7 and 8, clearly attested to the broad range of new initiatives and activities underway in all areas ranging from Awards to Certification to N-15 Standards to Public Information to the already-very-active Technical Working Group for Physical Protection. Up-to-date reports on each of our several INMM Committees, Chapters and Technical Group are presented elsewhere in this issue so I shall only extend well-deserved kudos for their significant achievements and progress, without attempting to "steal their thunder."

An important new change in our Safeguards Committee Chairmanship is highly noteworthy. Due to the press of other committments **Syl Suda** has had to resign his chairmanship of the Safeguards Committee, although he will be continuing both as a member of that Committee and in addition he will be Chairing INMM-8, our N-15 Subcommittee on Calibration Standards. It was my great pleasure to report at the Denver meeting that our new INMM Safeguards Committee Chairman is **Jim Powers,** a seasoned safeguards expert and well-known colleague, formerly with NRC and presently with Teknekron, Inc., McLean, Virginia. Jim is already undertaking some key task assignments and we wish him every success in his new position in INMM leadership.

One recurrent theme that seemed to emerge from the Denver meeting was the importance of continuing to expand INMM capabilities, professional activities and services for the benefit of all Institute members and for the advancement of our profession generally. In this connection, the thrust of the three main reactor safety "lessons learned" at 3 Mile Island (i.e., better professional training, better measurement instrumentation, and better emergency response) was viewed as directly translatable to a need for similar intensification of effort in the safeguards and security area. In another recent development, the work of many in preparing — on short notice — the INMM response to the request from U.S. Senator **Frank Church** for INMM comment and recommendations on the U.S.-Australian agreement on Nuclear Cooperation (cf, article by **Dennis Bishop,** pp. xx this issue) was very favorably received and cited as exemplary of INMM professionalism in action.

In response to recent developments of direct concern in the area of safeguards and materals management I have, with the concurrence of the Executive Committee, appointed a Public Information/Response Committee consisting of **Jim Powers,** Chairman, **Dennis Bishop, Herman Miller** and **Joe Stiegler.** The mandate of this Ad Hoc Committee is to develop an inventory/directory of INMM expertise and capabilities for (1) providing public information, education, consultation and expert assistance when and as requested and (2) for responding appropriately to new developments (whether abrupt, emergency or gradually evolving) within our area of expertise. This might involve, for example, providing an explanation, in laymen's terms, of physical protection or materials acountancy principles and practice, or of explaining the practical significance of an abnormally large Inventory Difference such as might occur at nuclear facilities within either the private or government sector.

And now for some bad news! It should come as no surprise that the INMM Executive Committee has felt compelled to increase its membership dues: starting in Fiscal Year 1981, INMM dues will be $30 annually. Through the dedicated efforts of all concerned we have valiantly held dues constant at $20 for the past four years, but the steadily increasing scope and level of Institute activities and services, together with the inexorable onslaught of inflation, have made an increase in INMM dues inevitable. To put things in perspective, I would invite comparison of INMM dues with those of any other professional society in the nuclear field — or

Dr. Keepin

any technical field for that matter. Taken in this context, I believe most of you will agree that INMM still offers one of the best dues bargains going — and of course, your INMM dues are tax deductible as a professional business expense.

Turning now to a topic of paramount importance, I want to try to summarize, as faithfully as I can, the thrust of current thinking and consensus of the INMM Executive Committee with regard to the overall direction of the Institute in the difficult and challenging years ahead. The Institute has long recognized the considerable benefits that would accrue from having an "Executive Director" of recognized professional background and stature in the nuclear community. Such a leader could provide effective direction, continuity and advocacy of the unique role and contributions that the INMM — as the leading professional society in its area of specialty — can bring to the field of nuclear materials management and safeguards. Initially, it may be desirable, or indeed necessary, to secure the professional services of such an individual on a part-time basis, although such a decision would clearly involve many factors, some of which are simply unknowns at present.

After due consideration, the consensus of the INMM Executive Committee, as formally expressed at its November meeting in Denver, is that the time has come for the Institute to initiate a search for well qualified candidates for the key position of INMM Executive Director. In order to proceed in an orderly fashion with the implementation of this general policy guidance and future goal as set forth by the Executive Committee, I have appointed an Ad Hoc Committee of three to serve as a Candidate Search and Evaluation Committee; its members are **Yvonne Ferris,** Chairman, **Vince DeVito** and **Ralph Lumb.** Although formal advertising for this key position is not contemplated at this time, Institute members are encouraged to provide their comments and input, both as regards the Executive Director position in general and as regards qualified individual candidates. Communication directly with members of the Ad Hoc Committee or with any member of the INMM Executive Committee are equally appropriate. It is most important to note that there will be no precipitous action in this vital matter, and indeed the time scale involved in recruiting the right individual may well extend over many months, or perhaps even a year or more. Many details of the functions of the subject position and interactions with other INMM headquarters staff, the INMM Executive Committee and Standing Committee Chairmen, have yet to be defined, and will depend, in part, on the preferences and inputs of individual candidates, as well as policy guidance from the Executive Committee.

In a related development, members of the Executive Committee are preparing a Policy and Procedures Manual for future guidance in efficiently conducting the professional activities and operations of the Institute. Also, recognizing the broader issue of overall future direction and thrust of the INMM, the Executive Committee has asked that their specific policy guidance with respect to an Executive Director be incorporated into an overall Long Range Plan for the Institute that appropriately reflects the INMM's leadership role in safeguards and materials management. This broad undertaking, obviously closely related to the mandate of the Ad Hoc Committee as indicated above, is presently envisioned as an activity of the entire Executive Committee under the guidance of a designated Coordinator of the overall effort. It is our goal to have a Long Range Plan developed during the course of the current INMM Fiscal Year, 1980.

As always, the valuable input of individual INMM member is actively sought; please let us hear from you on any or all of the important issues just outlined, or on any other topics you may wish to raise. Your input is clearly essential as together we chart our future role and unique professional contribution to the viability of the nuclear power option.

In this connection it seems most appropriate to note here in closing that the Constitution and Bylaws of the Institute specifically provide for and encourage attendance by INMM members at all INMM meetings, including INMM Executive Committee meetings. The next meeting of the Executive Committee is scheduled for April 15 and 16 at the Hilton Inn in Wilmington, North Carolina; we'd be delighted (even if a little surprised!) to see you there!

Nominating Committee Solicits Input

The INMM Nominating Committee will soon begin to prepare an election slate FY 81 (7-80 to 6-81). 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, 1980. Address Roy G. Cardwell, Chairman, INMM Nominating Committee, ORNL, P.O. Box X, Oak Ridge, TN 37830.

W. B. 'Bill' Thomas, First Secretary of INMM

The Institute was saddened to learn of the passing of **W. B. "Bill" Thomas** on November 7, 1979. One of the founders of INMM, Bill was an untiring contributor to the Institute, having been our first secretary. Bill played a major role in the early organizing committee and personally handled our initial incorporation filing in the State of Pennsylvania. During the period 1958 through 1967, Bill participated in essentially all facets of Institute activities. Those who knew and worked with Bill are quite aware of his contributions to the Institute. Bill served as Nuclear Materials Accountability Representative for Westinghouse-Bettis for some 15 years. His recent assignment with Westinghouse was with their financial accounting department. Our sympathy goes out to Mary and the children. For your information, Mary Thomas may be contacted at 59 Moffett Street, Pittsburgh, PA 15243. — **Harley L. Toy**

Forscher Joins U.S. NRC, Resigns INMM Post

By Dr. Frederick Forscher
U.S. Nuclear Regulatory Commission
Washington, D.C.

This is my last report to the INMM membership as Chairman of the Certification Committee. My new association with the Nuclear Regulatory Commission, Office of Standards Development, could lead to conflict of interest that both the INMM and I must avoid.

For the past six years, I have endeavored to make nuclear material safeguards a profession in the true sense of the word. To this end, the Certification Committee worked diligently to develop a Certification Program that would compare favorably to other accepted programs for certification or licensing of professionals. The early phase of this program development is now coming to an end, and the implementation of the program is about to commence.

During the past year, a library of certification examination questions has been formulated to provide this objective means. This test library has been revised, edited, and validated through the testing of three selected groups and a control group to determine the adequacy and pertinence of the test items. These results are presently being evaluated with the expectation that a Certification Board will be established in early 1980 to implement and conduct the certification process.

Now is an appropriate time to relinquish the chairmanship of this important committee, to thank the Institute for affording me the opportunity to serve, and express my deep appreciation to all members who have assisted with the work of the committee. This work has involved the certification of Nuclear Materials Managers, the determination to suspend this certification, and to establish a new and more objective means for certifying individuals.

Now is also an appropriate time to apply the lessons of the TMI Accident that so clearly emphasized the importance of the human factors; i.e., the operator training and the man-machine interactions. It has now become abundantly clear that there is no acceptable safety, no acceptable safeguards, without properly motivated, trained, and qualified (certified or licensed) operators, managers, and inspectors.

In connection with the problem of public acceptability of the evolving safeguards system, I see the function of Certified Safeguards Specialists as analogous to the safety function of (licensed) reactor operators. To follow this analogy further, I would like to **paraphrase** one recommendation — the one for training the operating personnel — from the Report of Presidential Commission on the Accident of Three Mile Island (The Kemeny Commission):

The Commission recommends the establishment of accredited training institutions for the safeguards specialists and the immediate supervisors of safeguards specialists. These institutions should have highly qualified instructors who will maintain high standards, stress understanding of the fundamentals, and train safeguards specialists to respond to emergencies.

a. These institutions could be national, regional, or specific to a part of the nuclear fuel cycle.

b. Safeguards specialists should be required to graduate from an accredited training institution. Exception should be made only in cases where there is a clear documentary evidence that the candidate already has the equivalent training.

c. The training institutions should be subject to periodic review and reaccreditation by the restructured NRC.

d. Candidates for the training institute must meet entrance requirements geared to the curriculum.

e. Training should not end when candidates are given their certification. A comprehensive ongoing training must be given on a regular basis to maintain the level of knowledge of safeguards specialists. Such training must continue to be indicative of the safeguards experience and situations expected to be encountered.

It is expected that at the conclusion of such a training program, the candidates will be able to meet the requirements of the professional examination, administered by the independent Certification Board.

It is hoped that the various domestic and international agencies concerned with safeguards will recognize this certification process as a desirable quality control function on personnel and take advantage of it in employee selection and licensing.

Dr. Forscher

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Utility Executive To Be Keynote Speaker

By John L. Jaech, Chairman
INMM Annual Meeting Technical Program Committee
Richland, Washington

The Monday morning Plenary Session for the June 30 - July 2, 1980 meeting in Palm Beach will feature the keynote address by Dr. **Robert Uhrig,** Vice-President of Advanced Systems and Technology for Florida Power and Light. His paper is entitled, *"Regulation of the Nuclear Power Industry: Its Uses and Abuses."* The Program Committee feels fortunate to have Dr. Uhrig on the program, speaking on behalf of the nuclear industry in general and the utilities in particular on this important topic in pursuit of the conference theme, *"Safeguards – Today and Tomorrow."*

The other three speakers in this Plenary Session are also prominent individuals who will develop the conference theme from a number of perspectives. From the Department of Energy, we have Mr. **Duane Sewell,** Assistant Secretary for Defense Programs. Representing the Nuclear Regulatory Commission is Mr. **William Dircks,** Director, Office of Nuclear Materials Safety and Safeguards. The fourth Plenary Session speaker will address the current status and future outlook for safeguards from an international perspective. He is Dr. **H. Gruemm,** Deputy Director General of the Department of Safeguards, International Atomic Energy Agency.

Another meeting highlight will be the Tuesday afternoon Plenary Session. This will feature a presentation on waste management by Mr. **Colin Heath** of the Department of Energy's Office of Nuclear Waste Management, and will provide the audience with an opportunity to react on this important subject. Also in this session, we will have the opportunity to hear Dr. **W. Higinbotham,** the 1979 INMM Distinguished Service Awardee, speak on the outlook for safeguards from his viewpoint. Those who have heard Willie speak will attest to the fact that his address alone will be well worth the *"price of admission."*

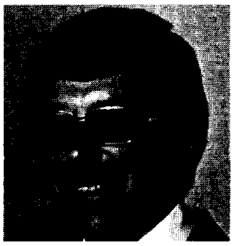
As in Albuquerque, we will again have a number of invited papers sessions to complement the contributed papers sessions. **George Huff,** Chairman of the Invited Papers Sessions Subcommittee, has lined up a number of sessions on such topics as physical protection, the analysis and interpretation of material acounting data, safeguards measurements technology, and safeguards in ESARDA (European Safeguards Research and Development Association). There may be one or two additional invited papers sessions, but plans are not firm as of now.

The Chairman of the Contributed Papers Subcommittee, **Dick Chanda,** anticipates that there will be a large number of contributed papers again this year. Tri-current sessions, which proved to be very popular in Albuquerque, are again being planned for Palm Beach, and there is the distinct possibility that for one or two half days there will be four concurrent sessions to entice the attendee. Final decision on this will depend on the response to the Call for Papers.

We hope that this preliminary description of program highlights will lure you to Palm Beach and make the 1980 meeting the best yet. See you there!

Robert E. Uhrig, '80 Keynote Speaker

John L. Jaech, Chairman of the Technical Program Committee for the 1980 INMM Annual Meeting, has announced that Dr. **Robert E. Uhrig** will be the keynote speaker for the meeting. Dr. Uhrig was an invited speaker during the utilities session at the 1979 annual meeting in Albuquerque. Among his responsibilities are the Company's nuclear-related activities (including NRC licensing of nuclear facilities), environmental licensing and planning, the quality assurance program, and the Corporate-wide research and development program.



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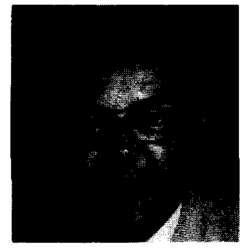

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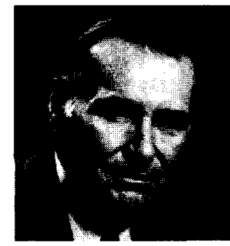


Uhrig

From 1960 to 1968, Dr. Uhrig was Chairman of the Department of Nuclear Engineering at the University of Florida. From 1956 to 1960 he was Associate Professor of Nuclear Engineering at Iowa State University. From 1954 to 1956, he was an Instructor in the Department of Mechanics at the U.S. Military Academy while on active duty with the United States Air Force. During the interval from 1948 to 1954, he held positions as Instructor, Research Associate and Graduate Assistant at Iowa State University while pursuing graduate work.

Dr. Uhrig was the 1972-73 Chairman of the Engineering Advisory Committee of the National Science Foundation, and 1972-73 President of the Southeastern Section of the American Society for Engineering Education. He is a past member of the Board of Directors of the Engineers' Council for Professional Development, a past member of the Board of Directors of the American Nuclear Society, and a past chairman of its Education Committee. He currently serves as a consultant in the U.S. Congress Office of Technology Assessment, and on the Department of Energy's Fossil Energy Advisory Committee.

Dr. Uhrig received the B.S. degree (with honors) in Mechanical Engineering from the University of Illinois in 1948, and the M.S. and Ph.D. degrees in Theoretical and Applied Mechanics from Iowa State University in 1950 and 1954 respectively. He is a 1976 graduate of the Advanced Management Program of the Harvard Business School. He is the author of approximately 75 technical papers and presentations; a book, **Random Noise Techniques in Nuclear Reactor Systems** (Ronald Press, 1970); and the editor of two books based on Symposia. He is the recipient of the Secretary of Defense Meritorious Civilian Service Award in 1968, the 1969 National Pi Tau Sigma — Richards Memorial Award by the American Society of Mechanical Engineers, the 1970 recipient of the University of Illinois alumni honor award for Distinguished Service in Engineering and the Alumni Professional Achievement Citation in Engineering from Iowa State University in 1972. He was elected a Fellow of the American Nuclear Society in 1970.

Dircks to Speak

William J. Dircks, Director of the Office of Nuclear Materials Safety and Safeguards for the U.S. Nuclear Regulatory Commission, has accepted an invitation to speak at the Monday morning (June 30) plenary session at the 1980 INMM Annual Meeting June 30 - July 2 at the Breakers in Palm Beach, Florida.

The Office he heads is responsible for licensing and regulating the handling of nuclear materials, construction and operation of nuclear fuel cycle facilities, waste management, and the safeguarding of nuclear facilities against sabotage and nuclear materials against theft. He joined the NRC in April 1975 and served as Deputy Executive Director prior to assuming his current position.

Prior to the NRC, Mr. Dircks served from 1974 to April 1975 as Executive Assistant to the Administrator, Environmental Protection Agency; from 1971-74 as Senior Staff Member, Council on Environmental Quality, Executive Office of the President; from 1968-71 as Director, Department of Commerce, Office of International and Travel Research and Analysis Office.

During 1967-68, he was Director of the Office of Policy Review in the Economic Development Administration of the Department of Commerce; from 1966-67, he was Director of Operations Analysis and Review in the special field programs of the Office of Economic Opportunity; during 1965-66, he was Planning and Programming Officer for Joint AEC/NASA Space Nuclear Propulsion Office and from 1963-65, he was Director of Administration for the AEC Bio-Medical Research and Development Laboratory in New York City.

Mr. Dircks served from July 1960 to January 1961 as a management intern in the Atomic Energy Commission in Washington, D.C., and from September 1959 to June 1960 he was assistant instructor in the Department of Economics, University of California, Berkeley.

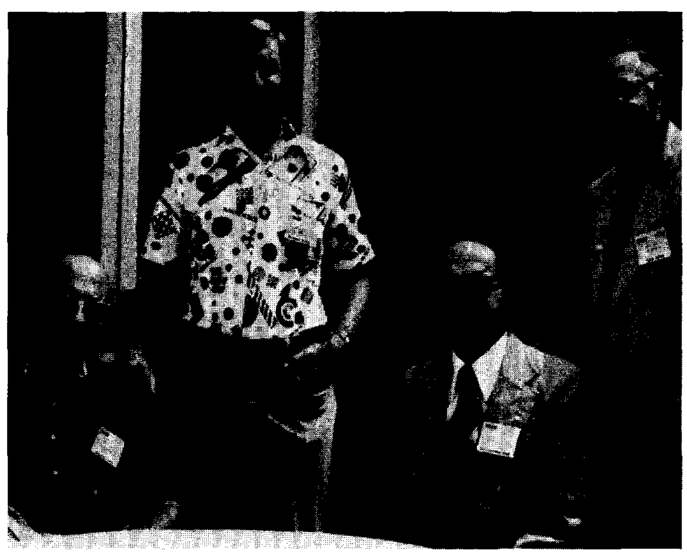
Mr. Dircks served from July 1951 to September 1959 as an officer in the United States Air Force.

He received his bachelor of science degree in economics in 1951 from Fordham University in New York City, was granted the masters of arts degree in economics in 1958 from Clark University, Worcester, Mass., and did pre-doctoral studies in economics from 1959-60 at the University of California, Berkeley.

He was born September 20, 1929, in New York City.

Sewell on Program

Duane C. Sewell, DOE Assistant Secretary for Defense since August 1978, has accepted an invitation to speak at our 1980 INMM Annual Meeting set for June 30 - July 2 at the Breakers in Palm Beach. The announcement of Mr. Sewell's acceptance was made by **John L. Jaech**



G. F. Molen (seated right), Vice Chairman of the Institute, will be General Chairman for the 21st INMM Annual Meeting set for next June 30-July 2 at the Breakers Hotel, Palm Beach, Fla. Mr. Molen, Manager of Safeguards at Allied General Nuclear Services, Barnwell, S.C., will be ably assisted again this year by Joseph E. Stiegler (standing left) of Sandia Laboratories, Albuquerque, and John L. Jaech, (right) EXXON Nuclear Co., Richland, Wash. Mr. Stiegler is in charge of annual meeting arrangements; Jaech heads the Technical Program Committee. James W. Lee (seated left), North Palm Beach, Fla., is Local Arrangements Chairman.

Camp Directs LLL Safeguards Technology Program

David C. Camp has been appointed director of the DOE supported Safeguards Technology Program at the Lawrence Livermore Laboratory. Work in support of domestic Safeguards has been carried on at LLL for the past eight years. Recently, LLL has begun several tasks supported by the International Safeguards Project Office (ISPO), a part of the U.S. support program to IAEA Safeguards. Camp also serves as the Laboratory coordinator for ISPO activities at LLL.

Prior to joining the Safeguards effort, Camp attained a broad and varied background in both basic research and applied technology. After receiving his Ph.D. in nuclear physics from Indiana University, he joined the Nuclear Chemistry Division at LLL. There he carried out research in nuclear decay scheme spectroscopy, specializing in the development and optimization of Ge(Li) detectors for gamma-ray spectroscopy. Following a year's research and teaching leave to the Delft Technische Hogeschool, The Netherlands, in 1971-72, he helped develop the technique of energy dispersive x-ray fluorescence analysis (XRFA) for trace element analysis of environmental samples. Also, he started an applied research program between LLL and the UC Medical School, focussing on noninvasive, nuclear-based techniques for use in diagnostic nuclear medicine. He has numerous publications in each area of research.

The LLL Safeguards Technology Program has been active in developing the NDA technique of gamma-ray spectroscopy to determine the isotopic abundances of plutonium. This requires the development of sophisticated computer codes that are used to analyze the very complex gamma- and s-ray spectra that result.

Other areas of LLL's program include research on the use of energy dispersive XRFA for on-line and off-line NDA of actinide solutions; and the development of customized, computer-based analysis systems for both the domestic and international Safeguards effort.

Dr. Camp

(EXXON Nuclear), Chairman of the INMM Annual Meeting Technical Program Committee.

In his position, Mr. Sewell is responsible for DOE's programs which are in support of the national defense of the United States. These programs include: research, development, testing and production of all nuclear weapons for the Department of Defense; nuclear materials production; safeguards and security; classification; international security affairs and inertial confinement fusion.

Previously Mr. Sewell was Deputy Director of the Lawrence Livermore Laboratory (LLL), one of DOE's major multi-program laboratories. The programs he supervised included research and development on nuclear weapons, non-nuclear energy, biomedical and environmental areas, laser fusion, and magnetic fusion energy. He had been associated with the LLL since its establishment in 1952.

After World War II, Mr. Sewell was associated with the University of California at Berkeley, where he became involved in the technical development and operation of the 184-inch cyclotron which launched the era of high energy physics. In 1950 he worked with a linear accelerator project involving the Berkeley Radiation Laboratory and the California Research and Development Corporation at Livermore.

When the Livermore site of the Radiation Laboratory was established in 1952, Mr. Sewell became a member of the Director's staff and directed scientific operations. He organized Livermore's weapon testing operations and managed these operations through the 1950s. During the 1958 series of tests he was Scientific Advisor and Chairman of the Nevada Test Organization Advisory Panel. He also served as Chairman of the Nevada Test Site Planning Board.

During the late 1950s, he devoted increasing attention to the needs of the rapidly growing LLL and was named Associate Director for Support. During the 1960s, he directed the efforts of more than half the LLL staff — those involved in scientific and engineering support of the defense effort.

Mr. Sewell played an active role in California and national defense planning. He served as a member of the California Governor's Radiological Defense Advisory Committee, 1961-1964; as Scientific Officer to the General Advisory Committee to the Atomic Energy Commission, 1963-1968; and as Chairman of the Albuquerque Operations Office Weapons Advisory Committee, 1967-1978. He served on the University of California Computer Policy Board, 1973-1978.

A native of Oakland, California, Mr. Sewell received a B.A. in chemistry from the College of the Pacific in 1940. His graduate work at the University of California at Berkeley was interrupted in 1941 when he was assigned to the wartime Manhattan Project at Berkeley where he helped plan and develop techniques for separating uranium-235. Later he went to Oak Ridge, Tennessee, to assist in the transfer of the results of this research work into practical application at the large industrial Y-12 plant.

Mr. Sewell was awarded the Atomic Energy Commission Citation in 1971 for contributions to military and peaceful uses of nuclear energy. In 1977, he received the Energy Research and Development Administration's Distinguished Associate Award, which particularly emphasized his contributions toward organizing and developing laboratory programs.

Mr. Sewell and his wife Ruth currently reside in Arlington, Virginia.

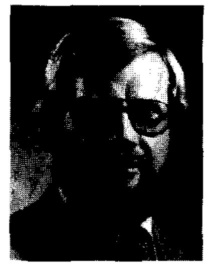
ORNL Scientists Create Synthetic Mineral

BOSTON, Mass. — Oak Ridge National Laboratory (ORNL) scientists have created a synthetic mineral which mimics one of nature's most stable crystalline structures and which they believe has the potential for safely immobilizing the longest-lived forms of radioactive waste for a billion years.

The development was reported here November 27 at an International Symposium on the Scientific Basis for Nuclear Waste Management sponsored by the Materials Research Society. ORNL is one of four major energy-related facilities operated by Union Carbide Corporation's Nuclear Division for the Department of Energy.

The synthetic mineral is an analogue of a relatively rare phosphate mineral called monazite. As found in nature, monazites contain appreciable quantities of thorium and uranium, heavy elements which have remained tightly bound within the lattice-like monazite crystals since the structures were formed more than a billion years ago.

The presence of these radioactive elements suggested that synthetic forms of the same material might make ideal hosts for the heavy man-made actinide elements such as plutonium, neptunium and americium, which are the longest-lived constituents of nuclear waste.



Frank O'Hara To Vienna

Dr. **Francis A. O'Hara,** a member of the INMM Executive Committee, has been selected for a position as a cost-free expert by the International Atomic Energy Agency Division of Development and Technical Support in its Section for System Studies.

The cost-free expert program is conducted under the auspices of the International Safeguards Project Office at Brookhaven National Laboratory, Upton, N.Y. **Leon Green** is Director of Project ISPO.

In his new capacity, O'Hara is responsible for developing short detection time inspection procedures for reprocessing, mixed oxide, and high enriched uranium fabrication facilities. This appointment was effective February 1. His new address: IAEA, P.O. Box 200, A-1400, Vienna, Austria.

Dr. O'Hara will be available to continue his INMM Executive Committee responsibilities through June 30 when his two-year term expires.

Prior to joining the IAEA, O'Hara was a Senior Research Specialist and Program Manager at the Battelle Columbus Laboratories in Columbus, Ohio.

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Material Safeguards Engineer

Experience required in one or more of the following areas: operating plant QC, nuclear fuel QA, ASME Code programs, QA management audits, and vendor surveys.

Environmental Engineer

Experience required in performing a wide variety of environmental impact studies for Federal, state, and local governments; familiarity with technical and legal requirements of the NEPA; knowledge of technology related to environmental management. Preferred academic backgrounds: Civil, Mechanical, Industrial, Chemical Engineering. Some background in economics and business management desirable.

Positions require a technical degree or the equivalent experience.

Send resume and salary requirements for immediate consideration to:

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NUSAC, Incorporated
7926 Jones Branch Drive
McLean, Virginia 22102

Endorses Development Of Nuclear Energy

WASHINGTON — Congressman **Steve Symms** said recently that the report issued by the Presidential Commission on Three Mile Island "appropriately emphasizes the need for improved nuclear safety while generally endorsing the continued development of nuclear energy."

Symms, ranking Republican member of the House Energy and Environment Subcommittee, said a major finding of the report is that "there will be no significant, detectable health risks as a consequence of the Three Mile Island accident.

"The average radiation dose to persons living in a 50-mile radius was approximately less than 1 percent of the annual natural background radiation," Symms said.

Symms said that he questions some specific recommendations made in the report but "it will be a tool in developing recommendations to prevent another incident such as Three Mile Island.

"Positive recommendations in the report include improving the training of personnel, correcting certain mechanical deficiencies, such as the control panels in reactors, and placing a higher priority on emergency response preparation," Symms said.

"Some of these improvements are already underway and the nuclear industry itself has established a new training program for nuclear safety for personnel."

Symms said he will use his position as ranking minority member of the Energy and Environment Subcommittee to insure that the lessons learned at Three Mile Island will lead to safer, more efficient nuclear energy.

"It would be extremely unfortunate if this incident was used to stop development of nuclear energy instead of improving the safety and efficiency of this important energy source.

"Nuclear energy is an important option in solving our long-term energy problems," Symms said. "Our responsibility is to do everything possible to see that it is a safe option."

Engineers—Nuclear

Opportunities in the nuclear industry for the following:

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Specializing in staffing services for the nuclear field.

George Kuklinski, 65, Succumbs

George B. Kuklinski, an avid baseball fan and golfer and a long-time member of the Institute of Nuclear Materials Management, died in Spokane, Wash., on November 6, 1979. He had retired in January 1979 from active employment in nuclear materials accountancy.

Born January 14, 1915, in Los Angeles, Calif., Mr. Kuklinski earned a B.A. degree in 1937 at St. John's University in Minnesota. He was also a member of the National Association of Accountants.

After graduation from St. John's, he worked with the National Youth Administration at St. Paul, Minn., prior to joining E. I. du Pont de Nemours at Hanford, Wash., in August 1943 where he entered the nuclear materials accounting field in July 1951. He was designated a Certified Nuclear Materials Manager February 5, 1968.

Mr. Kuklinski worked with the changing contractors at Hanford (General Electric, Isochem, Atlantic Richfield and Rockwell) until retirement.

His survivors include his wife, six sons, father and 11 grandchildren.

The editors of the INMM Journal are grateful to **J. W. Jordan**, Richland, Wash., for supplying the above information.

The Readers of Nuclear Materials Management . . .

are able to keep up with the latest information in the field of nuclear materials management including news about the Institute of Nuclear Materials Management, its meetings, various committee and technical group activities, its members, plus news of interest to professionals in accountancy, safeguards, nuclear materials control, security, instrumentation, regulations, plus a wealth of technical articles in every issue. Subscribers also receive a copy of the Proceedings of Institute Annual Meetings. It's an excellent deal (less expensive than most other professional publications) for the price: U.S., $30 per year; Canada and Mexico, $40 U.S. a year; and all other nations, $50 U.S. a year. On July 1, 1980, subscription rates will be increased to $40 U.S., $50 (Canada and Mexico) and $60 U.S. (all other countries). So now is a good time to subscribe. Multiple year subscriptions will be taken at the current rate if postmarked on or before June 30, 1980. Send your purchase order and/or check today to:

Nuclear Materials Management
Journal of INMM
P.O. Box 6247
Louisville, Kentucky 40207
(502) 895-3953

Call for Help for INMM Public Information Activities

By Herman Miller, Chairman
INMM Public Information Committee
Mt. View, California

PUBLIC INFORMATION COMMITTEE

Activities of the Public Information Committee (PIC) are drawing increased effort and support. The Executive Committee has authorized an adequate financial budget for the year and is giving good support for our activities. Our program must be positive and pro energy of all practical domestic sources.

Starting with this issue of the Journal, we will work for a new and more informative PIC section. The new Cartoons and the new "Notable Notes and Quotes" are intended to entertain and inform. Let us know what you think of these sections, or anything else.

Tom Collopy and **Ed Johnson** report in the following paragraphs on activities of the Speakers Bureau and Communications Bureau. They need your help, sign up.

A Press Release on MUF, prepared by **Syl Suda** and **Dennis Bishop,** was issued to local and national news media during this past quarter. This release was made through our regular contacts and our News Bureau to try and explain this seemingly simple yet complex concept: There can be a MUF without any material diversion.

The LASL videotape on Dynamic Nuclear Material Accountability (Safeguards) Systems is available on a free loan basis from me or from **Bob Keepin** at LASL. This is a very professional, well done presentation and is very useful in describing this aspect of Safeguards.

Chuck Demos has agreed to take charge of the preparation of an audio-visual Nuclear Safeguards presentation. This presentation, hopefully, will be available for first showing at the July 1980 INMM meeting. It will then be made available, under INMM auspices, to other Industry, Technical and Governmental groups. With Chuck's extensive experience in communications, we expect this audio-visual presentation to shed light on the efforts of Government and Industry in safeguarding nuclear materials.

A session on Public Information is being planned for the July 1980 INMM meeting. We intend to make this a working session to help all those interested in participating in this important activity.

The PIC's effectiveness is dependent on your help. Get involved!

CALL TO WORDS

Who's for independence? Who's for solving our energy problems by increasing our domestic energy supply through expanded nuclear power? We are, and we can make a contribution by individual and collective action through the INMM.

Our contributions are being increasingly made possible through activities now being implemented by the INMM Public Information Committee.

How can you help in this effort and get the satisfaction of real accomplishment and self growth? Consider the following activities and pick one which meets your objective.

SPEAKERS BUREAU

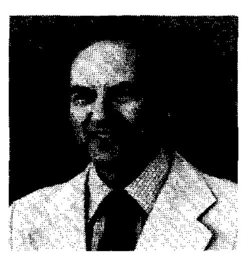
The INMM Speaker's Bureau is beginning to get organized even though visible evidence has not shown to date. Former files of interested speakers have been reviewed and listed personnel are being contacted to confirm their continued interest. One new interest **(Charles P. Demos)** has been obtained from the card inserted in the last issue of the Journal. Let's pitch in and make yourself known and active should the Speaker's Bureau partly fulfill your needs to promote the nuclear industry. Please send your card to Herman Miller. —**Thomas J. Collopy,** UNC (203-848-1511, Ext. 334).

COMMUNICATIONS BUREAU INITIATES CONGRESSIONAL INFORMATION PROGRAM

There are a number of basic misconceptions in the minds of the media, the public and some members of Congress regarding the ability of the U. S. to utilize nuclear energy on a large scale, in a safe and environmentally acceptable manner, in order to meet our growing energy needs. These misconceptions include those related to.

(1) the safety of nuclear power plants, supporting fuel cycle facilities and transportation activities,

(2) the ability to properly manage radioactive wastes over the requisite time periods,



Miller

(3) the ability to safeguard nuclear facilities and strategic materials from sabotage and diversion to unauthorized uses,

(4) the effects of low-level radiation on human life,

(5) the need for development and deployment of the breeder reactor to extend energy resources for centuries, and

(6) the economics of nuclear power.

Decisions which will be made in Congress relating to the future use of nuclear power will be made on the basis of the perceived status of available technology, socio-economics, the availability of institutional mechanisms for expanding the use of nuclear power, environmental effects — and political considerations. While it would be improper for the INMM as a professional organization to attempt to influence political decisions, it is incumbent upon the INMM to make the extensive experience of INMM members in nuclear technology available to Congressional decision makers, so that future decisions can be made with an accurate base of knowledge.

Accordingly, the INMM Communications Bureau is embarking on a program commencing in 1980 to provide technical and other factual information on nuclear energy to members of Congress and their staff personnel. This program can only be successful if all INMM members participate by sending information which is provided by INMM to their Congressmen and Senators along with additional relevant information otherwise available to the members.

The program will involve the following activities at the outset

- On about a quarterly basis the INMM will send out a mailing to all members which contains the voting records of all senators and representatives on nuclear issues. This mailing is for general information purposes to inform the membership of how various Congressmen are voting — which will give insight into their sympathies and level of understanding of the matters involved.
- Periodically, as votes on major nuclear issues appear to be imminent in Congress, separate mailings will be made, briefly describing the bills involved and encouraging members to provide relevant information to their individual Congressmen immediately by letter or wire so that the Congressmen will have the benefit of qualified opinions prior to their vote.
- The INMM will prepare from time to time short topical documents on various nuclear issues such as safeguards, waste disposal, nuclear economics and the like for distribution to Congressmen and their staff — to give the Congress the benefit of the membership's knowledge on such issues.

If successful, this program could be extended to state legislatures in states where nuclear legislation is being considered.

It is important to recognize that the success of this program is primarily in the hands of the INMM membership. No matter how timely and effective the information is that is provided by the Communications Bureau, it will have no impact unless it is promptly transmitted to Congressmen by constituent members along with additional factual information which such members have as a result of their own education, knowledge and experience.

Let's all work hard to make this program a success. Let's make sure that Congressional decisions affecting the future use of nuclear energy are made from an accurate base of knowledge and fact rather than as a result of emotions, rhetoric and unsupported allegations. —**E. R. Johnson**

NOTABLE NOTES AND QUOTES

DICK NOLAN, Columnist. "Forget about shutting down all nuclear power plants. It is not going to happen, nor should it. We need more reactors, not fewer. Better ones, and lots more of them.

"In its first couple of centuries, anti-intellectualism beset the Great Republic. Now, in its third, it's anti-technology that's the rage, accompanied by a kind of determined timidity and pessimism.

"The trouble with so many of our opinion makers is that they'd rather be considered chic than thoughtful. Suddenly it is the In thing to admire Jane Fonda and to throw rocks at anybody who can find his way around a table of logarithms. One-liners come so easy.

"Fonda is a gutsy woman whose once most notable feature was an utterly seductive derriere. Lately the pop-and-pot set has established her as one of its reigning philosophers, and her latest motion picture, a winner, as latter day gospel."

S. F. Chronicle, 8 April 1979

***

JANE FONDA, Actress. "But one of the disadvantages of being famous is that the media seem to have this resentment or this fascination with famous people taking up so-called causes, and they require you to be an instant expert.

"So I borrowed other people's rhetoric. Words that I didn't even necessarily understand. I said things that I didn't even mean or believe. I made mistakes, but don't we all?"

Focus, November, 1979

***

MARVIN L. GOLDBERGER, President, Caltech. "The United States will have to develop every potential major energy source to come to grips with the energy crisis; otherwise, the burden on the remaining sources will become too great to balance our needs."

Caltech News, October, 1979

***

PROF. PETER BECKMANN. "The natural radioactive background in Colorado is twice the American average (the difference from sea level is equivalent to 5,000 nuclear plants), yet the cancer rate is 30 per cent below it."

The Daily Telegraph (London) Aug. 7, 1979

***

KEMENY REPORT HIGHLIGHTS. "The amount of radiation released from the damaged reactor was negligible, but the accident caused 'severe mental stress' among area residents.

"The risk of added cancer and genetic damage to residents near the site of the Three Mile Island nuclear accident is almost non-existent.

"The analysis estimated that the radiation at worst may add one cancer death to the 325,000 expected among 2 million people living within 50 miles of the Middletown, Pa., plant."

Associated Press, November, 1979

***

MIKE NYE, Business Rep., Central Labor Council AFL-CIO. "We must build up confidence in our institutions again. Religion, government, business and labor all are suspect by the public these days."

Peninsula Times Tribune, 31 Oct. 1979

***

FLOYD L. CULLER, JR., EPRI, President. "Proceed with caution, but proceed.

"Whether the use of nuclear energy for production of electrical energy expands, remains constant, or even is discontinued altogether," Culler told the congressional panel, "this nation must develop and implement a nuclear waste management program."

EPRI Journal, July/August 1979

***

CHAUNCEY STARR, Vice Chairman of EPRI. "We perceive the threat (of catastrophe) resulting directly from the pending unavailability of petroleum and natural gas at a reasonable cost. This unavailability could lead to global tensions and political instabilities, economic crises, and ultimately, military conflicts based on the need to obtain and control liquid fuel resources. . .

"The catastrophe that could be avoided (by making use of nuclear energy) is at least as threatening as the one projected by those who oppose the use of nuclear power . . . and, I would argue, more realistic."

EPRI Journal, July/August 1979

***

ENERGY IN AMERICA'S FUTURE. "It said nuclear power and synthetic liquid and gaseous fuels from coal will have to provide much of the nation's energy in the near future. Nuclear energy may become more acceptable if stricter safety requirements are applied and if the plants are located away from densely populated areas.

"The analysis said nuclear power's dangers are exaggerated in the public mind because of the failure to compare them with the dangers of other forms of energy.

"In that comparison, it said, coal is a far more hazardous fuel, taking into account the accident rate in coal mining and handling as well as its effects on air pollution."

Study for Resources for the Future

TO: Herman Miller, Chairman, Public Information Committee, INMM
National Nuclear Corporation
1904 Colony Street
Mountain View, CA 94043

I want to participate in the following INMM Public Information Program(s).

Check Appropriate Box(es):

☐ **1. News Bureau — Herman Miller**
Provide interface/information to the news media

☐ **2. Speakers Bureau — Tom Collopy**
Provide speakers on Nuclear Safeguards and Nuclear Power

☐ **3. Communication Bureau — Ed Johnson**
Provide oral and written communications on a person to person basis

Date: ____________________

Signed: ____________________

Address ____________________

Phone: ____________________

Xerox copies of this coupon are acceptable to Mr. Miller.

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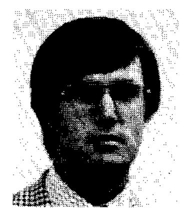
Box Score on New Standards

By D. M. Bishop
General Electric Company
San Jose, California

As a result of many years of work and the efforts of numerous individuals, the INMM N15 Standards Committee is now in the final stages of developing a fresh crop of American National Standards Institute (ANSI) standards relating to important aspects of safeguards and nuclear material control.

Based on current plans, 1979 closed with seven new ANSI-INMM standards either issued or in the final stages of the ballotting process. Additionally, two standards which previously had been issued were revised and reaffirmed. Building on this base, the scope statements for three future INMM standards were approved by ANSI. A brief description of each standard is provided in Table I.

These standards become part of the over 40 INMM-ANSI standards already issued or under development. Consensus standards of this type and quality form a fundamental basis for **professionalism** in the field of nuclear materials control. The N15 organization has been formulated to offer each INMM member an opportunity to contribute in his or her area of professional expertise. Interested members or non-members alike are invited to get involved by contacting individual subcommittee chairmen (see Table II).



Bishop

TABLE I. UPCOMING N15 STANDARDS

		RESPONSIBLE SUBCOMMITTEE
NEW STANDARDS ISSUED		
N15.23-1979	Nondestructive Assay of the Fissive Content of Unpoisoned Low-Enriched Uranium Fuel Rods	INMM- 9
NEW STANDARDS NOW IN BALLOTING PROCESS		
N15.5-1972	Statistical Terminology and Notation	INMM- 3
P/N15.35	Calibration Materials for Nondestructive Assay by Passive Gamma Ray Counting	INMM- 9
P/N15.36	Nondestructive Assay Measurement Control and Assurance	INMM- 9
P/N15.37	Automation of Nondestructive Assay Systems for Nuclear Material Control	INMM- 9
P/N15.38	A Generic Guide for Auditing Nuclear Materials Safeguards Systems	INMM- 7
P/N15.40	Definition of Terms and Symbols Associated with the Physical Protection of Nuclear Materials and Facilities	INMM-10
OLD STANDARDS REAFFIRMED		
N15.3-1972	Physical Inventories of Nuclear Fuel	INMM- 6
N15.15-1974	Assessment of the Assumption of Normality (Employing Individual Observed Values)	INMM- 3
PROPOSED NEW STANDARDS		
P/N15.41	Guide to Nuclear Facility Measurement Control	INMM- 5
P/N15.42	Guide to Response Planning	INMM-12
P/N15.43	Guide to Closed Circuit Television for Physical Security at Nuclear Facilities	INMM-10

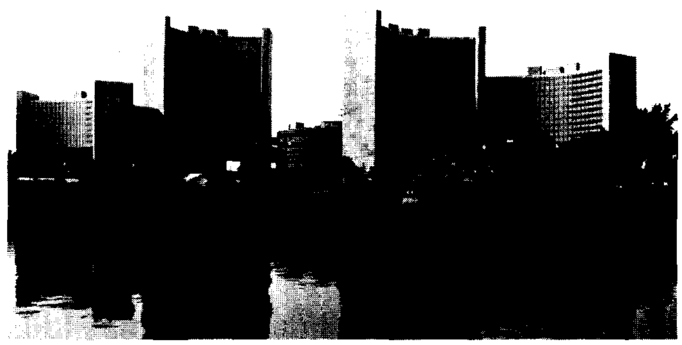
First Class Facilities at V.I.C.

The two months which have elapsed since the last letter from Vienna was published have been devoted, for those of us who work for the IAEA, first to moving to the new Vienna International Centre (VIC) and second to getting over having moved to VIC. As you can imagine this was no easy task. It took four weeks to move 1,285 people with their furniture, books, papers, pictures, coffee machines, magazine collections, etc., not to speak of the specific problems involved in moving the computer, the library, the printing shop, the medical department, the hydrology laboratory, etc. But it all took place in relative calm. A recent survey of the old premises revealed that, countrary to predictions, not a single staff member had been forgotten. (Although an inspector returning from a long mission was found wandering around with a blank stare in his eyes, his furniture had been moved to VIC, and the Administration would take no account of the mishap.)

And now we are here. All 3,000 of us if you include UNIDO and other United Nations units which share the premises with us. The VIC is admittedly very impressive; as those of you who have seen it will no doubt agree. The view is beautiful in every direction. My office is on the 19th floor facing southwest. I see the Danube in the foreground with the new bridge, the "Reichsbrücke" under construction, and beyond the whole of Vienna, then the Vienna woods and (visible only very rarely) the tall "Schneeberg." The facilities are first class, including a restaurant and a cafeteria. The meeting rooms are plentiful and well furnished. The size of the whole complex is such that the average staff member now walks more than 15 kilometres per day, which should improve his health a bit. (There was one report of a wife phoning Security that her husband had been missing for three days, and could he possibly be lost in the VIC. However, the subsequent report that Security sent two guard dogs to look for the man and one of the dogs was lost for two days is generally considered to be an exaggeration.)

So come and visit us, and see for yourself. I am sure that among the many meetings organized by the Agency in 1980 there must be one which justifies your attendance!

— C. Buechler, Chairman, Vienna Chapter, INMM.



Vienna International Centre

TABLE II
INMM - N15 STANDARDS COMMITTEE ORGANIZATION*

SUBCOMMITTEE	TITLE	CHAIRMAN	AFFILIATION	PHONE
—	N15 Chairman	Dennis Bishop	General Electric	(408) 925-6614
—	N15 Secretary	Robert Kramer	Northern Indiana Public Service	(219) 787-8531
—	ANSI Representative	Mary Crehan Vaca	ANSI	(212) 354-3360
INMM-1	Accountability and Control Systems	Howard Menke	Westinghouse	(412) 373-4511
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) 942-4767
INMM-7	Audit, Records and Reporting Techniques	Marv Schnaible	Exxon	(509) 375-8153
INMM-8	Calibration	Syl Suda	Brookhaven National Lab.	(516) 345-2925
INMM-9	Nondestructive Assay	Darryl Smith	LASL	(505) 667-6514
INMM-10	Physical Security	Tom Sellers	Sandia Labs	(505) 264-4472
INMM-11	Training and Certification	Fred Tingey	U. of Idaho	(208) 526-9637
INMM-12	Site Response Planning	Ed Young	Rockwell International	(303) 497-2518
INMM-13	Transportation (Proposed) **	Bob Wilde	Sandia Labs	(505) 264-7323
INMM-14	International Safeguards (Proposed) **	Bob Sorenson	Battelle-PNL	(509) 942-4437

** Currently under review by an N15 Advisory Group to evaluate scope and feasibility.
* ANSI contact: Mary Crehan Vaca (212) 354-3360.

Lou Doher Retires from Standards Work

By D. M. Bishop
INMM Executive Committee
San Jose, California

After many years of valuable service and contributions to the INMM, **Lou Doher** of the Rocky Flats Plant of Rockwell International has recently announced his retirement from the ANSI INMM N15 Standards Committee effective October 3, 1979.

Mr. Doher is a native of Nebraska and attended both primary and secondary schools there. He was graduated with a B.S. degree in Pharmacy in 1949 from the University of Colorado, and earned a M.S. degree in Pharmaceutical Chemistry from the same institution in 1951. Mr. Doher was active for several years in the field of Pharmacy as both a pharmaceutical field representative and in a private retail venture.

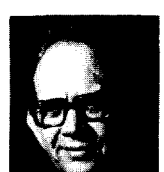
During 1952 Lou joined the staff of the Dow Chemical Company as an analytical chemist at the Rocky Flats Plant. The Rocky Flats Plant was then, as it remains today, a portion of the USAEC (now DOE) weapons complex which handles nuclear materials. During his tenure with the Dow Chemical Company, Lou held positions of Quality Control Engineer and Accountability Chemist prior to his entry into the management ranks. In 1975, Rockwell International, Energy System Group assumed the prime contract for the operation of the Rocky Flats Plant. Lou continued his employment with this contractor and currently is responsible for the direction of the Rocky Flats Chemistry Standards Laboratories. In this capacity, Lou's organization is responsible for providing calibration services for Rocky Flats production support, research and primarily accountability projects. Thus, his position provides leadership and technical support of calibration and measurement control techniques, once applied. Lou also serves on Rocky Flats committees and technical and management groups involved with nuclear materials measurements.

Mr. Doher became a member of the Institute of Nuclear Materials Management in 1960. His involvement with nuclear materials measurements led to the publication and presentation of numerous INMM-related papers and articles. The subjects of these presentations included innovative methods for preparation of analytical control samples, nondestructive assay measurement control, sampling studies, reporting of control systems, status reports of calibration standards activities, and volume calibration of nuclear materials process tankage.

Lou's vast experience in the calibration of bulk measurements for nuclear materials control led to his selection as Chairman of N15 Subcommittee INMM-8, "Calibraton Techniques." Doher organized the subcommittee into four writing groups, INMM 8.1 through 8.4, mandated with the task of proposing American National Standards for Calibration of Mass, Volume, Nondestructive Assay and Nuclear Calorimetry measurements. During 1975, INMM-8 proposed and received concurrence from ANSI to publish four American National Standards for calibration of bulk measurements of nuclear materials. They are: ANSI N15.18-1975, "Mass Calibration Techniques for Nuclear Material Control"; ANSI N15.19-1975, "Volume Calibration Techniques for Nuclear Material Control"; N15.20-1975, "A Guide to Calibration of Nondestructive Assay Systems" and N15.22-1975, "Calibration Techniques for the Calorimetric Assay of Plutonium Bearing Solids Applied to Nuclear Material Control."

He has remained active in N15 affairs by directing the application of the above standards both at Rocky Flats and other facilities. Of notable importance is the application of ANSI N15.18-1975, wherein both DOE contractors and NRC licensees are currently implementing the concepts of the Standard to uranium hexafluoride mass measurements. This implementation is feasible as demonstrated in a pilot program reported by Doher at the 1978 IAEA Symposium on "International Nuclear Materials Safeguards."

The N15 Standards Committee will miss Lou's experience and leadership. He will stay active in INMM standards work in an advisory capacity, as a consultant to the N15 Chairman.



Doher

Tank Volume Calibration

A Tank Volume Calibration Workshop was held at the DOE/E.I. duPont de Nemours and Co., Inc., Savannah River Plant (SRP) at Aiken, S.C., on May 17, 1979. The Workshop, held at the time of the calibration of a dissolver hold tank for uranium reprocessing, was chaired by **Frank E. Jones,** representing the National Bureau of Standards (NBS) Office of Measurements for Nuclear Safeguards (now the Office of Measurements for Nuclear Technology), and was organized by Mr. Jones and **James G. Fowke** of DOE at SR. The Workshop gave participants from industry and Government the opportunity to observe the actual calibration of a tank using the techniques developed at NBS.

The participants, in addition to Dr. **James R. Whetstone** of NBS and **John E. Owen** of duPont/SRP who conducted the tank calibration, were:

Donald L. Baldwin, Babcock and Wilcox, Lynchburg, Va.
Wendell L. Belew, DOE/SR.
W. David Conner, DOE/SR.
John M. Crawford, AGNS, Barnwell, S.C.
Gorden E. Gunderson, NRC Headquarters.
Dr. **Greg J. LeBaron,** Rockwell Hanford Operations, Richland, Wash.
Thomas D. Lee, NRC, Irwin, Tenn.
James W. Mateer, Exxon, INEL, Idaho Falls, Ida.
Lewis C. Osborn, LASL.
Loren E. Shuler, Rockwell International, Rocky Flats Plant, Colo.
Sylvester C. Suda, Brookhaven National Laboratory, Upton, N.Y.
Philip Ting, NRC Headquarters.

The participants assembled at the Administration Building for badging followed by coffee and sweet rolls graciously provided by DOE. Mr. **A. J. Skinner,** Chief, Materials Control and Accountability Branch, DOE/SR, welcomed the participants on behalf of DOE. Mr. **L. H. Meyer,** Program Manager — Special Programs, duPont, welcomed the participants on behalf of duPont and discussed SRP Safeguards Upgrading. Frank Jones made some brief introductory remarks and outlined the Workshop schedule. Buses transported the participants to the area in which the tank was calibrated, where two groups were formed. Dr. James Whetstone and John Owen showed each of the groups the calibration equipment and discussed the procedures as a calibration run was being made. After lunch, a Workshop wrap-up session was held during which detailed informal discussions were held.

The Workshop was very successful, due in large part to the cooperation and hospitality of duPont and DOE and the enthusiasm of the participants.

INMM Annual Distinguished Service Award

To be presented
July 1980
at the
Twenty-first Annual Meeting
West Palm Beach, Florida

It is the intent of the Institute to present its Annual Distinguished Service Award to a deserving individual during its 21st Annual Meeting. Nominations will be accepted until March 1, 1980.

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

Nominations should include a biographical sketch and supporting information.

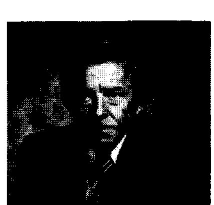
Submit nominations to:
Ralph F. Lumb
Chairman, Awards Committee
c/o NUSAC, Incorporated
7926 Jones Branch Drive
McLean, Virginia 22102

INMM Education Committee Looks To Expanded Role in 1980

By Harley L. Toy, Chairman
INMM Education Committee
Columbus, Ohio

In addition to formal course offerings in 1980, the Education Committee has been directed by the Executive Committee to investigate and report on additional educational services. At the present time, we are looking into two possible areas which would extend and supplement our current activities. These areas are:

- Investigation of the feasibility of presenting a safeguards seminar directed to industry management and administration. Such a seminar would provide yet another vehicle for presenting the "safeguards message." Early indications reveal a need and a favorable response for a safeguards seminar. In conducting this study to determine the feasibility for such a seminar, the Education Committee will work closely with our Safeguards Committee and the Public Information Committee. Our initial thought on this subject is that we would hope to bring about a similar workshop or seminar that was presented in December of 1978 on IAEA implementation of the NPT.
- Investigate continuing professional education (CPE) as to the services INMM could contribute to the professional society community. **Russ Weber** of NUSAC brought this matter to the attention of the Education Committee and the Executive Committee. According to Russ, our Annual Meetings, Workshops, and Formal Course Offerings could very well qualify for continuing professional education credits. Most professional certifications require continuing education to maintain the validity of the certification. A case in point is the American Institute of Certified Public Accountants. As a start, we are studying a "Statement on Standards for Formal Group and Formal Self-Study Programs" issued by the continuing Professional Education Division of the American Institute of CPAs. The significance of continuing educational programs is reflected by the recognition of state legislation which in most states specify minimum CPE credits to maintain state certification and/or licenses. The Education Committee, along with the assistance of Russ Weber, will investigate the possible role of the INMM in the Continuing Professional Education area and report back to the Executive Committee at their next meeting.


Toy

Our next report will address the progress in these two areas. Once again, your Education Committee welcomes any and all comments regarding the present educational program. If we are to put forth meaningful educational programs, we need your input.

As promised in the past, we are expanding the Education section of the Journal to provide a listing of upcoming meetings, conferences, workshops, and courses which we feel will be of interest to our members and readers. **Tom Gerdis** is to be credited with getting this section underway. Through Tom's efforts, we now have an ongoing program to provide current information on such events.

UPCOMING PROGRAMS OF INTEREST

ESARDA Symposium

- **2nd Symposium on Safeguards and Nuclear Materials Management**
  March 26-28, 1980
  University of Edinburgh, Scotland
  Contact: **L. Stanchi,** Joint Research Center
  1-21020 Ispra (Varese) Italy

American Society for Industrial Security

1980 ASIS Educational Programs

- **Assets Protection Course**
  March 24-28
  Atlanta, GA
  Fees: ASIS Members $490
  Nonmembers $550
  Contact: **Debra Moss**
  202-331-7887

- **6th Public Utilities Workshop**
  April 21-22
  Arlington, VA (Washington, DC)
  Fees: ASIS Members $180
  Nonmembers $230
  Contact: **Susan Bauer**
  202-331-7887

Participants in the Fall "Selected Topics in Statistical Methods for SNM Control" held at Battelle's Columbus Laboratories, October 29-November 2, 1979, included the following attendees, along with Mr. John L. Jaech (Instructor), Mr. Harley L. Toy (Education Chairman), and Lavella Adkins (Secretary to Mr. Toy): Forrest C. Aspengren, B&W; N. Karen Condy, B&W; Gary J. Carnival, Rockwell International; Daniel L. Colwell, B&W; Jack R. Craig, USDOE; Art Crawford, ORNL; Rush O. Inlow, USDOE; Ray F. Jackson, Monsanto Research Corp.; Alan M. Krichinsky, ORNL; Martin Levy, USNRC Hqs.; George J. Mattern, Combustion Engineering, Inc.; David W. McCune, Union Carbide Corp.; Patrick T. Reardon, Battelle's Northwest Labs.; Alan Siegel, System Planning Corp.; and James M. Swartz, Science Applications, Inc.

- **Advanced Security Management Program**
  June 1-6
  Reston, VA
  Fees: ASIS Members $490
  (ASIS members only)
  Contact: **Debra Moss**
  202-331-7887

- **The ASIS 26th Annual Seminar and Exhibits**
  (Major yearly convention)
  September 22-25
  Miami Beach, FL
  Fees: ASIS Members $160
  Nonmembers $215
  Contact: **Susan Bauer**
  202-331-7887

American Nuclear Society
1980 ANS Meetings and Conferences

- **Waste Heat Utilization**
  March 2-6
  Salt Lake City, Utah
  Hilton Hotel
  Technical Program Chairman: **Gary M. Sandquist,** University of Utah, Salt Lake City, Utah 84112. 801-581-7272.

- **2nd International Conference on Liquid Metal Technology in Energy Production**
  April 20-24
  Richland, Washington
  Technical Program Chairman: **J. M. Atwood,** Hanford Engineering Development Laboratory, W/C-45, P. O. Box 1970, Richland, WA 99352.

- **Annual Meeting**
  June 8-13
  Las Vegas, Nevada
  MGM Grand Hotel
  Technical Program Chairman: **Mary Gerry White,** Environmental and Safety Division, U.S. DOE — Box 550, Richland, WA 99352. 509-942-6681.

- **International Executive Conference on Non-Proliferation and Safeguards**
  September 14-17
  Mexico City, Mexico
  General Chairman: **John E. Gray,** President, International Energy Associates, Ltd., 600 New Hampshire Avenue NW, Suite 600, Washington, DC 20037. 202-338-8230.

- **Winter Meeting**
  November 16-21
  Washington, D.C.
  The Washington Sheraton Hotel
  Technical Program Chairman: **M. J. Ohanian,** University of Florida, 202 Nuclear Science Center, Gainesville, FL 32611.

For Savannah River Plant

Du Pont Contract Extended

DOE has extended the contract for the operation of the Savannah River Plant with E.I. du Pont de Nemours and Co. for an additional five years. The Savannah River Plant is the prime production site for special nuclear materials used in the nation's defense programs.

Du Pont first signed a contract in 1950 for design, construction and operation of the Savannah River Plant. This new five-year contract extension, effective this past Oct. 1, is the sixth in a series of renewals dating back to 1957, and will run through Sept. 30, 1984.

Under the contract, du Pont is responsible for conducting construction and operation activities. It receives no fee for operating the plant. Fiscal year 1980 funding for plant operation and construction is expected to be approximately $500-$600 million.

Implementation of ANSI N15.18 Hexafluoride Mass Measurements

By Lou Doher—N15
Rockwell International
Energy Systems Group
Golden, CO

and

Ed Johnsen, Administrator—ANSI N15.18 Program
National Bureau of Standards
Gaithersburg, MD

The implementation of ANSI N15.18 uranium hexafluoride (UF_6) mass measurements was reported during the summer of 1971.[1] The report described the Replica Mass Standards (RMS) UF_6 cylinder facsimilies calibrated by the National Bureau of Standards, and the ANSI N15.18-1975 concept of comparison of the RMS to produce known values of In-House Standard (IHS) cylinders at each facility. The report further announced the implementation program and introduced Mr. E. G. Johnsen, recently appointed administrator of the program, together with the program goal to **Provide an Efficient Means for Obtaining Uniform Mass Measurement of UF_6 Based on the National Measurement System.**

The current status of the program is as follows:

1. The completed questionnaires, the proposed Standard Operating Procedure (SOP) and attendant questions and concerns which were the outgrowth of the seminar and workshop held in June 1979 comprised the agenda of the INMM 8.1 meeting in Albuquerque, NM, in July 1979. The discussions at this meeting provided the following decisions:

A. The first phase of the program will involve only facilities handling 30B cylinders.

B. In some cases, participation will initially be limited to calibration of IHS using RMS.

C. Organizations that will participate in the first phase (30B) are: **General Electric, Exxon Nuclear, Babcock & Wilcox, Goodyear Atomic, Westinghouse, Combustion Engineering** and **Union Carbide (Oak Ridge).**

D. The SOP will be published during November 1979.

E. The first RMS shipment will occur during October 1979.

2. Interested participants and representatives of USNRC and USDOE attended a hardware workshop in September 1979 hosted by NBS employees **Paul Pontius, James Whetstone,** INMM-8, and **Ed Johnsen,** INMM 8.1. The workshop involved NBS demonstration and attendee participation in the comparison of quasi-IHS to the 30B RMS (empty and full) employing the "fast four series" technique. Results of the participation experiment were in excellent agreement with those of NBS. Attendees provided excellent comments to their INMM-8 hosts and expressed their pleasure with both the "hands on" and the data treatment methodologies.

3. The 30B RMS were shipped to Union Carbide (Oak Ridge) during October 1979.

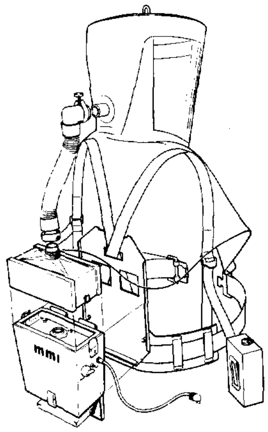
4. Union Carbide reports that the IHS have been calibrated using the RMS and that the RMS are available for the next participant.

5. The program administrator is making visitations to participating facilities in order to provide an appropriate priority listing and schedule for continuation of the program.

Reference

1. Doher, L. W., "Implementation of ANSI N15.18 Uranium Hexafluoride Mass Measurements," Nuclear Materials Management, Vol. VIII, No. 2, p. 33, Summer 1979.

Doher



MMI Respirator

The Model 900 **High Efficiency Respirator** is designed to provide the wearer with protection from potentially dangerous airborne particles or microorganisms. The unit is suited for situations in which there is a need for strict microbiological security. The Model 900 HEPA filters are 10 times more efficient than required by Federal Standard 209B for Class 100 conditions. The unit will filter particles of 0.02 to 2 microns with a penetration of no more than 0.003% for an efficiency of 99.997%. Model 900 uses permanent stainless steel HEPA filters which may be autoclaved or gas sterilized. The Model 900 is completely field tested and in use by laboratories in several nations including the USA.

The Model 900 is battery powered by sealed-rechargeable, lead acid batteries. An audible and visual alarm alert the user to a low battery condition. The battery is sufficient for 6 hours use. A spare battery may be worn on a belt clip if desired.

The hood of the Model 900 provides good visual and audible communication for the wearer. A double cape-collar construction allows adjustment for positive pressure for each wearer. The sealed design of the entire system, including the battery case, allows the entire system to be hosed down with disinfectant solution without adversely affecting the electrical system or penetrating the collar. The respirator may be used by both men and women. Contact: Medical Measurements, Inc., 215 Union Street, Hackensack, NJ 07601.

Contract Awarded

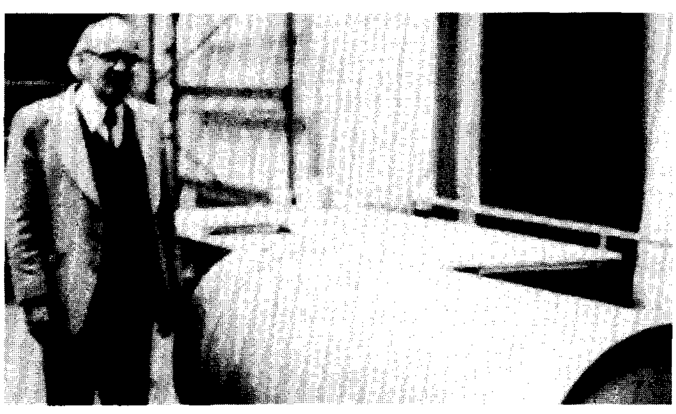
NUSAC, Inc., McLean, VA, a consulting firm, has been awarded contracts by Florida Power Corporation and the U.S. Nuclear Regulatory Commission.

Under the nine-month agreement with FPC of St. Petersburg, Fla., NUSAC is developing an NRC-approved security force training and qualification plan for FPC's Crystal River Nuclear Plant No. 3.

NUSAC's nine-month applied research and development contract with NRC calls for the firm to investigate advanced techniques for control and accounting of bulk nuclear materials. The NRC study is the first phase of a three-phase program which may involve nearly $500,000.

Publisher's Statement

Statement required by the Act of October 23, 1962, Section 4369, Title 39, United States Code, Showing Ownership Management and Circulation of **Nuclear Materials Management**, Journal of the Institute of Nuclear Materials Management. Published quarterly (distributed on February 1, May 1, August 1 and November 1) plus a Proceedings of the INMM Annual Meeting (distributed October 1). Owner and Publisher: Institute of Nuclear Materials Management, P.O. Box 628, Piketon, Ohio 45661. Institute Journal Editor: Thomas A. Gerdis. Address at P.O. Box 6247, Louisville, KY 40207. Owner: The Institute of Nuclear Materials Management, Inc. is a nonprofit membership corporation organized under the laws of the State of Ohio. It is exempted from Federal Taxation. Its officers are: Chairman, **G. Robert Keepin**, MS 500, Los Alamos Scientific Laboratory, Los Alamos, NM 87545; Vice Chairman, **G. F. Molen**, Allied-General Nuclear Services, P.O. Box 847, Barnwell, SC 29812; Secretary, **Vincent J. DeVito**, Goodyear Atomic Corporation, P.O. Box 628, Piketon, OH 45661; Treasurer, **Edward Owings**, Oak Ridge National Laboratory, P.O. Box Y, Oak Ridge, TN 37830. Its known bondholders, mortgagees, and other security holders owning or holding one percent or more of the total bonds, mortgages, and other securities are: none. The average number of copies each issue during the preceeding 12 months: (A) Total number of copies printed (net press run): 990 (B) Paid circulation: (1) to term subscribers by mail, carrier delivery, or by other means: 771; (2) sales through agents, news dealers, or otherwise: 44. (C) Free distribution (including samples) by mail, carrier delivery, or by other means: 94. Total number of copies distributed: 879. The number of copies single issue nearest to filing date are: (A) Total number of copies (net press run): 950. (B) Paid circulation: 771. (2) Sales through agents, news dealers, or otherwise: 44. (C) Free distribution (including samples) by mail, carrier delivery, or by other means: 94. Total number of copies distributed: 879. I certify that the statements made by me above are correct and complete. (Signed) Thomas A. Gerdis, Institute Journal Editor.



Paul Pontius of the National Bureau of Standards with one of the 30B UF_6 RMS.

Charles Vaughan (left) and Mel Smedley (center) at GE-Wilmington with one of GE's 30B UF_6 I.H.S.

U. S. Stagnating in Indecision Over Energy Problem

Editor's Note: The following article was written by **John Armistead** of the Public Information Staff at Los Alamos Scientific Laboratory. This report appeared in the Nov. 21 edition of the LASL Newsletter and is reprinted with permission.

Llewellyn King says the United States has divided itself into two societies — humanities and science.

And this division, says the publisher of the Washington, D.C.-based **Energy Daily**, is fostering such a balanced debate on this nation's energy problem that the United States is stagnating in indecision.

"You can't resolve the energy problem, or any other problem, if you can't decide on the shape of the problem. Shape is very critical, because the energy problem is so complex that it is leading to the shaping of our very society," he said in the LASL colloquium Nov. 13.

King highlighted the debate between consumerists, environmentalists, and anti-nuclear forces; and the scientific, corporate, and technological groups.

He said part of our society is suspicious of expertise, scientific knowledge, and technology. This camp is against power companies, corporations, and the scientific community.

"These debaters, who rely on emotions rather than facts, think that if growth and production can be reduced or stopped in this country, then judgements can be made based on politics, not technology. It will be a move away from capitalism and all the bad things these people associate with capitalism," King said.

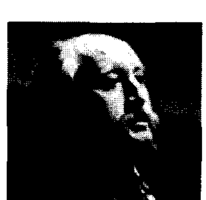
"The attack on nuclear power is illogical. The anti-nuclear people have no cohesion in their arguments They don't use facts. The attacks are emotional, but highly contagious. The information disseminated by these debaters has nothing to do with science or technology," King stated.

The journalist feels nuclear power is neither good nor bad. It has become embroiled in debate, and has had various labels placed on it. Liberal politicians and thinkers say no to nuclear power, and conservatives endorse it.

"So the energy debate is creating political and sociological camps. This debate is interrupting the important business of the country.

"The anti-nuclear forces have seduced the nation into a marvelous fight. They would end nuclear power development at any cost, even if it means drastic changes in society, and they would replace our governing philosophy with a democratic socialism," he said.

King



The news media are really not part of the debate, King said. They must report on it, and all too often gather the bad news on science and technology, concentrate it, and push it.

"The credibility of the technological camp has suffered immensely, and the public, through the news media, gets a picture of technology as ruthless, in league with capitalists exploiting people everywhere," he said.

This "profound misunderstanding by environmentalists, consumerists, and liberals" is unfortunate, claims King, "because they don't understand how fragile nations and institutions are. Many feel that we in this country always will have prosperity and abundance, regardless of strains placed on it. Alas, it is not so."

King mentioned several elements he feels have contributed to the lack of confidence in institutions and technology in the United States.

"Many people lost confidence in technology in the U.S. in the 1960's because of the civil rights movement, the environmental movement, the Vietnam war, and because of the scandals in government and industry during and since the war.

"A combination of events and emotions has created this atmosphere of mistrust. But the country must rise above its impotence, determine the shape of its problems, and begin to find solutions," he said, then adding, "The energy problem is very critical among these.

"Technology is our heritage, our culture. We should celebrate it, enjoy it, and not curse it."

King mentioned the example of the big oil companies, who "are very good at finding oil, and very good at distributing the product. They have engineered a unique distribution system, and they earn a profit for their efforts. But they are criticized and hated in this country."

The oil distribution system and the electricity system are two things that work extremely well, King said. But, because they sell a necessity, they are vilified. "We tend to hate people who sell necessities to us. We want to spend our money for things we don't need.

"This country need never be short of electricity. By using breeder reactors we can create enough electricity for this nation for thousands of years, but social, political, and environmental forces are going to force a shortage."

King feels there will be a turning point, however, in this stagnating debate between the two parts of American society. "There will be a return to confidence in technology, because we cannot have a nation this large dependent on other nations for its future. We cannot be impotent, we must lead in a cohesive manner. As the U.S. goes, so goes civilized life in the world."

INMM Membership Continues to Grow As Membership Reaches 660

By James W. Lee, Chairman
INMM Membership Committee
North Palm Beach, Florida

Like all organizations, INMM experiences the awesome reckoning that comes the first quarter of every fiscal year, when the membership roll is purged of those members who have not paid deliquent dues. This period of time is when the usually comforting regularly increasing membership total jolts the officers and Membership Committee into urgent action by showing an abrupt drop in the number of members. Telephones ring, lists of names are scanned to try to determine why some individuals failed to renew their memberships. Usually the net decrease can be explained by logical reasons. Change of employment, change of job responsibilities, persons who joined on the spur of the moment and now find that they have no real community of interest with this area of the nuclear industry. Perhaps this is a good thing. It does make the Membership Committee give extensive consideration to ways of reaching potential new members.

GRATIFYING FIRST QUARTER RESULTS FOR FISCAL 1979 - 1980

First quarter results have been good this fiscal year. Members of the nuclear industry continue to display increasing interest in the programs and activities of INMM by record increases in the number of new members. After all adjustments for non-renewed memberships and the first quarter gain in new memberships, the Institute's total membership as of this writing stands at approximately 660 persons.

EMPLOYMENT BREAKDOWN OF FIRST QUARTER APPLICATIONS

During the first quarter of fiscal 1979-80 a total of 90 persons applied for membership in the Institute. The breakdown by employment categories follows:

Government and Government Contractors	55
Industry	13
Utilities	1
Foreign	21
Total	90

New Members

The following 44 individuals have been accepted for INMM Membership during the period September 1 to November 30, 1979. To each, the INMM Executive Committee extends its welcome and congratulations. New members not mentioned in this issue will be listed in the Spring 1980 (Volume IX, No. 1) issue to be sent out beginning May 1, 1980.

Djali Ahimsa, Member of SSAS, Department of Safeguards, International Atomic Energy Agency, Vienna International Center, P.O. Box 200, A-1400 Vienna, Austria.

Kikuo Akai, President, Nippon Computer Bureau Ltd., 1-7-2 Akasaka, Minato-ku, Tokyo 107, Japan.

John Andersen, Technical Staff Member, Sandia Laboratories, Division 1721, Albuquerque, NM 87185.

George H. Anno, Senior Staff Scientist, Pacific-Sierra Research Corp., 1456 Cloverfield Boulevard, Santa Monica, CA 90404.

Dr. **Henry F. Atwater,** Staff Member, Los Alamos Scientific Laboratory, MS/562, Los Alamos, NM 87545.

Gayle Burch, Shift Manager, Rockwell Hanford Operations, P.O. Box 800, Richland, WA 99352.

Kenneth R. Byers, Safeguards Staff Analyst, Rockwell Operations, MO-032, 200W Area, P.O. Box 800, Richland, WA 99352.

P. Dennis Cannon, Sales Engineer, Princeton Gamma Tech, P.O. Box 36157, Denver, CO 80236.

Robert L. Carpenter, Manager, Analytical Laboratories, Rockwell International, P.O. Box 464, Golden, CO 80401.

Arthur B. Crawford, Oak Ridge National Laboratory, P.O. Box X, Bldg. 7601, Oak Ridge, TN 37830.

Francis Delobeau, Safeguards and Security, Commissariat a L'Energie Atomique, 29-33 Rue de la Federation 75015 Paris, France.

Charles P. Demos, U.S. Department of Energy, SSD, 9700 South Cass Avenue, Argonne, IL 60439.

Mary S. Dodgen, Senior Chemist, E. I. duPont de Nemours & Company, Savannah River Plant, Aiken, SC 29801.

Bruce H. Erkkila, Staff Member, Los Alamos Scientific Laboratory, MS/539, Los Alamos, NM 87545.

F. Gary Fetterolf, Analyst, Nuclear Materials Control, Rockwell Hanford Operations, P.O. Box 800, 2704-Z, 200-W, Richland, WA 99352.

John W. Fraser, Supervisor, Order Control, Bendix Corporation, Kansas City Division, P.O. Box 1159, Kansas City, MO 64141.

Dr. **Mark K. Goldstein,** Senior Technical Advisor, JGC Corportion, 2-1 Ohtemachi, 2-Chome, Chiyoda-ku, Tokyo, Japan.

John R. Gough, First Officer P-4, International Atomic Energy Agency, Vienna International Center, P.O. Box 200, A-1400 Vienna, Austria.

Robert E. Heineman, Jr., Manager, Safeguards, Rockwell Hanford Operations, P.O. Box 800, Richland, WA 99352.

James B. Hicks, Section Head, Goodyear Atomic Corporation, P.O. Box 628, Piketon, OH 45661.

Katsuji Higuchi, Manager, Division of Planning, Nuclear Material Control Center, 2-3-4 Akasaka, Minato-ku, Tokyo, Japan.

Faye Hsue, Staff Member, NDA Measurements, Los Alamos Scientific Laboratory, Los Alamos, NM 87545.

Dr. **Mahavir Jain,** Staff Member, NDA Measurements, Los Alamos Scientific Laboratory, MS/539, Los Alamos, NM 87545.

Keiji Kanda, Associate Professor, Research Reactor Institute, Kyoto University, Kumatori-cho, Sennan-gun, Osaka 590-04, Japan.

Yoshitaka Kimura, Deputy Chief, Japan Atomic Energy Research Institute, 1-1-3 Shinbachi, Minato-ku, Tokyo, Japan.

Edward A. Kohler, SS Accounting Supervisor, Union Carbide Corporation, Nuclear Division, P.O. Box 1410, Paducah, KY 42001.

Shuichi Koreki, Section of Information and Data Treatment, Tokyo Electric Power Company, Akasaka Park Building, 9F, 2-3-4 Akasaka, Minato-ku, Tokyo, Japan.

Yoshio Kusano, 886-5 Ucuthara Uchihara Cho, Higashiibaragi-gun, Tbaraguen 319, Japan.

Mark S. Laidlow, Senior Engineering Technician, Virginia Electric and Power Company, P.O. Box 26666, Richmond, VA 23261.

Judy J. Lim, Engineer, Lawrence Livermore Laboratory, L-116, Livermore, CA 94550.

R. Larry Lynch, Senior Technical Associate, NUSAC, Inc., 7926 Jones Branch Drive, McLean, VA 22102

Dr. **Roger D. Marsh,** Head, Division of Safeguards and Nuclear Materials Control, British Nuclear Fuels, Ltd., Head Office, Risley, Warrington, Cheshire WA3 6AS, England.

Shun-ichi Miyasaka, Division of Safeguards, Information Treatment, Nuclear Material Control Center, 2-3-4 Akasaka, Minato-ku, Tokyo 107, Japan.

Kenneth M. Moyers, Auditor-in-Charge, U.S. General Accounting Office, P.O. Box 5400, Albuquerque, NM 87115.

Yoshihiro Nakagome, Research Associate, Research Reactor Institute, Kyoto University, Kumatori-cho, Sennan-hun, Osaka 590-04 Japan.

Hiroshi Okubo, Marketing Manager, Kozo Keikaku Engineering, Incorporated, 4-38-13 Honcho, Nakano-ku, Tokyo 164, Japan.

Robert Pogna, Security Officer, Los Alamos Scientific Laboratory, MS/688, Los Alamos, NM 87545.

Toshio Sawahata, Power Reactor and Nuclear Fuel Development Corporation, Tokai-mura, Ibaraki-ken 319-11, Japan.

Chuichi Someya, Electrical Department, Kyokuto Boeki Kaisha, Ltd., 2-1, 2-Chome, Otemachi, Chiyoda-ku, Tokyo, Japan.

Takeshi Someya, Safeguards Inspector, International Atomic Energy Agency, Vienna International Center, P.O. Box 200, A-1400 Vienna, Austria.

Takao Taguchi, Sales Manager, Daini-Seikosha Company, Ltd., Scientific Instrument Division, 6-31-1 Kameido, Kotoku, Tokyo 136, Japan.

Willi Hans Paul Theis, Safeguards Inspector, International Atomic Energy Agency, Vienna International Center, P.O. Box 200, A-1400 Vienna, Austria.

William R. Vroman, Assistant Chemist, Argonne National Laboratory, P.O. Box 2528, Idaho Falls, ID 83401.

Arnold A. Wolvendyk, Nuclear Materials Coordinator, United Nuclear Corporation, 67 Sandy Desert Road, Uncasville, CT 06382.

Address Changes

The following 14 changes of address have been received by the INMM Publications Office (Phone: 502-895-3953) at P.O. Box 6247, Louisville, Kentucky 40207, as of November 30, 1979.

James E. Doyle, President, CMS, Inc., 6446 Caroldale Lane, Goleta, CA 93017.

Douglas George, NUSAC, Inc., 7926 Jones Branch Drive, McLean, VA 22102.

Edward R. Herz, 1900 Stevens Drive, No. 313, Richland, WA 99352.

Mark H. Killinger, U.S. Nuclear Regulatory Commission, NMSS, Mail Stop SS881, Washington, DC 20555.

Akihiko Kitano, Tokyo Electric Power Co., 1901 L Street, N.W., Washington, DC 20036.

Allan M. Labowitz, 601 Wilkes Street, Apt. 304, Alexandria, VA 22314.

W. D. McCluen, 343 Margrave Street, Harriman, TN 37748.

Thomas I. McSweeney, 1056 Hepplewhite Street, Westerville, OH 43081.

Kenneth E. Sanders, U.S. Nuclear Regulatory Commission, Office of Standards Development, Washington, DC 20555.

Thomas J. Schmierer (Ret)., 5010 Crownpoint Court, N.W., Albuquerque, NM 87120.

Marvin R. Schneller, Route 1, Box 66BB, Medical Lake, WA 99022.

William R. Severe, International Atomic Energy Agency, Vienna International Center, P.O. Box 200, A-1400 Vienna, Austria.

Cecil S. Sonnier, International Atomic Energy Agency, Vienna International Center, P.O. Box 200, A-1400 Vienna, Austria.

C. C. Thomas, Jr., Staff Member, Los Alamos Scientific Laboratory, Q4, MS/541, Los Alamos, NM 87545.

BOOK REVIEW

RAND P-6308, "International Cooperation in Nuclear Fuel Services: European and American Approaches," by Horst Mendershausen, December 1978 (the Rand Corporation, Santa Monica, California).

By E. V. Weinstock
Technical Support Organization
Brookhaven National Laboratory
Upton, Long Island, New York

In the last few years the possibility of "multinationalizing" certain phases of the nuclear fuel cycle in order to reduce their potential for proliferation has received considerable attention, including, prominently, a study by the IAEA on regional fuel service centers, completed a couple of years ago. Since the Administration's onslaught on reprocessing and the breeder as proliferation hazards, the technical community, in particular, has looked hopefully to multinational operation of "sensitive" facilities as a means of saving the uranium-plutonium cycle that it feels to be essential to the nation's energy future.

Now comes this report by a Rand analyst which dashes some pretty cold water on the whole concept of multinationalization in the name of non-proliferation. It does this by contrasting European and American attitudes towards and expectations for multinational nuclear enterprises and analyzing actual experiences with examples of such institutions, like Eurodif, Euratom, Urenco, etc. It also identifies the basic differences in the European and American philosophies for the control of proliferation. Without major changes in these, the gulf between the U.S. and Europe (and Japan, as well) seems unbridgeable. For proponents of multinationalization, the results of the analysis will be discouraging, if not depressing, and what faint glimmer of hope is held out for this approach depends on the aforementioned fundamental changes.

In certain respects, the report, published in December of 1978, has been overtaken by events such as the winding up of INFCE and the Three Mile Island accident, but it is of such general interest to the safeguards community and has received so little notice in these circles that it seems worthwhile to review it at this time.

At the outset it should be said that the report is so well written as to arouse the suspicion that the author is a foreigner. This turns out not to be quite true; although German-born, he is an American citizen. The language is often vivid, sometimes irreverent, and utterly free of bureaucratic jargon and pomposities; nor does the author fear to allow an occasional glimpse of the all-too-human motivations lying behind some of the lofty sentiments expressed in official communiques. Once started, the report is difficult to put down, a claim that can hardly be made for most of the output in this field. Another virtue is its brevity — at 91 pages it must set some kind of record in the field of non-proliferation studies, which just goes to show that a report need not be weighty to be profound.

The information for the study was based not only on the literature but on personal interviews with specialists and officials from government and industry abroad. The participants are not identified, so that the discussions could be conducted and reported on with a refreshing frankness. Although interviews took place only in Europe, many of the observations and conclusions apply to Japan as well.

In its analysis of the differences in American and European perceptions, the report traces the evolution of U.S. policy towards multinational control from the Baruch plan of 1946, rejected by the Soviet Union, to the 1954 Atoms-for-Peace proposal of President Eisenhower, which gave birth to the IAEA, the espousal of multinational reprocessing plants by the then Secretary of State Kissinger in 1975, the Carter Administration's policy announcement of April 7, 1977, opposing reprocessing, and its aftermath.

In retrospect, the Kissinger statement was particularly ironic, because in it the Secretary specifically endorsed the study of regional fuel-cycle centers then being performed by the IAEA, largely as a result of U.S. initiatives. By the time the report came out (by coincidence, in April 1977) the U. S. attitude towards reprocessing in any form had, of course, changed to one of implacable hostility.

Mendershausen is caustic about most of the studies of multinational facilities originating during and after this period, reserving his most acid comments for the IAEA report. It was excessively vague, abstract, and academic in its approach. For example, it never explained why nations should be organized by region rather than by some other characteristic, and never attempted to distinguish between one region and another or, for that matter, between one nation and another, on political, economic, or other grounds, as though such differences were unimportant. Nor did it identify and convincingly demonstrate incentives that might induce a country to join a regional center rather than to operate its own facilities or to enter into some other multinational arrangement such as equity-sharing or purchasing services from another country.

The lack of realism displayed in the IAEA study also afflicts other proposals for multinational ventures of various kinds; indeed, he says, "the exploration has taken on almost a playful character. Proponents and critics tend to treat such ventures as phenomena located at the end of the rainbow, or as something that must be assumed to work if everything else fails — because something has to work; and elaborations of detail occur mostly at a distance from the political marketplace, say, in the rarefied political air of international organization offices." He goes on to give a number of

Dr. Weinstock


examples, one of the most interesting of which was **Wolfe Hafele's** "energy island," which Mendershausen backhandedly compliments by calling it "a refreshingly original technical utopia," and which, in his view, does not stand a chance of ever being implemented.

More serious, however, than the tendency to bandy about abstractions was the change in the American attitude towards such centers. Originally, Kissinger had not viewed them as the exclusive purveyors of reprocessing services but rather as competing on favorable terms with and thereby discouraging national ventures. In later American thinking, however, they came to be linked with the forswearing of national reprocessing as a condition for participation. This emphasis on abstention from national control over sensitive activities became an essential ingredient of all subsequent American proposals of a multinational nature, such as the international storage of spent fuel and nuclear fuel banks.

The "supply-for-abstention" position of U.S. policy has become the chief bone of contention between the U.S. and Europe in this area. It is not that Europeans are indifferent to the dangers of proliferation, but that, as Mendershausen says, they "do not accept the view . . . that because **some** might divert to military use certain fissionable materials . . . arising in or acquired for their nonmilitary pursuits, **all, and particularly the European nations** themselves who deny such intentions, should forego the production, storage, or acquisition of such materials within their own sovereignties."

In contrast to the American principle of denial, the European approach would be "to use profitable international transactions in nuclear services as a means of attracting and binding partners to the avoidance of proliferation, within a stable framework of mutually-agreed rules of conduct." In other words, countries would be bound by a web of trade relationships involving both their economic self-interest and non-proliferation obligations, and could not violate the latter without endangering the former.

Of course, much of this sounds self-serving, as Mendershausen acknowledges, and to purists, at least, it lacks intellectual rigor. Furthermore, the original heedless rush of the French to sell reprocessing plants to Pakistan and South Korea, since checked by American pressure, makes for a certain skepticism about the approach, although counterbalancing this are the extremely tight safeguards provisions of the German-Brazilian agreement. The Europeans, however insist that the very emphasis on self-interest makes the approach more workable than one based on "sovereignty-limiting schemes . . . arbitrary regulation, and unilateral prohibition"; in short, that it is the best that can be achieved in an imperfect world.

To illustrate the differences between the theory and the reality of multinational institutions, Mendershausen describes the evolution of a number of such enterprises in Europe, namely Euratom, Eurodif, Eurochemic, Urenco, and Unirep. By far, the predominant considerations in the founding of all of them were (1) technological and commercial opportunity, (2) reliability or independence of fuel supply (mainly from the U.S.), and (3) risk sharing. In addition, the interests of an international organization played a role in the origin of Euratom. Non-proliferation concerns, on the other hand, were never more than a secondary factor and ususally revolved around Germany, which, aware of these fears, regarded multinational participation as a means of allaying them.

The incentives to form or join the enterprises were strongly country-specific. Thus, in the case of Unirep, the U.K. and France had large military reprocessing plants with excess capacity and were planning to build commercial facilities; Germany, without a military program, needed experience in the design and operation of large reprocessing plants for a planned civilian program. The main incentive for the first two countries was to avoid "ruinous competition," which United Reprocessors would do by coordinating plant expansion and regulating reprocessing contracts; the incentive for the Germans was technology transfer. Urenco was formed as a risk-sharing enterprise by the U.K., Germany, and the Netherlands; the British and German interest was to develop an enrichment capacity large enough, at least, to serve their domestic markets and provide independence from the U.S.; the Dutch, whose domestic needs were much more modest, were interested in the commercial export of enrichment services and technology. Similarly, the other organizations catered to the specific needs of their membership. If those needs or other circumstances were to change, one would expect the organization to change, also.

Of the five, only Eurochemic has disappeared, but, with the possible exception of Eurodif, all the others have undergone considerable strain and, in the case of Euratom, at least, some alterations. Eurochemic was abandoned for a variety of reasons, among them the ability of the participants, on the basis of their experience, to start their own reprocessing plants (giving some substance to the technology-transfer argument against multinational reprocessing plants), dissatisfaction with the multinational management of the operation, and competition with other reprocessing plants, such as the one at West Valley, New York. Unirep, set up essentially as a cartel to regulate the reprocessing market in the interests of its partners, has failed to fulfill the Germans' expectations for a substantial technology exchange between them and the other two participants and may be affected by the resultant dissatisfaction. Euratom was motivated primarily by a desire to develop nuclear technology in Europe for commercial exploitation, but its originally-intended role of actual control of the fuel-cycle facilities never materialized and it has been reduced to a sometime role as a purchasing agent for fuel or enrichment services and to the carrying out of safeguards.

The two enrichment enterprises seem the healthiest (both were originally opposed by the U.S.). However, the Dutch were almost expelled from Urenco when, during the negotiations for the German-Brazilian deal, they tried to introduce stronger anti-proliferation features. Only Eurodif, described in a section amusingly headed "Beautiful Eurodif," has sailed a relatively serene course. From the point of view of non-proliferation, it is almost a model multinational organization: its production facilities are located in a weapons state (France), its diffusion technology is difficult and expensive to replicate, and its outside partners have only limited access to it. The advantages to the French are not inconsiderable either: others share the financial risk but they alone manage the enterprise. Naturally, they tend to be rather smug about the whole arrangement, while disparaging the centrifuge as "proliferation prone."

The history of these enterprises demonstrates, according to Mendershausen, that countries can be induced to join them only by solid incentives related to their unique needs. The stability of the organizations, once formed, likewise depends on the particular circumstances of the members and upon external considerations, changes in which may result in either the alteration or the demise of the organization. "One should therefore be skeptical of assertions that the future of fuel-cycle enterprises belongs to multinational ventures," he declares. "Such assertions . . . may reflect wishful thinking."

Concerning the more recent U.S. initiatives in multinationalization, spent-fuel storage and fuel assurances, he feels that they will founder on the issue of abstention from reprocessing required by both schemes as a condition for membership. There are other problems as well, including, in the spent-fuel case, the difficulty of finding a nation willing to host the activity.

The European and American views on controlling proliferation may therefore be summarized as follows, in the words of Mendershausen: ". . . the American approach tends towards putting explicit rules of nonproliferation behavior and their implementation through international organizations first, and continuity of commerical transactions, second. The European approach . . . tends toward putting the development and continuity of economic transactions first, and **ad hoc** understandings on nonproliferation behavior between the parties to these transactions, second."

Is there any way to reconcile these views? Menderhausen thinks not, unless the U.S. abandons the major obstacle to agreement, its opposition to sensitive national facilities, at least in Europe. As he sees it, present American policy involves four paradoxes: (1) the supply-for-abstention offer ignores the fact that the main reason the Europeans want national facilities is to reduce their dependence on the U.S.; (2) the giving up of these facilities in Europe "to set an example" may actually encourage their spread elsewhere; (3) the U.S. renunciation of reprocessing may have the same effect; and (4) the credibility of the fuel-assurances sections of the Nuclear Nonproliferation Act of 1978 is undermined by the complexity and unpredictable outcome of the export-licensing procedures of that very same Act.

If Europe refuses the supply-for-abstention bargain, the U.S. will then be faced with certain serious dilemmas. The denial of supplies and enrichment services to Europe would wreak havoc with her nuclear energy plans, but at the cost of grave damage to other important U.S. foreign policy objectives in the areas of economics, energy, and security, for the achievement of which European, including German, cooperation is essential. Applying the policy selectively to nonweapons states in Europe would have the same effect, and in addition would raise the issue of dividing the European community. Even an attempt to limit application to non-industrial countries or non-OECD members would offend certain friendly countries, like Mexico, which adhere to the NPT and whose good will is important to the U.S.

In a brief concluding section, Mendershausen suggest ways in which the U.S. could avoid these "policy contradictions." Essentially, they amount to moving closer to the European position, and would involve dropping the supply-for-abstention principle (the **sine qua non** of cooperation), at least for Europe, exerting strong pressure to enlarge the circle of NPT adherents, consolidating the London Suppliers' Guidelines, supporting the European breeder development program instead of hoping for its demise, and adopting the European approach of weaving a network of bilateral trade agreements with strong safeguards that binds the parties together through self-interest.

Adoption of the first of these measures would permit consideration of the only multinational endeavor that Mendershausen thinks has a chance of being accepted, the international control of plutonium. The Europeans are more receptive to this idea now than formerly, but even here their receptivity will depend on the economic and political costs, and, in particular, on the extent of the control.

It may be that Mendershausen is too pessimistic and that, as a result of INFCE, other nations are more sensitive to the dangers of proliferation and are willing to pay a higher cost to avoid them than he indicates. However, as the Iranian situation reminds us, there are forces in the other direction. The energy crisis appears to be closing in on us with frightening speed, and it may be that the U.S will decide, at last, that the risk of war over energy resources is greater than that of proliferation.

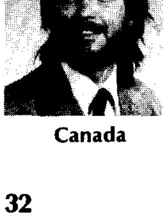
Kiawah Island Measurements Conference, Or 'I Survived Mingo Point'

By Walter W. Strohm
Mound Laboratory
Miamisburg, Ohio

Over 200 members of the safeguards community met at Kiawah Island, S. C., November 27-30, 1979, to participate in the Conference on Measurement Technology for Safeguards and Material Control. The conference was co-sponsored by the American Nuclear Society's Isotopes and Radiation Division, the National Bureau of Standards, and the Institute of Nuclear Materials Management. **Tom Canada** (LASL) was General Chairman of the conference.

The formal meetings were all technical sessions with no attempt to provide political or philosophical papers or discussion. Such conferences are important in advancing the state of our art. Business was easily conducted at all hours in the isolated environment of Kiawah Island. Abundant social opportunities included a poolside reception with a bluegrass band, sponsored by the several vendors participating in the conference, and a Low Country oyster and BBQ roast.

The first session on Standards and Analytical Chemistry got the conference off to a rousing start under the leadership of Chairman **Bob Larsen** (ANL). The session started with a group of nicely related papers addressing various aspects of measurement traceability. **Carleton Bingham** (NBL) emphasized the relationship of traceability in demonstrating measurement accuracy to the ability of an MC&A system in detecting diversion, thus putting this session in a safeguards context appropriate to the conference. **Bill Reed** (NBS) continued the thought in discussing the role of standards in achieving measurement traceability. **Anna Voeks** (NBL) followed with a progress report on the development of prototype uranium NDA standards. In response to comments from the floor questioning the applicability of these standards to the "real world," **Nancy Trahey** (NBL), coauthor of the paper, responded that we have to start somewhere in developing NDA reference materials and that an interlaboratory comparison utilizing these prototype NDA standards may well turn out to be a useful and informative excercise.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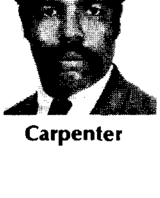
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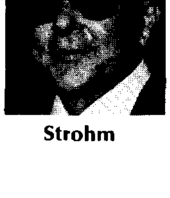

Strohm

Ernest Garner (NBS) reported the results of a mass spectrometric measurement of the half-life of ^{241}Pu. This was a welcome report which complements concurrent measurements at LASL and Geel, Belgium. With the completion of all these efforts, we should know the half-life of ^{241}Pu to an uncertainty acceptable for safeguards purposes. This initial group of papers concluded with a discussion by **Wolfgang Beyrich** (KFZ-Karlsruhe) on analyzing the results of analytical, interlaboratory comparisons.

It is at this point that an important activity of the Institute in developing written standards becomes apparent. Specifically, the standards on measurement control will provide the bridge from the many aspects of traceability discussed in the above papers to the analyst performing safeguards measurements. A progress report on the development of these standards and some of the approaches being used or debated would have been a useful addition to the conference. Perhaps we will see such reports in future safeguards meetings.

With a couple of exceptions, the rest of the session on Standards and Analytical Chemistry discussed improvements in measurement technology and instrumentation directed towards suitability for incorporation into modern safeguards systems. **Bill Ulbricht** (NBL) described a time-of-flight mass spectrometer using plasma desorption to measure isotopic ratios. This instrument could be "transportable" and emphasizes usefulness, not necessarily improved accuracy. **C. Rodrigues** (IPEN-Brazil) described a very precise quadrupole mass spectrometic measurement of $^{235}U/^{238}U$ ratios.

Some assay techniques discussed included "Acid-compensated Multiwave-length Determination of Uranium in Process Streams" by **Debra Bostick** (ORNL), "Low Level Uranium Determination by Constant Current Coulometry" by **Wanda Mitchell** (NBL), "Determination of Trace Uranium by Pulsed Laser Fluorometry," a new technique described by **Craig Zook** (NBL), and a "Computer Assisted Controlled-Potential Coulometric Determination of Plutonium" by **Brian Freeman** (NBL). Other automated methods included "An Automated Ion-Exchange System for the Rapid Separation of Plutonium from Impurities" by **Brian Freeman** (NBL) and "Computer-Aided In-Line and Off-Line Analytical Control System" by **Bert G. Brodda** (KFA-Juelich).

Brodda de-emphasized the need for highly accurate analytical measurements in a reprocessing facility because of uncertainties in volume measurements. **Syl Suda** (BNL) responded that automated electromanometer based volume measurements are good to 0.1% and was supported by **Al Skinner** (DOE) who stated that accurate volume measurements are now achieved at SRP following a cooperative development effort with NBS. **Paul DeBievre** (CBM-GEEL) also expressed his doubt about 0.1% measurements of real reprocessing plant solution. The question seemed to arise from the lack of a convincing method to demonstrate the accuracy of volume measurements in production application (i.e., Is the traceability of the volume measurement demonstrated?).

Going another route, Paul DeBievre described another approach in adding a spike to an input tank to improve the assay of the SNM content. The reported improvement was from approximately 2% obtained previously to about 0.3%. The particular approach described offered a safeguards advantage in addition to improved accuracy.

H. Schleicher (Euratom) chaired an interesting session on applications to National and International Inspection which started with three papers by IAEA, DOE, and NRC inspectors. **A. Ramalho** (IAEA) stated that measurements are used by IAEA inspectors to check the calibration of measurements and for qualitative and quantative verification of SNM. Standards for NDA measurements are a problem; a limited IAEA library of standards as well as those at the facility being inspected are used. Inspector training is an important IAEA need. **Craig Smith** (DOE) considers remeasurement to be the key to determining quality of the inventory and the reliability of inventory measurements. Off-site measurements by an independent laboratory, as well as on-site item counts and validation of weight statements, are used. As a result of the off-site measurement program, DOE contractors are implementing dynamic calibration of plutonium NDA using calorimetric assay for measurement control. On-site calorimetric assay by DOE inspectors will be initiated in 1980. **Walt Martin** (NRC) reported on an active program of on-site, independent verification measurements. A working standards library now exists for NRC inspectors including standards for measurement of duct work and pipes. Martin stated that current instrumentation is, however, better than the existing standards.

The first part of the session on Application to National and International Inspection concluded with a paper by **Curt Fellers** (Mound) describing "Instrumentation Development for the Enhanced Utilization of Calorimetry for Nuclear Material Assay." A description of the transportable calorimeter to be used by DOE inspectors was included. Discussion of instrumentation development to meet a variety of inspection needs formed the last half of the session. **Howard Menlove** (LASL) presented an "Experimental Comparison of the Active Well Coincidence Counter with the Random Drive." **P.S.S.F. Marsden** (UKAEA-Harwell) described an Optical Character Recognition system for reading labels and transcribing and recording the data. The system is 3 to 4 times faster than visual reading and recording. **Leon Green** (BNL-ISPO) speaking from the floor, stated that a reactor track-etch power monitor, described by **Steve Carpenter** (NBS) was wanted by the IAEA for independent verification. The use of Cerenkov light intensity measurement for spent-fuel inventory confirmation was described by **Ed Dowdy** (LASL). **D. Smathers** (Sandia) described a tamper recorder for unattended safeguards instruments.

A session on Enrichment and Fuel Fabrication, charied by **Roy Nilson** (EXXON), started with a paper on "International Safeguards for the Feed and Withdrawal Facility of Gas Centrifuge Plant" by **David Gordon** (BNL). **Bob Studley** (SRP) described NDA measurements of similar solid HEU materials using a Shuffler; accuracies of 0.4% for greater than 600 g ^{235}U were reported. Lower density material resulted in larger errors. A new portal monitor with neutron and gamma-ray detectors was reported by **Paul Fehlau** (LASL) to provide improved sensitivity and was designed for unattended operation.

In the last half of the session, **T. K. Li** (LASL) described a glovebox filter holdup monitor which utilized a NaI (Tl) detector. **Gary Gottschalk** (Westinghouse Hanford) delivered two papers describing some of the extensive effort at HEDL in developing automated, real-time maintenance of process, inspection, and inventory data. Automated acquisition of fuel pin diameter, identification, and fissile assay were described in the first paper. Automated in-line inspection of fuel pellets was described in the second paper; a throughput of 1 to 3 pellets per second is realized. **H. Baxman** (LASL) described a uranium solution assay system which recently assayed 6 samples per day to less than 1% over a 4-day period. **Steve Brumbach** (ANL) concluded the session by describing techniques for verification of contents of fast critical assembly cores including autoradiography, reactivity measurements, and foil activation.

Gary Molen (AGNS) INMM Vice Chairman, chaired a full day session on Spent Fuel and Reprocessing. With one exception, the initial group of papers described NDA measurements of spent fuel. **David Lee** (LASL) described burn-up measurements employing neutron and/or gamma-ray detection. For PWR fuel a 5% relationship was demonstrated between ^{137}Cs abundance and burnup. **George Ragan** (ORNL) reported 3% agreement between calculation and experimental measurements using active NDA. **John Lipsett** (AECL-Canada) described a gamma-ray system to verify irradiated CANDU fuel bundles while they are being moved to bonded long-term storage. The calculational design of a delayed neutron-interrogation assay system to measure waste canisters and packages was described by **G. Eccleston** (LASL). **Tony Ramalho** (IAEA) discussed correlation between $^{134}Cs/^{137}Cs$ ratios measured by gamma-ray spectroscopy and burnup as well as the Pu/U ratio. Getting away from NDA, **Andre Brutus** (COGEMA-France) described the spectrophotometric determination of plutonium in irradiated fuels solutions. The measurement is used in a hot cell to provide rapid plutonium analyses with minimal exposure to personnel.

Automated tank volume measurements came up again at the conference in a paper on the subject delivered by **Baldwin Robertson** (NBS). Calibration to 0.02% using water was reported. A question from the floor concerning anticipated problems with recalibrating an operating tank with water was not discussed in detail.

Frank Jones (NBS) then described in-tank measurement of solution density from the differential pressure between two electromanometer probes immersed at different heights. Density measurements comparable to those obtained with standard analytical techniques were reported. **Don Rogers** (Mound) asked if the effect of temperature and encrustation had been studied. Syl Suda (BNL) responded that he had studied temperature effects and found none that were not accounted for by a simple linear expansion calculation. Any problem with encrustration was not identified in the discussion.

The last half of the session on Spent Fuel and Reprocessing provided discussion of a variety of measurement methods, many of which had applications other than reporcessing. **Ray Walker** (ORNL) reported on a resin bead method using mass spectrometry with pulse counting. For synthetic dissolver solution, accuracy of Pu and U measurements is better than 0.5%. **Claude Hudgens** (Mount reported on the development of a wave-length dispersive XRF measurement of the SNM content of dissolver solutions employing total sampling. Laboratory experiments on solutions pumped through a sampling cell showed no identifiable concentration effect or any identifiable bias from the addition of particulate matter up to 20u m in size. A study of a two-detector method for measure plutonium isotopes in bulk containers was described by **John Fleissner** (Mound). Results of the study showed that approximately the same accuracy and precision for the ^{240} Pu isotopic measurement can be achieved from the 600keV region as from the 160keV region. Gary Molen complimented John Fleissner for his well prepared and well delivered presentation calling it "refreshing." This is a very effective tactic session chairmen can employ to encourage better quality papers at future safeguards meetings.

Phyllis Russo (LASL) reported on a K-absorption-edge densitometer for analysis of total plutonium in dissolver solution and a gamma-ray measurement of plutonium isotopic composition in freshly prepared product solution. The densitometer will be evaluated at the reprocessing plant at Tokai-Mura, Japan, as part of the IAEA experiment there. **Paul Goris** (Westinghouse-Hanford) reported on NDA measurements on ^{233}U containing 7 ppm^{232}U. This work is part of a program for evaluation of safeguards measurements for alternative fuel cycles. Two papers from Rocky Flats described rather unusual measurement problems that can be encountered. **Fran Haas** (Rockwell-RF) described NDA measurements on plutonium samples containing 5 to 10% Am using a segmented gamma-scanner. On nine production samples, a bias of (-5 ± 6) % was observed. **Ron Harlan** (Rockwell-RF) described the uranium and plutonium assay of crated waste. Such a measurement is still under development with emphasis on reducing matrix dependence of the measurement. Even in its current state of development, the measurement is proving useful for material control.

A session on Integrated Material Control Systems and Conceptual Safeguards System Design, chaired by **Dick Chanda** (Rockwell-RF), concluded the conference. This session turned out to be a session on safeguards systems to meet IAEA goals or requirements. In that context, **Jim deMontmollin's** (Sandia) invited paper discussing "The Goals of Measurement Systems for International Safeguards" was very appropriate.

His paper suggested that current IAEA performance goals, which are recognized as unofficial at this time, are derived from external safeguards considerations and may be unobtainable in large plants. He suggested a more logical, perhaps progressive, structure of performance goals which recognize what is attainable now and which will provide direction for R&D to obtain what is eventually desired. **Jim Shipley** (LASL) gave an overview of "The Evolution of Safeguards System Design" emphasizing the importance of including safeguards requirements early into plant design.

Shipley also emphasized the requirement of an effective measurement control program in any safeguards system. Thus we came full circle to Carleton Bingham's Similar comment in his paper that opened the conference and the previously mentioned standards writing activities of the Institute. The Institute's efforts are not just important; they are needed for effective safeguards. Couple that effort with an ambitious program to provide appropriate standard reference materials and we will do more than just talk about traceability to that elusive "National Measurement System."

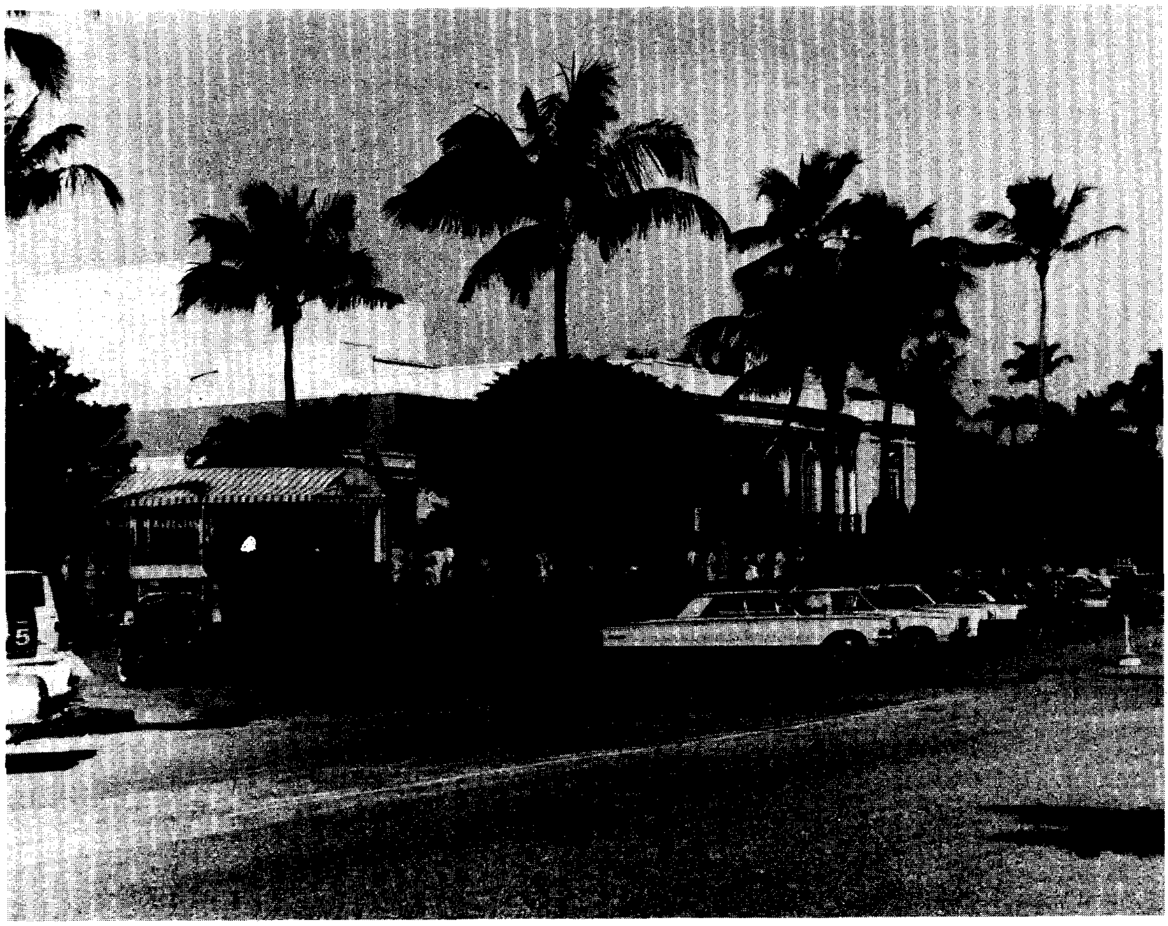
Two Euratom papers concluded the first part of this session. **Jeff Cullington** (DCS-Luxembourg) presented the results of a sensitivity analysis of the material balance of a large HEU fabrication plant. **Mike Franklin** (ISPRA-Italy) described a "Monte Carlo Simulation of MUF Distribution for Application to Euratom Safeguards."

Don Cobb (LASL) opened the last half of the session with a discussion of "Dynamic Materials Accounting for Solvent-Extraction System" which his studies show needs an inventory estimate of 5 to 10%. Examination of several models of mixer-settler contactors suggest that measurements of waste streams may indicate how far from equilibrium that column is operating which will allow a suitable inventory estimate. **Arnie Hakkila** (LASL) described a Material Measurement and Accountibility System, MMAS, for a model reprocessing plant to meet IAEA goals. Studies indicate IAEA goals can be met for a small plant like Tokai. For a large plant like AGNS, the goals can be met for an abrupt diversion, but not for a protracted diversion.

Two papers by our Japanese colleagues concluded the session and the conference. **Koji Ikawa** (JAERI-Japan) presented "Study of the Application of Semidynamic Material Control Concept to Safeguarding Spent Fuel Processing Plants" which was performed as part of the TASTEX program at the Tokai reprocessing facility in Japan. **Tamotsu Ishii** (Mitsubishi Metal Corp.) described a "Safeguards System of Back-End Facilities with Emphasis on Waste Management." The integration of materials accounting and containment and surveillance was featured and evaluated for safeguards effectiveness.

The proceedings to be published will contain all papers including several not mentioned here because of the particular approach used in preparing this report. Additionally, the discussion following each paper will be included.

Anyone who has read this far deserves to know the meaning of the subtitle to this report. The Low Country oyster and BBQ Roast was held outdoors at a place called Mingo Point on a very cold evening. As a result, however, of good food and drink and terrific companions, we did have a great time.



Crowds arriving at Fete du Soleil at Royal Poinciana Playhouse.

Palm Beach 1980 Meeting Site

This Year's Gathering Spot For INMM Members and Families

By James W. Lee, Chairman
INMM Local Arrangements Committee (1980)
North Palm Beach, Florida

Known internationally as a gathering spot for the rich and glamorous, Palm Beach has its important and historical and cultural sides, too. It is, in fact, the many-faceted jewel of Florida's east coast.

Warmed by the gulf stream, this lovely sub-tropical island presents a panorama of fascinating architecture, a vast array of art and art objects and period furniture, and a view of the life style enjoyed in luxurious mansions earlier in the century.

Our five-star hotel, The Breakers, designated as "culturally significant" by the National Register of Historic Places, was inspired by outstanding Italian villas. It incorporates both modern convenience and Old World grandeur — twin towers, graceful arches, vaulted ceilings, splashing fountains, frescoes and gardens, Florentine dining rooms and stately ballrooms.

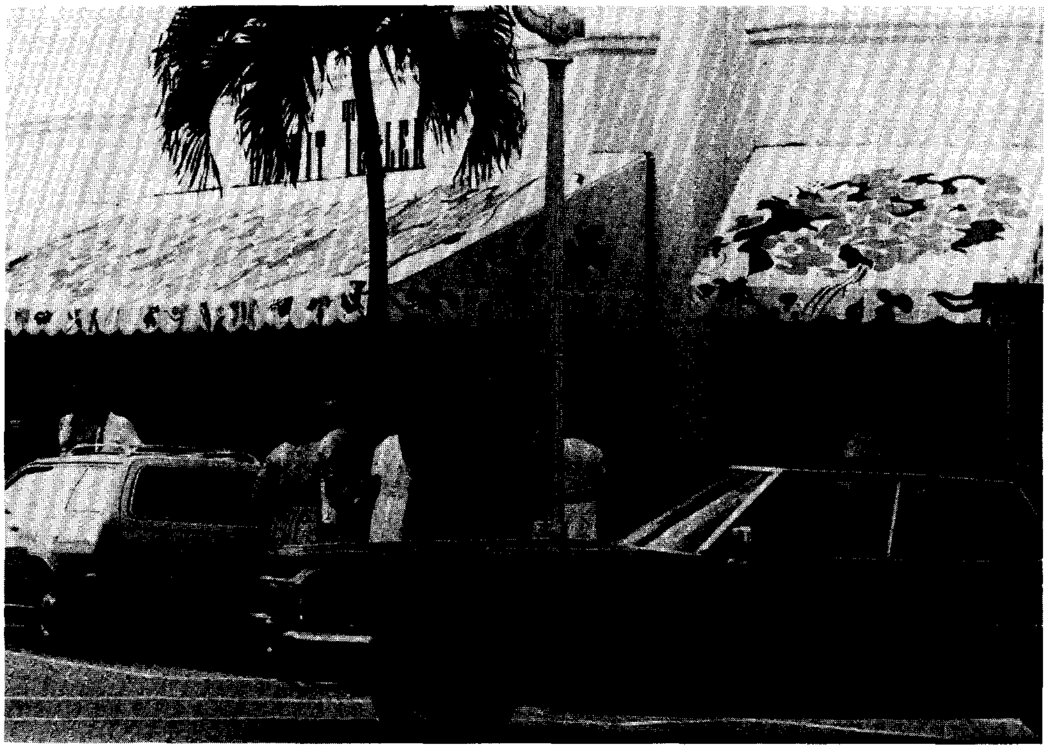
The Breakers boasts two 18-hole golf courses, 12 tennis courts, private ocean beach, salt water outdoor pool and fresh water indoor pool with Beach Club, lawn bowling, putting green, bicycles, shuffleboard, croquet, horseshoes and supervised children's playground.

The town of Palm Beach is admired for the Old World architecture, elegant homes, and luxurious apartment complexes, plus its immaculate streets and lush landscaping.

Palm Beach is an oasis and a haven for artists and musical buffs alike, — the Greater Palm Beach Symphony, Civic Opera of the Palm Beaches and numerous visiting symphony orchestras. The Flagler Museum (visitors see this magnificent mansion, "Whitehall", much as it was when the Flaglers lived there. The Rambler, Mr. Flagler's personal railroad car, is on the grounds, completely restored to its original handsome condition).

Other sightseeing attractions are Royal Poinciana Playhouse, Palm Beach County Science Museum, Four Arts Library Gardens, shopping on Worth Avenue, Lion Country Safari, and deep sea and pier fishing.

In addition to these two Palm Beach landmarks — The Breakers and Whitehall — the National Register



Worth Avenue at Bonwit Teller Corner.

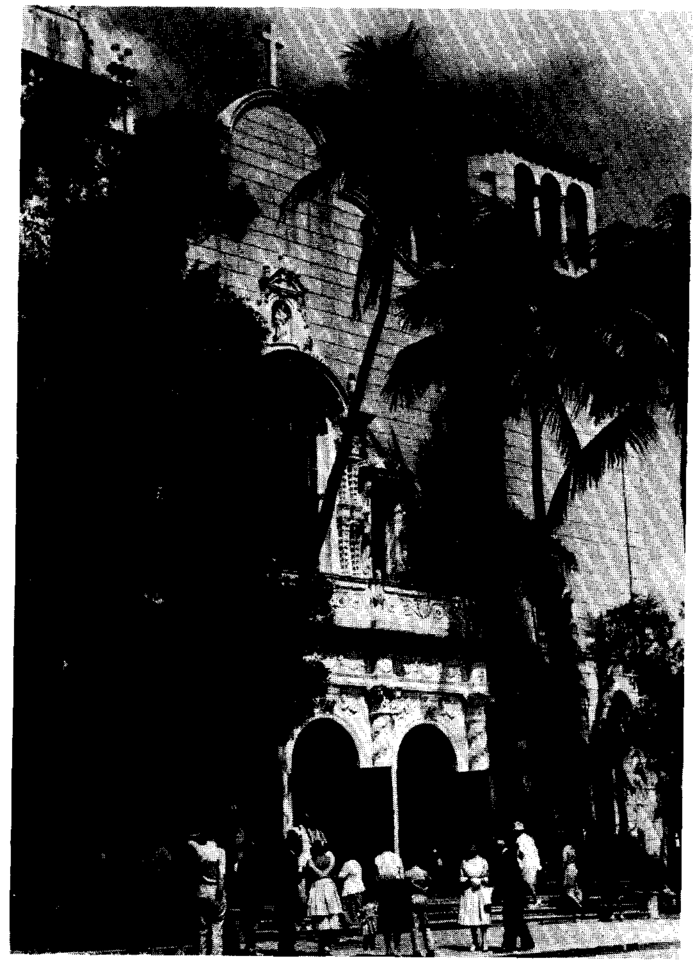
Royal Poinciana Plaza.

listings include several private homes and the Paramount Theatre building. Mar-a-Lago, the 17-acre estate given by **Marjorie Merriweather Post** to the federal government in 1972 and designated a National Historic Site, is not accessible to the public. A number of houses designed by **Addison Mizner**, early leader in Florida architecture, who had studied in Spain, are still extant.

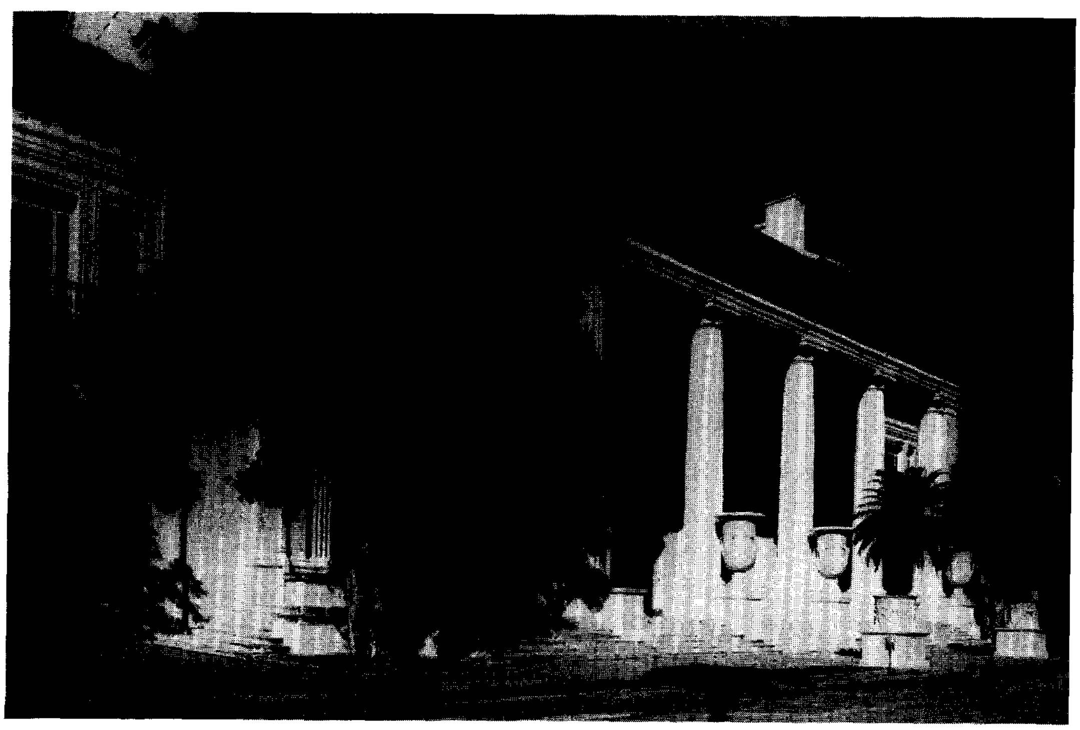
INMM members and families may also enjoy an optional pre-convention or post-convention weekend at the Dutch Inn, in Lake Buena Vista, Florida, adjoining Disney World, at a special convention rate of $50.00 per night, double or single, with children under 18 free. The Dutch Inn, a lovely resort hotel, operates a bus service over the private road connecting Disney World and Lake Buena Vista, thus avoiding the long traffic delays which are prevalent on the public highways during this peak season.

July temperatures will be warm so bring tropical clothes, bathing suits and informal wear, although coats are required in the evening in The Breakers dining room and in some of the Palm Beach area's better restaurants.

Society of the Four Arts — Silhouette of artist bringing in his painting to the Four Arts. Photos accompanying Mr. Lee's article (unless otherwise credited) are by Bob Davidoff Studios of Palm Beach.



St. Edward's Church, Palm Beach, Florida.



Photographer Sam R. Quincey of West Palm Beach captured this photo of the stately Henry Morrison Flagler, Whitehall Way, Palm Beach, Florida. Mr. Flagler was a partner of John D. Rockefeller before *heading south to develop the east coast of Florida by constructing* railroads.

General Electric Group Award To C. M. Vaughan

C. M. Vaughan, Manager of Nuclear Materials Management at General Electric, Wilmington, N.C., has received the GE Group Quality Performance Award.

Vaughan was honored for outstanding quality performance in the second quarter, 1979, for his contributions in meeting the increasingly stringent standards imposed by regulatory agencies, as evidenced by improved audit results and safeguards improvements within the Wilmington Manufacturing Department.

The GE employee newsletter reported in its August 23, 1979, edition that "Charlie's work has also resulted in reduced impact on normal operations by the uranium physical inventory. This is evidenced by physical inventory program modifications which netted a factor of 10 reduction in impact to manufacturing operations."

According to Mr. Vaughan, "receiving this award was a rather humbling experience since it is such a high award and the competition is so keen. Another point which was interesting was that it went to a person in the regulatory part of the business. It has been a long standing feeling that the regulatory part of the business survives only because the law is on their side . . . unnecessary evil, so to speak, in manufacturing. The scenario of this award shows that a manager and his personnel in a regulatory function can actually make a major team contribution to the manufacture of a product."

Mr Vaughan, active in ANSI INMM N15 standards activities and the December 1978 Special INMM Workshop on the Impact of IAEA Safeguards Agreement with the U.S., was flown to San Jose, Calif., for the presentation luncheon where he was presented an award plaque affixed on a highly polished fig tree burl.

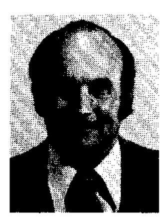
He holds a B.S. degree in chemistry from East Tennessee State University, Johnson City. Following graduation in 1965, he joined Nuclear Fuel Services, Erwin, Tenn., where he served until 1970 as a chemist and laboratory supervisor (low enriched uranium, highly enriched uranium, U-233, plutonium and thorium).

In 1970, Mr. Vaughan joined General Electric-Wilmington as Senior Safeguards Engineer. Four years later, he was named to his present position which involves overall responsibility for the Department's Safeguards Program. In addition, he is GE Coordinator for the extensive, integrated US/IAEA Safeguards exercise beginning in 1971 and running through 1978.

An active participant in Institute activities, Mr. Vaughan presented papers at the 1973 (San Diego) and 1978 (Cincinnati) annual meetings. He currently serves on the INMM Certification Committee which is evaluating and validating new certification tests.

The staff of the Journal extends its congratulations to Mr. Vaughan for his achievement in the field of safeguards — Tom Gerdis.

Editor's note: If you have been honored or recognized for outstanding work, please advise the editor. We would like to publish similar articles in future issues. March 1 is the deadline for material for the Spring 1980 issue (Volume IX, No. 1).



Vaughan

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Reports of Activities Of Member Attendees At '79 INMM Annual Conference

Compiled by Thomas A. Gerdis, Editor
Nuclear Materials Management
Journal of INMM
Louisville, Kentucky

The following 76 items have been submitted to **Nuclear Material Management** at the request of the editors from INMM members who were in attendance at the 20th INMM annual meeting this past July 16-18 in Albuquerque, New Mexico. In January, the editors requested similar sketches from INMM members who were *not* in attendance at the annual meeting. This latest set of sketches will be published in the Spring 1980 (Volume IX, No. 1) issue of the Journal to be distributed beginning May 1, 1980.

J. R. Barkman works for Union Carbide Corporation, Nuclear Division, in the production section of the Y-12 Plant at Oak Ridge, Tenn. He attended the first INMM annual meeting in Columbus, Ohio, in 1960, and became a certified Nuclear Materials Manager in February 1968. He was Chairman of the task group that prepared the first Institute standard: ANSI N15.1-1970, "The Classification of Unirradiated Uranium Scrap." In addition, he has served on several other standards task groups. His uranium processing experience started in 1944 at the Y-12 Plant.

Dr. **Carl A. Bennett** is located in Seattle, Washington, at the Human Affairs Research Centers of the Battelle Memorial Institute. He has been involved with nuclear materials accounting since the days of the Manhattan Project during World War II, and was associated with the early development of inspection and control methods for international safeguards. He is at present the U.S. member of the International Atomic Energy Agency's Standing Advisory Group on Safeguards Implementation.

Dr. **Alan M. Bieber, Jr.,** is with the Technical Support Organization (730) at BNL. Bieber's primary recent activities are involved with implementation of IAEA safeguards in the U.S. under the US/IAEA Agreement. He has worked with NRC in development of guidance for use by licensees in completing IAEA Design Information Questionnaires, and, most recently, has been involved with DOE in implementation of the reporting requirements of the U.S./IAEA Agreement.

Dennis M. Bishop is a Senior Program Manager with the General Electric Company in San Jose, Calif. He has been an INMM member since 1970 and currently serves on the Executive Committee. He is also Chairman of the INMM N15 Standards Committee. The 150-member committee develops consensus standards in 12 technical areas associated with current safeguards methods.

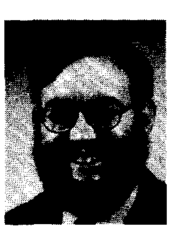
R. E. Brooksbank, an editorial advisor for this publication, is Section Head of the Pilot Plant Section within the Chemical Technology Division of the Oak Ridge National Laboratory. He currently manages the Radiochemical Pilot Plant, the Transuranium Plant and is responsible for several study groups including fuel cycle proliferation resistance and transportation technology. Mr. Brooksbank has served as a U.S. delegate to the Atoms-For Peace Conference and has served as member of the U.S.-Japanese Tokai reprocessing plant's safeguardability. He has coordinated the study of the Barnwell Nuclear Fuels Reprocessing Plant for DOE in response to congressional legislative requirements and concerns relative to proliferation resistance. His most recent endeavor has been to work in coordination with the President's Commission on Three Mile Island in cleanup operations of that facility. Mr. Brooksbank has published numerous articles in the area of the nuclear fuel cycle and safeguards.

Dr. **Frederick Brown** is Head of the Safeguards Office in the U.K. Department of Energy in London and is responsible for coordinating the implementation of Euratom and IAEA safeguards in the U.K. Before taking up his present position in 1972, he worked for the United Kingdom Atomic Energy Authority in various capacities in the fields of radiochemistry, isotope separation, plutonium chemistry, fast reactor fuel development and finally, studies of safeguards problems on all types of nuclear facilities in the U.K.

Joseph M. Cameron is a new member of INMM although he served as a consultant to INMM-8.1 and is now a member of INMM-5. Now a private consultant, he previously worked 30 years for the National Bureau of Standards and was Chief of their Statistical Engineering Laboratory (1963-68) and of their Office of Measurement Services (1968-77).

Dr. **Richard N. Chanda,** a nine-year employee at Rockwell-Rocky Flats, was recently appointed Manager, Safeguards and Security Systems. In this new function, he will


Barkman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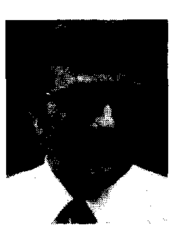
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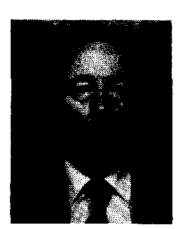
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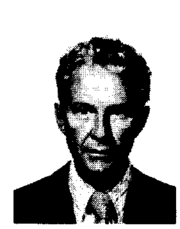
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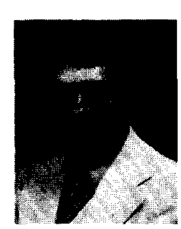
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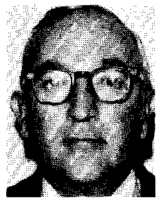
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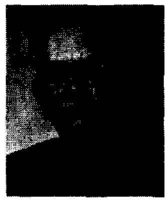
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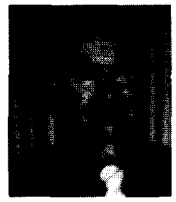
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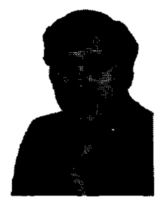
Groome

be responsible for coordination and planning of safeguards and security technical programs. Prior to this appointment, Chanda served as Manager, Instrumentation and Statistical Systems, an instrument development and statistical analysis group. Chanda has been active in the INMM for several years, most recently on the Annual Meeting Program Committee as Chairman, Contributed Papers.

Dr. **Leon D. Chapman** is the Supervisor of the Safeguards Methodology Development Division at Sandia Laboratories. He is the project manager for the development of methodology for the evaluation, design, and inspection of nuclear facilities and in-transit safeguards systems as a part of the U.S. NRC/RES program. Portions of the developed methodology are currently being utilized by NRC, DOE, and DOD in safeguards applications. Previous experiences have included the modeling of national energy systems, nuclear fuel cycles, and environmental systems.

Curtis A. Colvin of Rockwell International at Hanford (Richland, WA), is involved in Analytical Laboratory Management. While Manager of the Plutonium Analytical Laboratory, highly specialized analyses of plutonium oxide destined for the Fast Flux Test Facility (FFTF) were performed. Curtis is currently a member of the Executive Committee of the newly-formed Pacific Northwest Chapter of INMM. He presented a paper, "Establishing a Favorable Safeguards Climate at a Nuclear Facility," the last time the annual meeting was held at West Palm Beach, Florida.

J. M. Crawford is an engineer in the nuclear materials control group at Allied-General Nuclear Services in Barnwell, S.C. John, an INMM member for the last 10 years, has been in materials management and control for the past 15 years. He is a member of the writing group for revision of the ANSI Standard for Volume Calibrations.

Everett A. De Ver is the Nuclear Materials Representative at Monsanto Research Corporation, Mound Facility located in Miamisburg, Ohio. The Miamisburg, Ohio, facility was the first permanent AEC installation and was a pioneer in the use of various radioisotopes. As a result, Mound personnel have long been active in all areas of Nuclear Materials Management. Everett is completing his 21st year in Nuclear Materials Management and Safeguard Accountability. He and his staff were instrumental in developing a near-real time accountability record system with CRT terminal input. This record system was implemented in 1976 and has been very successful because of full inquiry capability from the terminals. He attended his first INMM meeting in 1961 at Denver, Colorado. His main objective is to maintain a high caliber and effective control system for handling nuclear materials at Mound.

B. F. Disselhorst of General Atomic, San Diego, CA, is active in improving measurement techniques and controls for high temperature gas cooled reactor fuels. He has been an INMM member since 1973.

Lou Doher is Manager of the Chemistry Standards Laboratory of the Rockwell International Rocky Flats Plant. Lou has been involved with SNM measurements at Rocky Flats for twenty-eight years and has been a member of the INMM for 19 of those. Lou has served as Chairman of INMM-8, "Calibration Techniques" and in 1975 published four American National Standards on Calibration of Bulk Measurements systems for Nuclear Materials Control.

A Charter Member of INMM, **Kenneth C. Duffy** is Manager of Nuclear Materials Management at General Atomic Co., San Diego, Calif. A 1950 graduate of Franklin (Ind.) College, Duffy was a U.S. naval aviator from 1943-46. From 1950-57, he was Assistant Physical Control Manager at Argonne (Ill.) National Laboratory. Prior to assuming his present position in 1963, Duffy held a similar position for M&C Nuclear, Attleboro, Mass., for six years. He was a local host for the 14th INMM Annual Meeting in 1973 in San Diego and served in the Institute's Executive Committee.

Dr **David L. Dye** is with the Energy Technology Applications Division of Boeing Computer Service (BCS). He was the nuclear sciences team leader for the 1977-8 BCS project to develop requirements for the NRC's Integrated Safeguards Information System. Currently he is working with system engineering approaches to waste management. He is active in the public debate over nuclear power, speaks to community groups and seminars around the Pacific Northwest, is Secretary of the Puget Sound Chapter of the American Nuclear Society, and presented a paper for the 1979 meeting of the American Scientific Affiliation on "Christian Perspectives in the Nuclear Energy Option."

Dr **J. Mark Elliott** is a Senior Consultant with International Energy Associates Limited (IEAL), Washington, DC. He has been responsible for several IEAL projects in physical protection of nuclear power plants including the development of an Access Control Handbook. Mark has served as a member of the INMM-10 Physical Security Subcommittee and is currently a member of the Physical Protection Technical Working Group.

Paul E. Fehlau of the Detection, Surveillance, Verification and Recovery Group at Los Alamos Scientific Laboratory recently has been working on an evaluation of vehicle special nuclear materials monitoring techniques. His other tasks this year have included developing training exercises for LASL's Nuclear Emergency Search Team members and conducting and IAEA study of radiation surveillance monitors.

William E. Gilbert is with the DOE Office of Safeguards and Security, originally hiring into the AEC in 1952 as a statistician. He was Chief of the Survey and Appraisal Branch for over ten years. His current responsibility is as lead-man for a number of the safeguards regulations and overall coordinator for all DOE safeguards and security regulations. Bill has been active with the Institute since its inception, assisting in the hotel selection for the 1967 meeting in Washington and involved in the development of many INMM-sponsored standards. Currently he is a member of the Measurement Control Subcommittee and recently assisted in the publication of the Standard Definitions of Terms Associated with the Protection of Nuclear Material and Facilities.

William E. Groome is Senior Engineer with Video Tek, Inc., Mountain Lakes, New Jersey. Mr. Groome has been involved in the development of the IAEA Safeguards video system for the CANDU power plants and the video perimeter systems for several reactors.


Guerra


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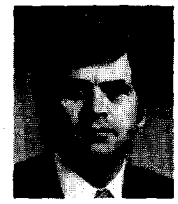
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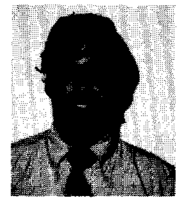

Hardt


Hatcher

Noe E. Guerra is consulting engineer for the Stone & Webster Engineering Corporation, Operations Services Division. He served as Supervisor of Engineering Security Services and is now doing considerable work in Interface & Integration Requirements of Engineered Safety, Emergency, and Physical Security Systems & Programs for Nuclear Power Facilities. Additionally, he performs studies in the improvement of physical security related methodology and procedures.

Dr. **Ray Gunnink** is Head of the Nuclear Applications and Technology Section of the Nuclear Chemistry Division at Lawrence Livermore Laboratory. His area of specialization is gamma ray spectrometry. He was instrumental in developing GAMANAL, a generalized computer program used to reduce and interpret germanium spectra. He has applied his techniques to Safeguard related analyses by developing precise methods for measuring isotopic abundances of plutonium in materials. His latest computer-based spectrometer was recently installed at the Tokai Reprocessing Plant where it is being evaluated as part of the TASTEX exercise.

Dr. **Arnold Hakkila** is Associate Group Leader for the Safeguards Systems Design Group at the Los Alamos Scientific Laboratory. He has been employed as an analytical chemist at LASL for 22 years, the last three in design and evaluation of advanced materials accountability systems for both domestic and international applications. He has authored or co-authored over 60 publications in the fields of transuranium analytical chemistry, x-ray spectrometry, electron microprobe analysis, and safeguards systems design, and is editor of the book "Nuclear Safeguards Analysis: Nondestructive and Analytical Chemical Techniques."

Glenn A. Hammond is with the Office of Safeguards and Security (Defense Programs) at DOE. He was recently named Chief of the International Support Branch, a part of the Safeguards Systems Development and Implementation Division. Glenn is completing his 24th year in both field and Headquarters levels of nuclear materials production, management, safeguards and security programs, the last seven (7) of which have been as Chief of Branches in the R&D programs involving Systems Development, Materials Control and Development, Component and Systems Development, and International Support. He has been a member of the INMM for the last 11 years with primary involvement in the technical program committees, presentations and as a voting representative of INMM-sponsored ANSI standards. His attendance at the 1979 annual meeting in Albuquerque was highlighted by the enthusiastic reception received from recent technological advances and demonstrations from DOE-sponsored programs in physical protection, materials control and accountability carried out by the participating laboratories.

Dr. **Todd L. Hardt** is Supervisor of the Radiochemistry Group at Babcock & Wilcox's Research Center in Lynchburg, Virginia. His primary involvement in nuclear materials management over the past two years has been in the area of nondestructive assay at B&W's fuel fabrication facility. Other areas of activity have been in radiochemical methods development, X-ray spectroscopy and burnup determination of spent nuclear fuel. The 1979 INMM annual meeting was his first and he is now serving on committee INMM 9.3.

Bobby L. Hatcher is Accountability Representative at the General Electric Co., Nuetron Devices Department, St. Petersburg, Florida. He is Manager of Inventory Control and assumed the responsiblity for nuclear materials in 1979. He attended his first INMM meeting in July 1979 at Albuquerque, NM.

Ron L. Hawkins is a Senior Technical Associate consulting in the areas of nuclear fuel quality assurance, material control and accounting, health physics, and nondestructive assay in the Quality Programs Division of NUSAC, Incorporated. He is serving on the standards subcommittee for "Container Standardization" and has been a member of the Institute for five years.

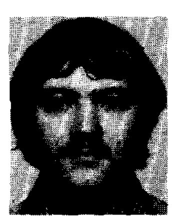
Deborah D. Hill is a chemist for the Nuclear Safeguards Branch at the Albuquerque Operations Office. She originally began work in the Safeguards field in 1972 at the Hanford plant in Richland, WA, at which time she also joined INMM. As a result of experimentation she conducted at Hanford applying security seals in varying environments, she participated on a panel about "The Use of Security Seals for Safeguards" at the 1974 annual INMM meeting in Atlanta, Georgia. In her current position, she travels nationwide to evaluate nuclear materials measurements and accountability techniques employed by the various contractors in the weapons complex.

R. D. (Davis) Hurt of the Engineering Technology Division of Oak Ridge National Laboratory works on the Consolidated Fuel Reprocessing Program. His responsibilities include the development and demonstration of advanced safeguards concepts for spent fuel reprocessing facilities. This work emphasizes material control and accounting strategies for international safeguards applications.

Since 1972, **Koji Ikawa** has been engaged in developing the national safeguards information treatment system, which was so designed as to account for and control of nuclear materials in Japan on the basis of all relevant articles of the IAEA-Japan Safeguards Agreement. This system, named the NPT-JAPAN, is a big computer code system for handling, processing and evaluating all the information necessary to maintain the so-called level II assurance of the national verification activities. Lately, he has also been doing work on Task F of the TASTEX project. Task F is a study of the application of dynamic


Hawkins


Hill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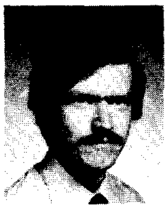
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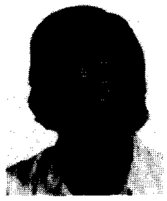
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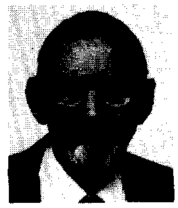
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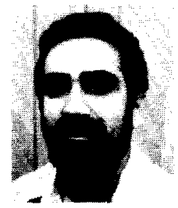
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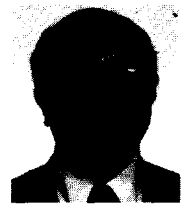

Labowitz

material control concepts to safeguarding spent fuel reprocessing facilities using Tokai Reprocessing Plant as a model facility. In this work, "we proposed a 10-day detection time model" based on weekly dynamic inventory taking as a feasible and back-fittable system to existing small scale facilities. The effectiveness of the model was fully evaluated through our diversion sensitivity analyses, according to Ikawa.

Michael F. Kelly recently attended his first INMM meeting in Albuquerque. A quality control statistician at UNC Naval Products, Montville, Connecticut, one of his primary concerns is to lend statistical support to UNC's SNM Accountability Program. He graduated with an MA degree in Statistics from the State University of New York at Buffalo in February 1978.

Mark H. Killinger, winner of the second annual INMM Student Paper Competition (1979), is now with the Division of Safeguards at the U. S. Nuclear Regulatory Commission, Washington, D.C. Before getting on board there, Killinger did safeguards work at Battelle in Seattle, Wash., while a graduate student in Nuclear Engineering at the University of Washington. He attended his first INMM meeting this past July.

Dr. **Ryohei Kiyose**, Head of the Department of Nuclear Engineering, University of Tokyo, enjoyed everything with his wife Tsuruki in participating in the 20th INMM Annual Meeting in Albuquerque last July. Dr. Kiyose has been serving as the Vice Chairman of the Japan Chapter of INMM since July 1978. He also served as the Technical Program Chairman of the First Seminar on Nuclear Materials Management which was held in Tokyo on September 28, 1979, under the auspices of the INMM Japan Chapter.

Harry Krake is with The Ralph M. Parsons Company, Pasadena, California. He has been responsible for special nuclear materials inventory, assay and safeguards systems and facility design on Parsons A and E contracts with DOE at ORNL, LASL and INEL. He was at NUMEC with **Jim Lovett** and later with **Dean Scott** prior to moving to the Rose Parade City in 1974.

Alan M. Krichinsky ia the head of the technical evaluation group for ORNL's ^{233}U Pilot Plant. This group evaluates process performance and performs nuclear material accountability functions for the Pilot Plant. Alan was instrumental in the software design and construction of the computerized accountability system featuring on-line monitoring of process liquids presently in use by his group. He is also a member of the INMM 8.2 Writing Group on the ANSI Standard for volume calibration.

Allan M. Labowitz retired from the U.S. Foreign Service in February 1979, after 30 years of Federal service, much of which has been with the U.S. AEC, before serving from 1970 to mid-1978 in the U.S. Mission to the IAEA in Vienna. He is now a partner with his son in the general practice of law in Alexandria, Virginia. At the same time, he continued his long-time interest in international safeguards, particularly the U.S.-IAEA safeguards agreement pending in the U.S. Senate, as a consultant to ACDA and the Department of State. He is also a consultant to the International Safeguards Project Office at Brookhaven National Laboratory, for whom he has provided advice on arrangements for the international air shipment by IAEA of safeguards samples containing plutonium.

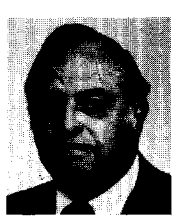
James E. Lovett, INMM Chairman in 1970-72, was among those who accompanied IAEA Director General **Dr. Sigvard Eklund** to the Albuquerque meeting. A member of the System Studies Section in IAEA's Department of Safeguards, Jim was en route to Japan to continue his work with the Japan Atomic Energy Research Institute on the possible application of dynamic materials accountancy principles in the reprocessing facility at Tokai, Japan.

Dr. **Ralph F. Lumb,** President of NUSAC, Incorporated, McLean, Va., has been heavily involved in the development of two new divisions of his company: the Computer Security and Environmental Assessments Division. Ralph has also agreed to accept the Chairmanship of the INMM Awards Committee. NUSAC is continuing its growth and today employs more than 35 people.

Larry Lynch has been named Senior Technical Associate in the Quality Programs Division of NUSAC, Inc., McLean, Va. NUSAC President, Dr. **Ralph F. Lumb,** said Lynch's responsibilities include the preparation and implementation of nuclear quality assurance programs for fabrication of nuclear reactor assemblies and components. He also is involved in the development of a program to interface process technology with nuclear materials safeguards management. He will report to **Wilkins R. Smith**, Manager of Quality Programs Division. Mr. Lynch comes to NUSAC from Nuclear Fuel Services, Inc., where he was Process Engineer. He holds a B.S. degree in Chemical Engineering from Virginia Polytechnic Institute and State University, a Master of Business Administration degree from East Tennessee State University, and has done additional graduate work in system management at the University of Southern California.

Henry H. McClanahan is the Manager, Nuclear Materials Control, at Babcock & Wilcox, Naval Nuclear Fuel Division. His responsibility covers head in phase of production, nuclear safety and all NRC licensing activities, along with physical control and accountability of SNM. He is a co-author of ANSI Standard N15.5, "Nuclear Material Control Systems for Fuel Fabrication Facilities (A Guide to Practice)." He is also a coholder of several patents pertaining to the manufacture of nuclear fuels. Henry's secondary functions involve Chairman


Lovett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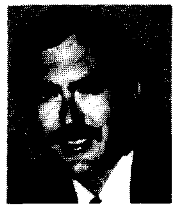
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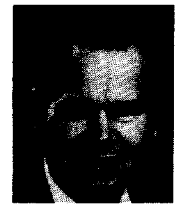

Myre


Nilson

of the corporate-wide Nuclear Materials Control Committee and Chairman of the NNFD Nuclear Licensing Board. He has been an INMM member since 1970. He attended the first safeguards training program held at Argonne in 1968. He presented his first paper to the INMM at the West Palm Beach meeting in 1971 on "Practical Applications of a Non-Destructive Uranium Assay Device."

Robert B. McCord is the Manager of Test Pin Fabrication for the Westinghouse Hanford Company, Richland, Washington. He is responsible for the fabrication of irradiation test pins and test assemblies. He has been an active member of the INMM-9.4 subcommittee, Measurement Controls, since 1975, participating in the preparation of the proposed ANSI N15.36 Standard, "Nondestructive Assay Measurement Control and Assurance."

Dr. **Samuel C. T. McDowell** is with the U.S. Department of Energy. He is the Director of the Division of Safeguards Systems Development and Implementation, Office of Safeguards and Security. Dr. McDowell was an early member of the INMM and holds the Certified Nuclear Materials Manager certificate. He established the INMM Standards Committee and served as its first Chairman. Since that time he has been very active in Institute activities involving domestic and international safeguards. He served as Chairman of the Awards Committee for 1979 and more recently was elected to membership on the Executive Committee. Other recent activities include Head of the U. S. delegation to the Joint Steering Committee on the Tokai Advanced Safeguards Technology Exercise (TASTEX) that is composed of representatives from the U.S., Government of Japan, France and the International Atomic Energy Agency. This is a program to evaluate advanced safeguards technology as a special part of the continuing United States program of technical assistance to the International Atomic Energy Agency. Also, Dr. McDowell serves as Chairman of the Safeguards Crosscut Group established in October of 1977 as part of the International Fuel Cycle Evaluation (INFCE) program.

Dr. **Douglas E. McGovern** is with the International Safeguards Division of Sandia Laboratories. After work on the DOE Intrusion Detection Systems Handbook, McGovern spent nine months in Vienna as a consultant to the IAEA. He is currently working on unattended containment/surveillance devices for the IAEA and is writing group chairman for an INMM/ANSI proposed standard on closed curcuit television for physical protection.

Dr. **Howard O. Menlove** works in the Nuclear Safeguards Program at LASL. He is the Group Leader of the International Safeguards Group Q-5. His primary involvement has been activities in support of IAEA safeguards. During the past 12 years, he has been actively engaged in the development of NDA techniques for nuclear safeguards applications.

William C. Myre is the Director of Nuclear Security Systems at Sandia Laboratories, Albuquerque. In this position he has responsibility for Sandia's Safeguards Programs sponsored by DOE, DOD and NRC. Sandia's responsibilities include R&D for Physical Protection and Containment and Surveillance Systems both for fixed facilities and material in transit.

Dr. **Roy Nilson** is in charge of EXXON Nuclear's Corporate Licensing and Compliance Group. As such, he is responsible for corporate policy in the safeguards and security areas. He is also first chairman of the recently-formed Pacfic Northwest Chapter of the INMM. He reported over 50 attendees at the first of quarterly meetings held on October 29, 1979. EXXON Nuclear has a unique position with fuel fabrication plants both in the USA and in West Germany. The German involvement has been helpful in obtaining early inputs on IAEA involvement with bulk facilities.

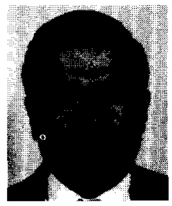
J. Harding Owen is Site Coordinator for Safeguards at the Savannah River Plant, where he has had a variety of assignments with duPont over the past 25 years. He taught chemistry at the University of South Carolina on a part-time basis for 15 years.

Edward Owings is employed by the Union Carbide Corporation at its Y-12 Plant in Oak Ridge, Tennessee. He is Supervisor of the nuclear materials control and accountability staff at Y-12. A licensed public accountant, he has worked in the nuclear industry for 28 years. He has served as Treasurer of the Institute for the past two years.

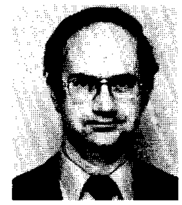
Charles E. Pietri is Assistant Director for Operations, New Brunswick Laboratory, U.S. Department of Energy, Argonne, IL. He has recently developed a Safeguards Chemical Analysis Course for training NRC and DOE field inspectors and others involved in safeguards measurements. Currently, he is a member of INMM-5 Measurements Control Committee. He attended his first INMM meeting in 1969 and has been a member since 1972.

Dr. **James A. Powers** is Principal Scientist and Group Leader at Teknekron Research, Inc., in McLean, Virginia. He is principal investigator for a government study, "Evaluation of the Safeguardability of Alternative Fuel Cycles," a project he reported on at the 20th Annual INMM Meeting. Dr. Powers is also Project Manager of several non-safeguards related studies at Teknekron. Prior to joining Teknekron in December 1978, he spent ten years in the AEC/NRC safeguards regulatory program.

Vernon J. Schaubert is Manager of the Nuclear Materials Management Department of the Rockwell International Energy Systems Group, Canoga Park, California. The Energy Systems Group was formerly known as the Atomics Interna-


Owen


Owings


Powers

Schneider

Shipley

Smith

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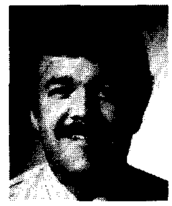


Swindle

Thorpe

tional Division. The firm currently is engaged in research and development of a variety of energy producing systems. Primary SNM activities involve the development and fabrication of fuel assemblies for test reactors and research reactors. Mr. Schaubert became an INMM certified Nuclear Materials Manager in 1968 and has been an INMM member since 1966.

Richard A. Schneider is a Senior Safeguards Specialist with the Exxon Nuclear Company in Richland, Washington. Dick has been active in domestic and international safeguards work since 1957. He has been an active technical contributor to the annual meetings and this Journal. Dick has been a member of the Institute since 1967 and attended the first meeting of the Institute in Columbus, Ohio, in 1960. He submitted his first technical contribution during the pre-Institute days of the annual AEC-Contractors meeting.

Since the 1979 INMM meeting in Albuquerque, to which he commuted daily, Dr. **James P. Shipley** has been appointed Group Leader of the Safeguards Systems Group (Q-4) at Los Alamos Scientific Laboratory. Lately, he and his colleagues have been heavily involved in several aspects of international safeguards, including participation in the IAEA-sponsored International Working Groups on Reprocessing Plant Safeguards and Fuel Element Fabrication. In addition, the Systems Group has just completed a two-volume study of international safeguards for reprocessing and nitrate-to-oxide conversion facilities.

Dr. **Nora G. Smiriga** is Section Leader of the Mathematics and Statistics Section at the Lawrence Livermore Laboratory. Nora has been a member of the INMM since 1978 and she is a member of the Statistics Subcommittee INMM-3. She is one of the principal investigators on NRC-funded projects concerned with the statistical properties of several estimators used in nuclear materials accounting and the use of statistical methods in nuclear materials management.

Dr. **Darryl B. Smith** has been involved in the nuclear safeguards development program at the Los Alamos Scientific Laboratory since 1967. He currently is investigating the potential application of IAEA safeguards at advanced isotope separation facilities. Darryl has been active in the development of ANSI standards since 1973 and is chairman of N15 subcommittee INMM-9 (Nondestructive Assay), and writing groups INMM-9.4 (Measurement Control) and INMM-8.3 (NDA Calibration).

Cecil S. Sonnier completed a 9-month assignment as the ISPO Liaison Officer at the US Mission to the IAEA in Vienna, Austria, in mid-June 1979. Following a short time in the US, including attendance at the 1979 Annual Meeting, Sonnier returned to Vienna for a one-year assignment with the IAEA's Department of Safeguards. Sonnier's responsibilities include a wide range of activities in the field of Containment and Surveillance. New Address: Cecil S. Sonnier, IAEA, P.O. Box 200, A-1400 Vienna, Austria.

Louis A. Sonz is with the Fuel Supply Department of Public Service Electric and Gas Company in New Jersey. He is responsible for the nuclear fuel budgeting and fuel cost work, as well as the nuclear fuel management information system. The latter includes the overview tracking of nuclear fuel materials and costs associated with this utility's six reactors. He has been a member of INMM since 1972 and has attended six of the annual meetings. He has noted that in recent meetings, particularly the one in Albuquerque, utility concerns are being addressed by specific papers and presentations.

David W. Swindle, Jr., is the Safeguards System Design Coordinator for the Oak Ridge National Laboratory Consolidated Fuel Reprocessing Program's Hot Experimental Facility. He has been with Union Carbide Corporation as a member of the Operations Analyses and Planning Division for three years. David's current work involves safeguards design engineering in cooperation with Bechtel National, Inc., and investigating radiation monitors for application in containment and surveillance for reprocessing plants. Other work involves participation on subgroups of the International Working Group on Reprocessing Plant Safeguards.

Munson "Whitey" Thorpe, Department Head of the Nuclear Materials Department at the Los Alamos Scientific Laboratory, enjoyed talking to new and old acquaintances at the registration desk for the Albuquerque meeting.

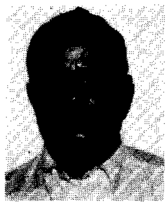
Dr. **Fred H. Tingey,** a long time member of INMM, recently retired from EG&G Idaho to become the Director, University of Idaho Center for Higher Education. The Center provides continuing education opportunities to the INEL site personnel and to the Idaho Falls community. In his new assignment, Dr. Tingey will continue his interest in Safeguards particularly with regard to data systems and their use in generating discrepancy indicators and trigger indices.

Dr. **C. John Umbarger** is with the Health Research Division of the Los Alamos Scientific Laboratory. He was a member of the LASL nuclear safeguards instrumentation development program from 1971 to late 1974, when he transferred to the Health Research Division. He is presently Section Leader of the Instrumentation Development Section in the Health Physics Group at LASL and is responsible for instrumentation development for health physics, environmental monitoring, *in-vivo* measurements, and radioactive waste management. He is also program manager for the LASL waste assay instrumentation development program that spans four technical divisions at Los Alamos (including the Nuclear Safeguards Division) and EG&G Santa Barbara.

Tingey

Umbarger

Waddoups



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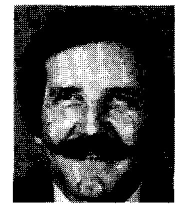


Wheeler

Williams

Ivan G. Waddoups is the Supervisor of the International Safeguards Division at Sandia Laboratories in Albuquerque. He is the Sandia Coordinator of the International Safeguards Project Office's U.S. support program to IAEA safeguards. His group's primary involvement is in containment and surveillance studies and equipment. Other recent involvement includes work in facility safeguard evaluations, malevolent dispersal of nuclear materials and safeguards control and communication systems.

David G. Ward is Executive Engineer with the Licensing Department of the Consulting Division of NUS Corp., Rockville, Md. Mr. Ward is involved in ANSI INMM N15 standards acitivities as a member of the INMM-10 (physical security) writing group. Dave heads up the NUS efforts in prevention of radiological sabotage, physical security, safeguards and nuclear plant licensing.

Russell E. Weber is actively involved in safeguards, materials management, and quality assurance with NUSAC, Inc., McLean, Va., and was one of the INMM's early treasurers and Chairman of the December 1978 INMM Workshop on the Impact of IAEA Safeguards in the U.S. During the 1979 annual meeting, Russ spent his free time promoting Albuquerque to his wife, Phyllis, for the next time he retires. Mr. Weber retired from U.S. DOE in mid-1978.

Mr. George Weisz is the Director of the Office of Safeguards and Security at the U.S. Department of Energy. He is responsible for the direction and conduct of those activities required for assuring adequate protection and response capabilities for DOE operations and other U.S. energy resources of importance to national security. Mr. Weisz became a member of the INMM in 1979 and attended the 20th annual meeting in Albuquerque. Other recent activities include his presentation of a paper entitled "Complementary Aspects of U.S. Domestic Safeguards and IAEA Safeguards" at the first annual European Safeguards Research & Development Association (ESARDA) symposium on safeguards and nuclear material management in Brussels, Belgium, in April. Mr. Weisz also became a member of the American Nuclear Society and the American Society for Industrial Security in 1979.

Larry E. Wheeler is the Accountability Representative at the Oak Ridge Gaseous Diffusion Plant. Larry has been the Accountability Representative for the ORGDP since 1970 and has worked in the Nuclear Accounting field since 1968.

William J. Whitty is an operations analyst with the Nuclear Safeguards Systems Group at the Los Alamos Scientific Laboratory where he specializes in mathematical modeling and statistics. Earlier work at LASL focused primarily on waste management studies and decision analysis. Additional experience includes statistical and mathematical analysis of air pollution data while with the Division of Environmental Engineering and Research, Phelps Dodge Corp., and various systems analysis studies, particularly cost-effectiveness and statistics, with The Dikewood Corp. and the National Bureau of Standards. Mr. Whitty has a B.S. degree in Biological Sciences and Engineering from Drexel University (1960), an M.S. in Systems Engineering from the University of Arizona (1966), and additional work in statistics and operations research. He is a member of the INMM, Institute of Management Sciences, and is an elected Member of the Operations Research Society of America.

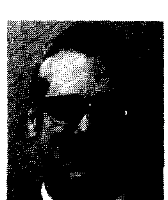
James D. Williams (Ph.D., Electrical Engineering, Purdue University, 1963; B.S. and M.S., Electrical Engineering, Massachusetts Institute of Technology, 1960) is the Supervisor of the Intrusion Detection Systems Technology Division at Sandia Laboratories, Albuquerque, New Mexico. He joined Sandia in 1963 and conducted and supervised research and development of semiconductor devices and integrated circuits before becoming associated with the DOE/SS-sponsored Fixed Facilities Program in 1975. He is a member of INMM.

Floyd Williamson is the Manager of Security at Westinghouse Hanford Company, Richland, Washington. Westinghouse operates the Hanford Engineering Development Laboratory for the Department of Energy. He has completed 20 years as a security professional and is currently involved in a major security systems upgrading program for protection of special nuclear material. His attendance concluded with a post-tour of the Sandia Laboratories to get a firsthand look at their accomplishments and development of sophisticated security systems.

Norman S. Wing is the Manager of the Analytical Laboratory for Exxon Nuclear. This was the first meeting he has attended. The meeting took on special significance because his third grandchild, Angie, was born while he was in attendance. Norm was co-author of the paper presented by **Dick Schneider.**

Dr. **George H. Winslow** joined INMM in 1976 when he transferred to the Special Materials Division from the Chemistry Division of Argonne National Laboratory. At that time he became an Editorial Advisor to the journal, but did not get to an annual meeting until this year, where he first met people he had conversed with by phone. He has been an author, or coauthor, of several papers in the Journal.

Bill N. Yates is with the Safeguards and Technical Security Division of Sandia Laboratories. He is the Nuclear Materials Manager and alternate Nuclear Materials Representative. He has been an INMM member for two years and attended his first annual meeting this year at Albuquerque.



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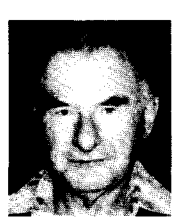

Winslow

Yates

ASSESSMENT OF DOMESTIC SAFEGUARDS FOR LOW-ENRICHED URANIUM

SPECIAL INMM REPORT

AD HOC WRITING GROUP OF THE
SAFEGUARDS COMMITTEE

D. W. WILSON, CHAIRMAN
D. M. BISHOP
R. F. LUMB
G. F. MOLEN
R. E. TSCHIEGG
D. W. ZEFF

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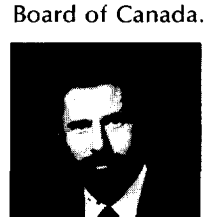
Dr. **H. Thomas Yolken** is Chief of the Office of Measurements for Nuclear Technology at the U.S. National Bureau of Standards where he is currently completing his 20th year. Besides being the start-up manager for the NBS Nuclear Safeguards Program, he is currently reviewing a potential role for NBS on Measurement Standards for Nuclear Waste Management.

Edward R. Young, Director of Safeguards and Security for Rockwell International at the Department of Energy's Rocky Flats Plant, presented an hour-long film concerning anti-nuclear demonstrations at the annual meeting in Albuquerque. Ed has been associated with Rocky Flats for over twenty years and has been a member of the Institute since 1972. Ed's responsibilities not only include nuclear materials accountability, but also physical plant protection, technical security, fire department and utility operations. Ed is currently organizing a new INMM-12 Standards Subcommittee for Site Response Planning.

Clifford W. Zarecki of Atomic Energy of Canada Limited, Whiteshell Nuclear Research Establishment, Pinawa, Manitoba, is the assistant to the coordinator of the Canadian Safeguards program. His main involvement is in helping to implement the "Canadian program of assistance to the IAEA" for the development of safeguards for Canadian CANDU reactors. He has also worked as a reactor Operations Supervisor and as a Scientific Advisor for the Atomic Energy Control Board of Canada.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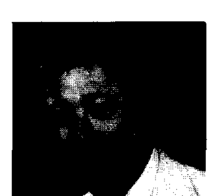

Young


Zarecki

Organization of Office of Safeguards and Security

Director's Office

This Office is responsible for the direction and conduct of those activities necessary to assure adequate protection and response capabilities for DOE and U. S. energy resources. Included are operations involving DOE nuclear weapons and associated materials and facilities, nuclear and non-nuclear energy-related operations, classified information and valuable government property. In addition, the Office is responsible for providing full safeguards technical support to the U. S. non-proliferation efforts. Activities are designed to: (1) gain a comprehensive understanding of the characteristics and intentions of potential adversaries; (2) identify vulnerabilities within facilities and operations, and the possible consequences if these vulnerabilities are exploited by an adversary; (3) translate the understanding of potential risks posed by potential adversaries into programs, policies, standards, requirements, guidelines, etc., which, when implemented at Headquarters and in the field, will reduce the risks to low, acceptable levels; (4) maintain contingency plans, response capabilities, and an operations center to effectively respond to incidents or emergencies, including assumption, when appropriate, of the directorship of Emergency Action and Coordination Team (EACT); plan and conduct exercises, games, etc., to verify and improve the DOE response capabilities; (5) conduct a research and development program to assist in the design, implementation, and operation of effective safeguards and security components and systems, including liaison and support to the private sector, NRC, IAEA, and the international community; (6) conduct a security program to insure high personnel reliability, effective Headquarters security, adequate protection of classified information, proper control of visitors to DOE operations, operational security, and related activities; (7) maintain the necessary liaison with the NRC, FBI, and DOD, as well as the appropriate Federal, state, and local governments and private industry to effectively coordinate on safeguards and security issues; and (8) maintain an information capability which interacts with relevant components, including the intelligence community to acquire timely information necessary to proper threat characterization, incident response, and non-proliferation initiatives, and concomitantly channels OSS requirements to the appropriate organizations.

Management Support Staff

This Branch is responsible for the budget formulation, presentation, and execution activities for the Office of Safeguards and Security (OSS). This includes the direct funded programs (the Nuclear Materials Security and Safeguards, and the Security Investigations Programs), the "Technical Assistance to the International Atomic Energy Agency," which is primarily a reimbursable work program, and the financial management aspects of the DOE-wide Safeguards Crosscut Program. Also included in this Branch are the administrativeactivities including personnel, staffing, travel, time and attendance, space management, centralized mail and files, graphic arts, training, management and manpower studies, and similar services.

DIVISION OF POLICY AND ANALYSIS

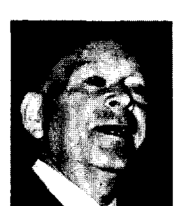
This Division consists of the following Branches:

Threat and Risk Analysis Branch.
Program Development and Requirements Branch.
External Coordination Branch

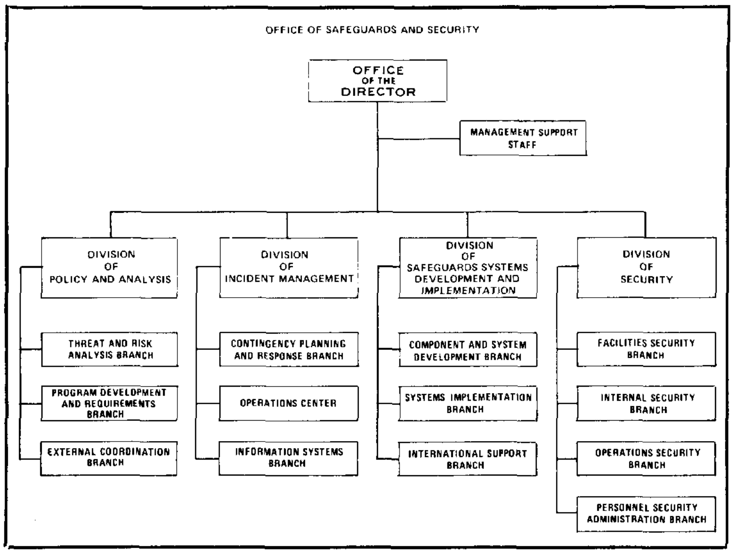
It is responsible for the conduct of those activities necessary to: (1) gain a comprehensive understanding of potential adversaries to DOE resources; (2) determine the vulnerabilities to and consequences of adversarial actions against these resources with national security significance; (3) identify the extent of risks to U. S. national security and public security and well-being arising from the potential successful exploitation of these vulnerabilities; (4) work with other appropriate government and non-government organizations to agree upon cooperation and the split of responsibilities in assuring adequate resource protection and incident response; and (5) prepare and issue programs, policies, guidelines, standards, requirements, etc., within the responsibilities and authorities as identified above which, when implemented, will result in acceptable residual risks.

Threat and Risk Analysis Branch

This Branch is responsible for conducting those activities necessary to the timely understanding of the



George Weisz
Director, DOE-OSS



characteristics of potential adversaries to DOE energy and national security resources, and for packaging that information in ways that allow for: effective programs, policies, and standards to be made; adequate and appropriate deterrence, protection, and response systems to be implemented and evaluated; and proper inspections and assessments of security system adequacy to be carried out. This Branch is also responsible for the determination of potential risks to national security and public well-being which might arise due to actions by criminal adversaries against DOE resources. This would include activities to determine the vulnerabilities and the potential consequences to national security or energy adequacy should such vulnerabilities be exploited by an adversary.

Program Development and Requirements Branch

It is the primary responsibility of this Branch to conduct the planning necessary for managing the overall safeguards and security program, coordinate the preparation of office planning documents, and formulate and disseminate policy and guidance in the form of Orders, requirements, standards, etc., which, when implemented, result in satisfactory protection of resources against potential malevolent activities.

External Coordination Branch

This Branch is responsible for establishing and maintaining effective liaison between the Office and those other organizations with whom the Office requires continuing effective communication. Liaison and maintaining clear communication and understanding with the FBI, DOD, DOS, etc., are primary responsibilities of this Branch, as well as continuing coordination with other responsible DOE Offices. A primary purpose is to insure adequate liaison with information organizations, including the intelligence community so that Office requirements are formulated and communicated as necessary, and that intelligence information necessary to ensure effective threat characterization, emergency response, and non-proliferation initiatives are received and disseminated in a timely manner. Also important are effective, responsive interactions with cognizant Congressional committees and members, the media, and, as appropriate, private industry, and the public so that there is broad understanding and support for the program which is of particular importance in times of incidents or crises.

DIVISION OF INCIDENT MANAGEMENT

This Division consists of the following Branches:

Contingency Planning and Response Branch.
Operations Center Branch.
Information Systems Branch.

It is responsible for assuring that DOE is adequately prepared to effectively respond to nuclear-related incidents or emergencies, including those affecting DOE resources. Included are: (1) the management, maintenance, and operation of the DOE Operations Center (including support to EACT during response to an incident or exercise); (2) the preparation and maintenance of contingency plans which delineate responsibilities and actions to be taken in the event of an incident, including coordination and understanding with other organizations and agencies; (3) the maintenance, improvement, and expansion of response resources, such as the Nuclear Emergency Search Team (NEST); (4) the planning, preparation, and conduct of exercises and tests to gain experience in responding to incidents, verify the adequacy of capabilities, and identify areas of needed improvement; and (5) real-time liaison with the FBI and other agencies in the event of a potential, anticipated, or ongoing incident.

Contingency Planning and Response Branch

This Branch is responsible for preparing and disseminating those contingency plans necessary so that in the event a nuclear-related incident or emergency occurs, the appropriate individuals and organizations are fully aware of their responsibilities. Included shall be the regular conduct of tests and exercises designed to acquaint decision-makers with the range of incidents that they may have to cope with. The Branch will identify and modify contingency plans or response capabilities to increase our capabilities to respond in case of emergency. This Branch is also responsible for assuring that existing emergency response capabilities are adequate and prepared in the event of a contingency for which they are required. Included, for example, is the management of the NEST capability to enable us to most effectively respond to nuclear-related incidents.

Operations Center Branch

This Branch is responsible for identifying operations, maintaining all the communications equipment systems and backup support necessary for DOE to be able to effectively carry out its responsibilities to anticipate and respond to incidents and potential emergency situations, and for establishing the necessary procedures and links to assure rapid, secure communications with other response individuals and organizations, as required.

Information Systems Branch

This Branch is responsible for the management and oversight of the information policies, procedures, and systems necessary for the maintenance of inventory-related information of safeguards relevance. Primary responsibility is for the direction of the Nuclear Material Management and Safeguards System (NMMSS).

Component and System Development Branch
Systems Implementation Branch.
International Support Branch.

It is responsible for activities to support development, implementation, and operation of effective safeguards and security systems. Included are activities to: (1) test, evaluate, and develop (when necessary) components and subsystems which may form part of safeguards and security systems; (2) work to support DOE programs and, as appropriate, private industry in the development, implementation, and operation of effective systems; (3) develop, refine and apply techniques to evaluate and verify the effectiveness of various systems, with the particular objective of analyzing the relative advantages and disadvantages of candidate systems for protection in terms of effectiveness, cost, operational impact, reliability, etc.; and (4) participate in the U.S. non-proliferation initiatives in the international context through technical and analytical support to the IAEA safeguards function, by the development of safeguards components and systems which minimize proliferation potential (in cooperation with other DOE and government elements), as well as by enhancing IAEA inspection effectiveness, and through bilateral and multi-lateral technical exchanges with other countries charged with the responsibilities of protection of nuclear resources.

Component and System Development Branch

This Branch will be responsible for the development and evaluation of components to be used in the safeguarding and protection of vital resources. Included will be components for physical protection, as well as nuclear material control and accountability. These components are then used in the design, development, test, and evaluation of safeguards and security systems. Systems will be designed to increase the effectiveness of existing DOE facilities (both nuclear and non-nuclear) to assist in the incorporation of effective security systems into new DOE facilities, to prepare representative designs of effective safeguards and security systems for potential commercial nuclear facilities, and to support U. S. non-proliferation initiatives. These designs will be closely coordinated with the DOE program managers who are primarily responsible for the systems being secured.

Systems Implementation Branch

This Branch is responsible for the implementation of developed safeguards and security systems and technology into DOE programs and operations, and, where appropriate, to private industry. The Branch will evaluate the effectiveness of safeguards and security systems at DOE facilities to determine the increased safeguards benefits to be derived from the application of candidate systems for protection, considering effectiveness, cost, operational impact, reliability, maintainability, etc. Implementation will be closely coordinated, on a continuing basis, with DOE program managers and Safeguards and Security Directors at Headquarters, Field Offices, and contractor levels. Cost effectiveness evaluations will be performed on safeguards and security upgrading measures of systems identified in annual budget projections for the various DOE programs. The Branch will be responsible for performing periodic appraisals of the safeguards and security systems at DOE facilities.

International Support Branch

This Branch is responsible for research, development and design activities to support the international nuclear community, and in particular, the IAEA. The Branch will coordinate the International Safeguards Project Office (ISPO) activities which provide technical support to the IAEA in order that their inspections may be of maximum effectiveness. This Branch will conduct bilateral and multi-lateral exchanges of information with other nuclear nations, and support U. S. non-proliferation initiatives. They will also provide technical input to policy-related issues being considered with regard to non-proliferation, and will conduct programs to provide timely and responsive input into international activities to maximize non-proliferation, such as follow-on efforts to the International Nuclear Fuel Cycle Evaluation Program (INFCE).

DIVISION OF SECURITY

The Division of Security consists of the following Branches:

Facilities Security Branch
Internal Security Branch
Operations Security Branch
Personnel Security Administration Branch

It is responsible for setting DOE-wide policy and for exercising oversight responsibilities in matters associated with the security of classified information, work, or materials, and in the protection of facilities and

(Continued on Page 91)

INMM Expertise Recognized by U.S. Senate

By D. M. Bishop
INMM Executive Committee
San Jose, California

The continued maturity and worldwide recognition of the Institute of Nuclear Materials Management has taken giant strides forward during the past several years. One example of this progress was the recent input provided by Institute Chairman **Bob Keepin** to the U.S. Senator **Claiborne Pell,** Chairman of the Subcommittee on Arms Control, Ocean, International Operations and Environment (see INMM Journal, Vol. VIII, No. 3, Fall 1979, pp. 44-49). The subject of the input was the US-IAEA Safeguards Agreement currently pending advice and consent to ratification by the United States Senate.


Keepin


Church

A second and equally significant contribution was recently made to U.S. Senator **Frank Church,** Chairman of the Committee on Foreign Relations. The subject of this input was the US/Australian Agreement on Nuclear Cooperation which President Carter submitted to the Senate on July 27, 1979. This agreement represents the first of the nuclear agreements to be negotiated pursuant to the Nuclear Non-Proliferation Act of 1978. The text of Dr. Keepin's letter is provided below. Inputs were provided by members of the INMM Executive Committee and several individual members.

The INMM can be proud of the timeliness and quality of contributions that it is making to national and international nuclear policy in the safeguards area. Inputs of this type personify the Institute's goals of **professionalism** and **communication** as the nuclear option moves into the 1980's. INMM members who would like to get more involved in such important and expanding activities should contact any officer or member of the INMM Executive Committee.

FRANK CHURCH, IDAHO CHAIRMAN

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WILLIAM B. BADER, STAFF DIRECTOR

United States Senate
COMMITTEE ON FOREIGN RELATIONS
WASHINGTON, D.C. 20510

September 6, 1979

Dr. Robert Keepin, Chairman
Institute for Nuclear Materials Management
c/o Nuclear Safeguards Program
Los Alamos Scientific Laboratories
Los Alamos, New Mexico 87545

Dear Dr. Keepin:

As Chairman of the Committee on Foreign Relations, I am writing you about the U.S.-Australian Agreement on Nuclear Cooperation, which the President submitted to this Committee on July 27. As you know, this agreement is the first of the nuclear cooperation agreements to be negotiated pursuant to the Nuclear Non-Proliferation Act of 1978. The Committee, under Section 401 of the Act, is authorized to consider the adequacy of the U.S.-Australian agreement and to recommend approval or rejection of it.

In this regard, I invite your organization to offer comment or opinion on the proposed agreement. There is a time constraint on the Committee's consideration of this agreement, so I would ask that you send your written comments to the Committee by September 27.

Should you have any questions regarding the agreement, please contact Committee staff member Eric Newsom, at 202/224-4651.

Sincerely,

Frank Church

Frank Church
Chairman

OFFICE OF THE CHAIRMAN
G. Robert Keepin
Nuclear Safeguards Program Director
Los Alamos Scientific Laboratory
Los Alamos, New Mexico 87545
Phone: 505 667-4018

INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT

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October 5, 1979

The Honorable Frank Church
Chairman, Committee on Foreign Relations
United States Senate
Room 245, Russell Building
Washington, DC 20510

Dear Senator Church:

Thank you for your letter of September 6 inviting comment from the Institute of Nuclear Materials Management on the U.S.-Australian Agreement on Peaceful Uses of Nuclear Energy, currently under consideration by the Senate Committee on Foreign Relations, and pending advice and consent to ratification by the U. S. Senate. Your staff has very kindly provided, upon my request, a copy of the proposed agreement to members of the INMM Executive Committee. Pursuant to our review and assessment of the Agreement, the following comments and observations are offered.

Despite significant concerns and reservations about practical implementation, commercial impact, and precedents that might be established by the agreement, the Executive Committee of the INMM, on balance, unanimously supports the U.S.-Australian Agreement as a necessary step toward achieving effective international safeguards and nonproliferation goals. Some of the more frequently expressed concerns and reservations are summarized below. Not surprisingly, a major concern of many in the INMM is the possible negative impact that the stringent provisions of the proposed Agreement may have on the U.S. nuclear industry's posture as a reliable nuclear supplier in an increasingly competitive world market. Many industry people are well aware of the importance of strong national safeguards systems as essential components of an effective overall international safeguards regime, but they are also quick to point out the need for implementation of more uniform and equitable safeguards standards among all nations -- both suppliers and recipient nations alike. Such standardization would help alleviate industry concerns about safeguards inequities while also contributing to the overall effectiveness of the IAEA's mandated function of independent inspection and verification.

The concept of "proportionality," set forth under the "Coverage of the Agreement" section of the Agreed Minute, has elicited a spectrum of opinion ranging from significant support for the proportionality approach to the suggestion that it be essentially replaced with a stipulation that IAEA safeguards be applied to all special nuclear material produced from materials or equipment supplied by others, when used in conjunction with U.S. supplied materials. Due to its reciprocal nature the U.S.-Australian agreement covers not only U.S. exports but also imports, so the principle of proportionality clearly applies, e.g., to Australian uranium undergoing enrichment in the U.S. whether intended for U.S. domestic or foreign use. In this connection it has been pointed out that potential problems could arise in the interpretation of "coverage of the agreement" in terms of lingering "contamination" in U.S. process facilities, e.g., very small amounts of Australian feed material that may remain from previous enrichment runs. In actual practice such problems (and hypothetics) could perhaps be avoided if some deminimus quantity of foreign-origin material could be established below which formal coverage under the agreement ceases.

Other expressed concerns have included certain details of implementation (e.g., selection of facilities for IAEA inspection, and specific reporting requirements), the expense and some degree of intrusion into plant operations that inspection and verification must inevitably involve.

Another indicated concern involves the potential restrictions that certain reciprocity provisions of the proposed agreement could place on future U.S. policy options regarding fuel cycle alternatives, particularly with respect to the back end of the LWR fuel cycle. Some apprehension was also expressed that the actual implementation of Articles 5, 6 and 10, requiring approval of each country involved in a series of successive transfers of nuclear materials (e.g., from fabrication to reactor to reprocessing to refabrication -- each process occurring in a different country) could in practice result in such a bureaucratic morass as to completely bog down the peaceful uses of nuclear energy.

Also in this connection it has been pointed out that the principle of fungibility (replacement with material of like kind) has been largely ignored in the formulation of the agreement. If this is intentional, the rationale for so doing should be clarified; if unintentional, the matter should probably be addressed briefly.

From the standpoint of some safeguards specialists, the subject agreement appears quite general and even vague on certain practical aspects of implementation, and it has been suggested that this be appropriately factored into future negotiations of new or amended agreements with other countries.

It has been suggested that the Committee on Foreign Relations should obtain assurances from DOE that the periodic review of physical security measures (cf. Article 7, paragraph 3) can be accomplished without compromising sensitive technology or information related to national security (NB in applicable enrichment facilities).

Finally, I would like to address the interaction, as many in the Institute view it, between the subject U.S.-Australian Agreement, and the proposed safeguards agreement between the U.S. and the International Atomic Energy Agency (IAEA). As you may be aware, in my letter of July 20 to Senator Claiborne Pell, I have already provided INMM commentary and input on the draft U.S.-IAEA agreement. The proposed agreement for cooperation with Australia in effect requires that the U.S.-IAEA agreement be brought into force before any uranium can be exported from Australia to the U.S. under new or recent contracts. Such a provision, we believe, is extremely important to the future energy outlook for the United States, and other countries as well.

As you know, the U.S. has been the principal source of U-235 enrichment services for both U.S. and foreign utilities, and plans to further increase its enrichment capacity. However, it also appears clear that other nations (e.g., in Western Europe, and the Soviet Union) will be providing an increasing share of needed enrichment services for the most common types of nuclear power reactors. Implementation of the proposed agreement with Australia will not, by itself, permit the U.S. to enrich Australian uranium purchased by U.S. or foreign utilities under new or recent contracts. In order for the U.S. to maintain that option, which is important to our balance of trade, as well as national energy needs and foreign policy objectives, the U.S.-IAEA safeguards agreement must also be ratified and implemented. Otherwise, the principal benefit to the U.S. of the proposed agreement with Australia would not be realized.

Ratification of the U.S.-IAEA safeguards agreement must, of course, stand on its own (worthy) merits, but we in the INMM also believe that practical considerations such as those just cited provide additional compelling reasons for giving favorable consideration to both of these important agreements now pending before the U.S. Senate.

As further indication of the broad spectrum of opinion in the U.S. technical and industrial community on the issues of nonproliferation, safeguards and international nuclear trade, I am taking the liberty of enclosing herewith copies of individual letters of response I have received to date from INMM officials and members. Others will be forwarded when and as they are received. Please let me know if the Institute can be of further service in this matter.

Very cordially yours,

G. Robert Keepin

G. Robert Keepin, Chairman
Institute of Nuclear Materials Management

GRK:ldc

New Home for National Nuclear Corporation

Compiled by Thomas A. Gerdis, Editor
Nuclear Materials Management
Journal of INMM
Louisville, Kentucky

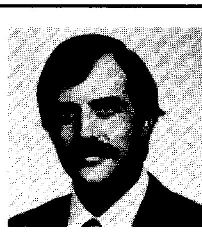
National Nuclear Corp., Redwood City, Calif., has a new building and a new phone number (415-962-9220). Several NNC professional staff members are active members of INMM led by **Herman Miller,** Chairman of the Board, who heads the INMM Standing Committee on Public Information and who will serve as Local Arrangements Chairman for the 1981 INMM Annual Meeting in San Francisco.

Dr. **Garth W. Redfield** is a new Senior Ecologist in the newly-created Environmental Assessments Division of NUSAC, Inc., McLean, VA. NUSAC is a consulting firm providing expertise in many specialities, primarily within the nuclear power industry. Its recently-created Environmental Assessments Division offers a wide range of services for government and industry on environmental concerns. Dr. Redfield comes to NUSAC from the University of California at Davis, where he conducted research as a Postdoctoral Research Associate on the ecology of inland waters. He is a specialist in the analysis of environmental impacts of reservoir formation and in the diagnosis of nutrient contaminations in freshwater systems.

Researchers from the Oak Ridge National Laboratory, Battelle Pacific Northwest Laboratories and Pennsylvania State University joined forces in December in northwest Georgia to conduct a three-week field study of the possible effects of power plant cooling tower and smokestack emissions on local weather and water quality. The study began December 3 in the area of the Georgia Power Company's 320-megawatt, coal-fired Bowen Electric Generating Plant — known locally as Plant Bowen — about 40 miles northwest of Atlanta. The plant was selected for the study because of its large natural-draft cooling towers.

Nuclear News (Nov. 79, pp. 158, 160) reports that "Edlow International Company has effected some changes in its corporate management. **Samuel Edlow,** founder of the company, has retired as President, but will continue as Chairman of the Board. **Jack Edlow,** who has been Vice President since 1970, will take over as President. He is succeeded as Vice President by **Diane Wright Harmon,** formerly Assistant to the Vice President."


Gerdis


Redfield


Samors

Two safeguards professionals at Brookhaven National Laboratory — **Tony Fainberg** and **Dick Fuller** — are organizing a local chapter of OXFAM, a private, non-political British-based famine relief organization with American and other affiliates. Fainberg and Fuller are working to help the two million facing starvation in Cambodia. "At this writing, the only organization which is succeeding in bringing large quantities of food, seeds, bowls and pots to the interior of Cambodia is OXFAM," they indicated in a letter to the editor which appeared in the November 16, 1979, issue of the **Brookhaven Bulletin.**

John L. Jaech of EXXON Nuclear in Richland has a very enterprising son, Jeff. **Jeff Jaech** has developed a tee shirt with the words "More Nukes, Less Kooks," each hand silk-screened in four colors. Jeff is looking for more information, encouragement and advice, orders for his product, and "whatever." If this is something that strikes your fancy and you wish to pursue it further, you can contact Jeff at 4969 North Backer Avenue, Apt. No. 252, Fresno, CA 93726. His phone number: 209-292-4137 (Home) and 209-442-0550 (Work).

Harvard Professor Dr. **Brian J. L. Berry** has been elected to the Board of Directors of NUSAC, Inc., McLean, VA. The election of Dr. Berry reflects the increasingly diverse activities of the company, according to NUSAC President Dr. **Ralph F. Lumb.** Dr. Berry is Williams Professor of City and Regional Planning at Harvard. He is also Professor of Sociology and Director of the University's Laboratory for Computer and Spatial Analysis. TWC President **George R. Wackenhut** is Chairman of NUSAC's Board. Besides Dr. Lumb, the other members are Dr. **Myron S. Malkin,** Director of NASA's Space Shuttle Program, and **Robert E. Miller,** Executive Vice President of Resources Science Corporation. Dr. Berry is a native of England who obtained his doctorate in geography from the University of Washington. From 1961 to 1976 he was a professor of geography at the University of Chicago. Since 1976 he has been at Harvard University. During 1978-1979 he was President of the Association of American Geographers, and in 1975 he was elected to the National Academy of Sciences.

My thanks to **Dennis M. Bishop** of GE-San Jose for the following items emanating from the Nuclear Energy Group of GE at San Jose:

Letter to the Editor

Past Chairman Expresses Thanks For Service Award

September 11, 1979

Mr. Thomas A. Gerdis
Editor, INMM Journal
P.O. Box 6247
Louisville, KY 40207

Dear Tom:

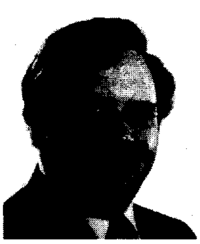
Please relay my sincere thanks and appreciation to the INMM for the Special Service Award presented to me in Albuquerque during the annual meeting.

To have been a part of the growth of the Institute from a small, active group to a significant international organization over the past few years has been a most gratifying personal experience. It would be extremely difficult to find another group of such pleasant associates with such a high level of both capability and dedication as those in INMM.

I look forward to a continued active association with the Institute.

Sincerely,

Roy G. Cardwell
Lenoir City, Tennessee



Cardwell

Disposal Of Hazardous Wastes

It is possible to control and dispose of hazardous wastes safely, and the Chemical Manufacturers Association is bringing together consultants from the chemical industry to share their expertise in this vital area through a series of six regional seminars. Left on schedule are seminars Mar. 3-4, San Francisco, and Mar. 6-7, Houston.

Plant managers and engineers, technical operating staff members, environmental professionals, and federal and state and local government personnel in this field will hear, during the two-day sessions, technical experts discuss how to evaluate existing landfills, investigate and manage inactive sites, bring existing landfills and surface impoundments into regulatory compliance, and incinerate hazardous wastes.

Registration fee for the seminars is $150. For further information and registration forms, contact Judie Lichtenberg, c/o Information Transfer Inc., 9300 Columbia Blvd., Silver Spring, MD 20910, (301) 587-9390.

MUF, Or Inventory Differences

The Department of Energy (DOE) has issued its fourth semiannual report on strategic special nuclear material inventory differences in its facilities for the period of April 1, 1978, through September 30, 1978.

All ID reports are available at DOE reading rooms in Washington, D.C., and the offices of the DOE Regional Representatives in the following cities: Boston, Mass.; New York, N.Y.; Philadelphia, Pa.; Atlanta, Ga.; Chicago, Ill.; Dallas, Tex.; Kansas City, Mo.; Denver, Colo.; San Francisco, Cal.; and Seattle, Wash. The reports are also at DOE Operations Offices at: Albuquerque, N.M.; Argonne, Ill.; Idaho Falls, Id.; Las Vegas, Nev.; Oak Ridge, Tenn; Richland, Wash.; Oakland, Cal.; and Aiken, S.C.

Copies of the new report may be purchased for $4.50 for a printed copy or $3.00 for microfiche from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia, 22161.

A multi-million dollar nuclear services training facility that will help further improve the performance of power plants equipped with GE boiling water reactors (BWRs) is being built in San Jose at the headquarters for GE's nuclear power plant business. The new BWR Services Facility will provide nuclear technicians and field service engineers with "real-life" conditions for hands-on training in refueling and maintenance procedures for the growing number of BWR nuclear plants in the U.S. and elsewhere in the world.

General Electric's Nuclear Energy Group also reports record orders in 1978 for fabrication of nuclear reload fuel, "fresh" fuel for nuclear plants presently in operation. Reload fuel orders in 1978 were balanced between domestic and international business. Of the $320 million total, $190 million, or about 60 per cent of the reload fuel orders, were placed by utilities operating nuclear power plants in the U.S. Some $130 million, or about 40 per cent of the orders were placed by utilities in Europe and the Far East.

NUSAC, Inc., McLean, Va., has announced the appointment of **Patricia W. Samors** as a Senior Technical Associate in the firm's Environmental Assessments Division. She is a graduate of Brown University and served as a research assistant in the International Affairs Division of the U.S. Treasury Department. The NUSAC division specializes in developing and preparing environmental impact statements for federal agencies and private industry.

Titles and Abstracts Of Recent Safeguards R & D Publications and Reports From New Brunswick Laboratory

Editor's Note: This is the tenth in a series of listings of titles and abstracts of recent safeguards R&D publications and reports from agencies and R&D laboratories. It has been complied by Dr. **Carleton D. Bingham** and colleagues at the New Brunswick Laboratory, Argonne, Illinois. We hope to have another listing in the Spring Issue (Deadline: March 1, 1980). If your agency or R&D laboratory is interested in being included in this series, please contact the editors, **William A. Higinbotham** (516-345-2908) at Brookhaven National Laboratory, or **Thomas A. Gerdis** (502-895-3953) at the INMM Publications Office, P.O. Box 6247, Louisville, KY 40207.

The following titles and abstracts have been taken from DOE Report NBL-292, "Progress Report for the Period October 1977 Through September 1978," October 1979.

An Improved Technique for Correcting Pulse Pile-up in Gamma-Ray Measurements, Richard C. Hagenauer.

Abstract

The report describes a technique for obtaining corrections for pulse pile-up to be applied to observed peak areas using passive gamma-ray spectrometry to measure U-235. The technique involves observing a change in an observed spectral peak area as a function of count rate at the detector. A calibration curve may be constructed from which pile-up corrections can be read for a given sample count-rate. Experimental data are presented which show an improvement in measurement precision of approximately 0.2% relative to the conventional use of ^{57}Co.

Evaluation of Two Weight Titration Techniques Using the NBL Titrimetric Method for Uranium, Linda H. Collins and A. Creig Zook.

Abstract

In the sample range of 50- to 150-mg uranium, and analyst can achieve precisions (i.e., reproducibility) of the order of 0.08 to 0.10% (RSD), using volumetric measurements of $K_2Cr_2O_7$ titrant in teh NBL method. Using conventional glass burets, over a 15-day period, analysts were able to achieve precisions (i.e., reproducibility) of 0.04 to 0.05% (RSD). A similar improvement was observed when using plastic "squeeze" wash bottles. Plastic "squeeze" burets are inexpensive, unbreakable, convenient to clean and handle and have a more favorable capacity-to-mass ratio compared to glass burets. Because of improved precision, with no loss of accuracy, resulting from weight titrations, all manual (i.e., non-automated) titrations at NBL are now performed by weight.

An Evalution of the NBL Automated Gravimetric Titrator Under Laboratory Operating Conditions, Bruce W. Moran

Abstract

An automated titrator which measures and records the mass of standarized $K_2Cr_2O_7$ required to titrate uranium using the NBL titrimetric method is capable of analyzing seven samples per hour. The following levels of precision were observed under routine sample analysis conditions: (1) with 50-150 mg U range, 0.07% RSD; (2) with the 15-50 mg U range, 0.08% RSD, and; (3) with the 5-15 mg U range, 0.14% RSD. Values obtained for a wide variety of safeguards samples agreed to within 0.1% of the results concurrently observed using manual titrations. A complete test and evaluation report is in preparation.

The AUTOSEP and AUTOCOULOMETRY Systems for Plutonium Assay, Brian P. Freeman, C. Scott Reynolds, Michael K. Holland, Joseph G. Servis, Thomas L. Frazzini, Jon R. Weiss, and Charles E. Pietri.

Abstract

An automated mini-anion-exchange purification system (AUTOSEP) and an automated controlled-potential coulometry system (AUTOCOULOMETRY) have been upgraded and evaluated since the previous progress report. In-box tests of the AUTOSEP system revealed plutonium recoveries of $100.03 \pm 0.08\%$. Coulometric measurements by AUTOCOULOMETRY on solutions prepared from NBS SRM 944 resulted in values of $100.03 \pm 0.08\%$ of the assigned value.

A Digital Voltage-to-Frequency Integrator for Controlled-Potential Coulometry — A Progress Report, Thomas L. Frazzini, Michael K. Holland, Jon R. Weiss, and Charles E. Pietri.

Abstract

A digital integrator has been designed to obviate the procedural and mathematical corrections required to compensate for biases in analog integrators. Initial testing and evaluation indicate accurate and precise integration of current during controlled-potential

coulometric measurements of plutonium. A detailed test and evaluation report will be published.

Investigation of Methods for the Precise Assay of Thorium, C. R. Balulescu, Wanda G. Mitchell, and Kenneith Lewis.

Abstract

A comparison was made of published methods for determining thorium including gravimetry, titrimetry, and coulometry. A variety of visual and potentiometric end point detection methods using EDTA as a titrant were examined. Several methods for standardizing EDTA were investigated. Comparative data are presented.

Preparation of Prototype NDA Standards for an Interlaboratory Comparison Program, Anna M. Voeks.

Abstract

Materials, selected to represent matrices from scrap or waste streams within the nuclear fuel cycle, are being prepared to evaluate the technical feasibility of centrally prepared, non facility-specific reference materials by which to calibrate NDA systems. The materials, characterized for chemical and physical properties, will be packaged and circulated for comparative NDA measurements to participating laboratories. An evaluation report will be published at the completion of the comparative measurement phase.

Preparation and Certification of U_3O_8 for Uranium and Impurity Contents, Richard D. Peavy

Abstracts

A lot of uranium oxied (U_3O_8) of natural enrichment has been prepared and certified for uranium, isotopic and impurity content. The material is of high purity and has previously been used as the base matrix for the NBL 98 series. Ceritfied values ($99.928 \pm 0.005\%$ U_3O_8) were derived from measurements performed concurrently on the proposed RM samples and NBS chemical and isotopic SRMs. Impurity elements (Al, Cr, Fe, Mn, Ni, P, Si—in the range 1-15 ug/g) were measured using atomic absorption spectrometry, emission spectrography and spectrophotometry. This material is available from NBL as NBL RM #114.

Recertification of HTGR Fuel Bead Materials, Richard D. Peavy.

Abstracts

Two types of HTGR fuel materials, previously analyzed for uranium and thorium content in a 1974 interlaboratory comparison program, have been certified for use as reference materials. BISO and TRISO bead lots were subsampled and assayed concurrently with chemical and isotopic standards. The NBL values agreed within 0.02% and 0.06% respectively, for the pooled mean values on BISO and TRISO beads obtained in the 1974 comparison program.

Technical Books

Technical Books and Monographs, a bibliography of books and monographs sponsored by the U. S. Department of Energy (DOE) and by the organizations brought together to form DOE, is published to help meet the information needs of scientists and engineers working in energy-related fields. This catalog provides access to a large body of knowledge generated by many programs — programs as diverse as the field of nuclear medicine, the exploration of physical mechanisms at work in the environment, and the varied technologies required to realize the potential of the country's energy sources.

Technical Books and Monographs provides a brief descriptive statement, lists or describes the contents for the most recent publications, and indicates the availability. The more than 560 publications are grouped under the following subject categories: general reference, biology and medicine, chemistry, computers and mathematics, energy, engineering and instrumentation, environment, health and safety, isotope separation, metallurgy and materials, physics, reactors, and vacuum technology. Included in the catalog are the titles from monograph series prepared in cooperation with the American Chemical Society, American Industrial Hygiene Association, American Institute of Biological Sciences, American Nuclear Society, and American Society for Metals. In addition to the technical books and monographs, separate sections at the end of each subject category list approximately 270 recent symposium proceedings and recent bibliographies. Author, series, and title indexes are provided.

Technical Books and Monographs is available as DOE/TIC-4582-R14 for $3.75 from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

Revisions of this catalog will be published every two or three years. Supplements listing only new titles will be published periodically and will be available free from the Technical Information Center, U. S. Department of Energy, P.O. Box 62, Oak Ridge, TN 37830.

Gossick Resigns

Lee V. Gossick, who was Executive Director for Operations of the Nuclear Regulatory Commission since the agency was created in 1975, submitted his resignation, to be effective no later than February 1, 1980.

In his letter, Mr. Gossick said, "I recognize that there are many pressing demands that the Commission must meet in the coming months, and that some time will be required for the Commission to clearly define the relationships between the Commission, the Executive Director for Operations, and the major program office directors—a step that I believe to be absolutely necessary before selecting my successor . . . It has been gratifying to have served the Commission and the staff and to have taken part in responding to the continuing challenges that have been with the NRC since its establishment in January 1975 . . ."

Some Safeguards Approaches And Evaluation Methods

By J. P. Shipley
Safeguards Systems Group, Q-4
Los Alamos Scientific Laboratory
Los Alamos, New Mexico

ABSTRACT

Some of the safeguards approaches and methods for systems evaluation currently being developed in the U.S. are summarized. The material is presented with a view toward safeguards for reprocessing plants, which is of increasing interest to the international safeguards community. Possible directions for future efforts are discussed.

I. INTRODUCTION

Large, high-throughput nuclear facilities of the future, particularly spent-fuel reprocessing plants having capacities of the order of 1500 tonnes per year of heavy metal, will require extensions of current technology, and development of new technology, to provide effective safeguards systems, both national and international. A fundamental part of this process is the determination of safeguards systems effectiveness, which is essential to every step of the design and implementation sequence.

In recognition of the importance of these activities, the International Atomic Energy Agency (IAEA) is sponsoring the International Working Group on Reprocessing Plant Safeguards (IWG-RPS). Subgroup 4 of the IWG-RPS deals with safeguards approaches and evaluation methods. The first task of Subgroup 4 was to survey the status of this topic in the participating countries, including the U.K., France, Japan, Italy, THE Federal Republic of Germany, and the U. S. This paper is excerpted from the U.S. contribution to the IWG-RPS/Subgroup 4 and summarizes information of interest to that group, such as technical safeguards measures, evaluation methods, and future efforts.

II. TECHNICAL SAFEGUARDS MEASURES

An effective international safeguards system requires the use of both materials accounting and containment and surveillance to provide detection of nuclear materials diversion. Improved safeguards depend on a coherent, balanced application of the techniques, both to the individual nuclear facility and to the entire fuel cycle.

Materials accounting draws balances about the nuclear material to indicate how much, if any, might be missing. In containment and surveillance, a containment is established around the normal process streams, and surveillance measures are applied to detect any abnormal movement of material through the containment and to detect activities that might lead to such abnormal movement. Materials accounting confirms the effectiveness of containment and surveillance, whereas containment and surveillance protect the materials measurement and accounting system. Thus, these measures are complementary.

The key importance of materials accounting stems from its ability to quantify the diversion and its significance and from its ability to provide continuity of knowledge about the state of nuclear material, both in time and in location within the nuclear fuel cycle. By nature, however, materials measurements have uncertainties. Containment and surveillance provide additional capability in that, by looking for any abnormal movement of material, they attempt to detect anomalies indicating diversion that could be hidden within the error structure of the materials measurement system. Furthermore, containment and surveillance provide an independent means for detecting possible indications of diversion on a timely basis.

A. Materials Accounting

By materials accounting, the IAEA seeks to obtain to a satisfactory degree of confidence (which is now accepted as 95%) assurance that a significant amount of nuclear material is not divertedfrom a materials balance area over a certain period.[1] In the case of reprocessing plants, the materials balance closing is determined by computing the material unaccounted for and its limit of error based on a measured, verified materials balance. The uncertainty associated with the nuclear materials balance depends fundamentally on the measurement system uncertainties, and on the plant throughput and inventories for the materials balance period.

1. Conventional Materials Accounting. Conventional materials accounting is based on drawing materials balances following periodic shut-down, clean-out, and physical inventory. The classical materials balance associated with this system is drawn around the entire plant or a major portion of the process, and is formed by adding all measured receipts to the initial measured inventory and subtracting all measured removals and the final measured inventory. During routine production, materials control is vested largely in administrative and process controls, augmented by secure storage for discrete items.

Although conventional materials balance accounting is essential to safeguards of nuclear material, it has inherent limitations in sensitivity and timeliness. The first limitation results from measurement uncertainties that desensitize the system to nuclear material losses, especially for large-throughput plants. The timeliness of traditional materials accounting is limited by the frequency of physical inventories. There are practical limits on how often a facility can shut down its process and still be productive.

Because of its dependence on physical inventories, conventional materials accounting must rely primarily on enhanced measurement technology to improve its sensitivity. However, it is unlikely that sensitivity, i.e., measurement uncertainties, can be improved sufficiently by this method alone to meet safeguards needs for throughputs larger than at some existing facilities. Furthermore, the timeliness question probably cannot be answered satisfactorily.

2. Near-Real-Time Accounting. Drawing a materials balance depends on the ability to measure, or estimate, the initial and final inventories for the materials balance period. In the past, available measurement technology generally has required the shut-down, clean-out, and physical inventory of a process to permit inventory determinations. With the advent of improved measurement and estimation techniques and devices, measurement of nuclear material during processing is becoming possible.

These developments foster the use of near-real-time accounting, [2-8] which is based on recently-developed NDA technology, conventional measurement methods, and sophisticated data-analysis techniques supported by computer and data-base management technology. The fundamental idea is to draw dynamic materials balances in near-real time about relatively small portions of the process, called unit-process accounting areas (UPAAs). Each UPAA is part of the more common materials balance area (MBA) structure. An MBA may contain one or several UPAAs, depending on the particular process, the benefits to materials accounting, and the associated process impacts and costs. This approach enhances the timeliness and sensitivity of materials accounting because balances can be drawn more frequently about smaller amounts of material. For example, Table I shows diversion sensitivities of a near-real-time system based on computer simulation of a measurement system and the Allied-General Nuclear Services (AGNS) Reprocessing Plant at Barnwell, South Carolina. The data and details of the concept appear in LA-6881[5] and LA-8042.[6]

It must be emphasized that near-real-time or dynamic materials accounting supplements, but does not replace, the shut-down, clean-out, physical inventory procedures currently used. Physical inventories are still necessary to provide materials accounting fiducials and a periodic zero-base inventory.

The choice of materials balance period, that is, the timeliness of near-real-time accounting, is based on both sensitivity and detection-time criteria. Thus, even though a small-throughput facility might require a materials balance only at six-month intervals to achieve the desired sensitivity, the desired timeliness criterion would not be achieved. In this case, materials balances could be drawn over two-week periods. The main requirement for near-real-time accounting is that sufficiently good measurements, or estimates, of the inventory in the process be available on the time scale chosen for the balance period. The proposed IAEA performance goals require that this period be no longer and 1-3 weeks for plutonium. Thus, the usual physical-inventory-based accounting scheme is impossible.

The requirement for measurement of in-process inventory is flexible in that the measurement uncertainty need only be small enough to meet the performance criteria. Therefore, a process having a small or nealy constant inventory will require less inventory measurement capability, perhaps none at all. The necessary capability depends on the specific facility and will likely be significant for high-throughput facilities.

If near-real time materials accounting is implemented by the facility operators and the system is also to be used for IAEA safeguards, then the inspectorate must be able to verify the results independently. This function could be performed as at present for a conventional accounting system, i.e., independent measurements linked to the physical inventory structure. In this case, the verification procedures are no different than for a conventional accounting system, and, certainly, the limitations on timeliness hold. However, near-real-time materials accounting offers the possibility of more extensive verification activities aimed at achieving the proposed IAEA goals. This is particularly ture if continuous inspection presence is employed and if inspectors are equipped with suitable instrumentation and can effectively make use of the facilities' installed accounting instrumentation. In all such cases, there are more measurement opportunities, both in time and in location. Furthermore, the much more comprehensive data from this dynamic materials accounting system facilitiate checks of internal consistency of the facility accounting data between physical inventories.

There are two possible disadvantages of near-real-time accounting relative to the conventional methods described earlier. One concerns the degree of inspector presence and the amount and nature of facility information and process operating data. However, inspection effort sufficient to accomodate a near-real-time accounting system would appear to be allowed under current agreements. Furthermore, although it is probably unavoidable that individual inspectors will become familiar with some of the details of the process, the sensitive information required for near-real-time accounting should not differ significantly from that required for a properly operating conventional materials accounting system.

The second consideration is the cost of the near-real-time accounting system. A recent study[5] calculates the capital cost to be on the order of 5-10% of the facility capital cost. This figure presumes no credit given to the materials accounting system for such benefits to the operator as improved process control, operating histories, criticality and radiological safety, and quality

TABLE I

DIVERSION DETECTION SENSITIVITIES FOR A 1500 MT/YR REPROCESSING FACILITY*

Measurement Strategy	Detection Time (h)	Sensitivity at Time of Detection (kg Pu)
8 hr balancing	8	4.2
	168 (1 week)	6.3
	672 (4 week)	12.6
1 hr balancing	1	2.6
	24	1.8
	168 (1 week)	4.2

*Detection probability = 0.5 and false-alarm probability = 0.001.

control. Further, the additional instrumentation required for near-real-time accounting is a small increment to that required for a conventional accounting system.[6] The major impact will fall on the data handling and computational capabilities necessary to operate the system most effectively.

B. Containment and Surveillance

Containment and surveillance have two functions. One is to detect anomalies indicative of diversion of nuclear material, and the other is to detect tampering with safeguards instrumentation. The possibility of instrument tampering requires that all international safeguards instrumentation be tamper-resistant and tamper-indicating. To some extent, this requirement can be satisfied by the expanded IAEA verification activities in near-real-time accounting; it also means that IAEA involvement in the measurement calibration and maintenance programs is necessary.

The containment and surveillance system can also assist, through direct observation of the instrument environment (e.g., camera or electronic surveillance of instrument access), in detecting instrument tampering. This is an easier task if most instruments are automated and interfaced directly to the materials accounting computer system; in that case, the operator has no reason to interact with the instrument, except for maintenance and calibration, in which the IAEA inspectors would also participate.

The additional surveillance technique of monitoring process variables for unauthorized or nonstandard materials movements probably complements materials accounting best in those areas where materials balance uncertainties are larger than desirable. The concept may be regarded as an extension of surveillance functions into the process area, and as an upgrading of the monitoring devices (or appropriate placement of them) to allow gross measurement of in-process material.

The process-monitoring system collects timely information that might be indicative of a diversion in progress. The system uses plant instrumentation wherever possible to draw approximate materials balances on transfers between tanks and across vessels. Similarly, an overall plutonium balance can be maintained. This balance is crude by accounting standards but has the advantage of near-real-time availability.

Such a process-monitoring system can provide nearly immediate detection of anomalies by continuously comparing actual operating conditions with those expected. However, it must always be supplemented by materials accounting to indicate how well it has been working during the last accounting period. This is especially true if there has been some malfunction or if some part of the process-monitoring system has been subverted.

One limitation of all containment and surveillance techniques, including process monitoring, is the inability to ascertain whether all diversion paths worthy of consideration have been enumerated; this is the question of completeness. Design and evaluation of containment and surveillance systems require one to make a cogent argument that any diversion paths not addressed by the system are "highly" unlikely to be used by a divertor. The complexity and number of possible diversion paths devisable by a knowledgeable, imaginative adversary (or critic) sometimes make such an argument difficult.

Another limitation results from the general inability of the containment and surveillance system to quantify the amount of missing material. Related to this is the difficulty of determining the meaning of an alarm generated by the containment and surveillance system. The solutions to both problems require the support of the materials accounting system. Despite these quantitative limitations, the importance of a comprehensive containment and surveillance system, as a deterrent and as a severe constraint on the flexibility allotted a divertor, should not be minimized.

Any sophisticated process-monitoring system will depend on detailed operating data and intimate knowledge of the process because the expected behavior of the process must be known and compared with the actual behavior. Depending on the extent of the monitoring activities, a computerized data base will be required, and a real-time computer model of the process may also be necessary to track the complex workings of an operating reprocessing plant. Thus, a comprehensive process-monitoring system is likely to be expensive and involve the need for more process operating data than the materials accounting system.

III. METHODOLOGY FOR EVALUATION OF INTERNATIONAL SAFEGUARDS SYSTEMS

Performance evaluation is the pivotal step in providing quantification and, therefore, assurance of safeguards effectiveness. Furthermore, it is the only means of providing technical guidance for the design sequence and for making those subjective choices or decisions that represent policy positions. Performance evaluation is both a synthesis tool and an analysis or assessment tool. It is applicable to a conceptual or ideal safeguards system, to a safeguards system based on the known capabilities of the facility and the IAEA, and to the safeguards system finally implemented.

A. The Evaluation Problem

Systems performance evaluation implies the definition of suitable performance measures that can be easily related to externally established criteria. Thus, there are two aspects of the analysis problem: first, defining performance measures, and second, relating those measures to established, quantitative performance criteria.

Several approaches to performance evaluation are described below. Although the approaches differ in detail, they have several areas of commonality. For example, the ultimate performance measures for all the methods embody the concepts of diversion sensitivity and timeliness. Most of the approaches have their backgrounds in work on the U.S. domestic safeguards program; however, many of the features of evaluation methods for domestic safeguards should be adaptable for international safeguards problems.

B. The LASL Approach

1. Performance Measures. Because of the fundamentally statistical nature of materials accounting, diversion sensitivity can be described appropriately in terms of the probability of detecting some level of diversion, while accepting some probability of a false alarm.[10] The usual procedure is to define three performance measures: the probability of detection, the total diversion, and the time over which the diversion occurs until it is detected. Whether the diversion occurs in an abrupt or protracted fashion is not a factor in the performance measure. The **total** amount diverted is the important characteristic. A fourth measure is the false-alarm probability. In keeping with standard statistical practice, it is fixed and thus does not affect the analysis although the impact of different false-alarm probabilities can easily be studied.

Using statistical techniques, one can show that the three performance measures are interrelated by a family of continuous functions that depend on the details of each particular safeguards system. Thus, a convenient way of displaying the capability of a system is a 3-dimensional graph of detection probability vs total loss and time. Such a graph is called a performance surface.[10]

The overall materials accounting performance surface of a facility depends on both the materials measurement system and on the statistical techniques used to analyze the materials accounting data. Discussion of the available analysis techniques is not included here, but details of a comprehensive set of statistical methods are given in Refs. 5 and 11-14. These methods have been used extensively in the LASL systems studies and are beginning to be used for analysis of actual materials accounting data at several facilities.

Performance surfaces for containment and surveillance, analogous to those for materials accounting, can be found **for those diversion paths treated by the containment and surveillance system.**[15] Because of the different kinds of devices used for surveillance, the calculation and appearance of the resulting performance surfaces will differ from those for materials accounting. For example, verification of a canister seal is generally independent of the canister contents; the corresponding performance surface is constant along the total loss axis. On the other hand, surveillance devices, such as portal monitors, that depend on gross materials measurements have performance surfaces closely resembling those for materials accounting.

The appropriate definition of detection for the containment and surveillance system is also uncertain. In analogy with the definition of detection chosen for materials accounting, the definition chosen for containment and surveillance is the detection of an anomaly that might be indicative of diversion. This provides an upper bound on systems performance and indicates that supporting evidence from the materials accounting system is required.

2. Calculation of Performance Measures. For a host of reasons, including cost, time, and unavailability and inflexibility of operating facilities, computerized modeling and simulation of the facilities and safeguards systems are indispensable tools in developing and analyzing advanced safeguards systems.[4-10]

For materials accounting, the modeling and simulation approach requires a detailed dynamic model of the process based on actual process design data. Design concepts are evolved by identifying key measurement points and appropriate measurement techniques, comparing possible materials accounting strategies, developing and testing appropriate data analysis algorithms, and quantitatively evaluating the capability of the proposed materials accounting system to detect losses. By using modeling and simulation techniques, the effects of process and measurement variations over long operating periods and for various operating modes can be studied in a short time.

Computer codes have been developed at LASL to simulate the operation of each model process using standard Monte Carlo techniques. Input data include initial values for all process variables and values of statistical parameters that describe each independent stochastic process variable. These data are best estimates obtained from process designers and operators. Each unit process is modeled separately. When a process event occurs in a particular unit process, the values of nuclear materials flows and in-process inventories associated with that unit process are computed and stored in a data matrix. These data are available for further analysis and as input to computer codes that simulate accounting measurements and materials balances.

The nuclear materials flow and inventory quantities from a process model are converted to measured values by applying simulated measurements. Each measurement type is modeled separately; measurement errors generally are assumed to be normally distributed, and provisions are made for both additive (absolute) and multiplicative (relative) errors. Significant measurement correlations are included explicitly. In most cases, the measurement models are derived from the performance of similar instrumentation characterized in both laboratory and field applications to similar materials. Simulated measurements are combined to form materials balanaces under various strategies for near-real-time materials accounting.

The most promising measurement and accounting strategies are combined with powerful statistical techniques in comparative studies of loss detection sensitivities. The result is a set of performance surfaces, similar to those described previously, that represent the capabilities of the system.

Techniques for analyzing the containment and surveillance system are similar in concept but differ greatly in detail. The primary difference is caused by differences in the philosophies behind process models required for the two analyses.

C. The Sandia (Albuquerque) Approach

At Sandia Laboratories a systematic effort is underway to develop containment and surveillance (C/S) systems, the ultimate goal being to integrate them with materials accounting systems.[16-19] As part of this effort, a method for evaluation of C/S systems is evolving. To help assure the completeness of the analysis, logic trees for reprocessing facilities have been developed based on geometric descriptions of containment boundaries. Diversion actions associated with known penetrations in containment are logically related in the trees. In addition, diversion actions associated with creation of clandestine penetrations are identified. Then, analysis of the logic trees identifies both known diversion paths and potential clandestine diversion paths. As with all international safeguards systems, the completeness of the analysis is limited by the accuracy of the design information that is provided.

To estimate the effectiveness of containment/surveillance systems, a straightforward evaluation technique has been developed under the assumption that C/S instruments are of a threshold type. Such instruments detect actions associated with the rate of movement of material above a certain quantity. Below its threshold, an instrument does not respond; above its threshold, the instrument indicates a possible discrepancy. Some instruments may have a zero threshold because they could detect actions possibly associated with diversion independently of the size of the diversion. An example would be an instrument designed to detect installation of a clandestine pipe. Other instruments, such as flow monitors in pipes, may have a threshold directly related to the flow rate they can detect.

The logic trees described above are converted into a branch network that shows all possible diversion paths considered credible. The nodes of the network represent diversion points and the arcs represent materials flows between the points. A conceptual C/S system is developed consisting of sensors associated with selected nodes in the network. The system configuration may then be evaluated by determining the maximum flow below threshold through the network. Other measures may also be applied. A cost of diverting through each node may be associated with each node, where cost is used generally here to include such factors as economic cost, difficulty, and effect on normal operations. After estimating a maximum cost acceptable to the diverting state, the network may be analyzed to determine the effectiveness of the C/S system under these limitations. The network may also be evaluated to determine the vulnerability of the C/S system to accidental or intentional (tampering) failure. In this case, the cost to the divertor (probability of random failure or cost of tampering) reflects the likelihood that a device will fail to detect any rate of diversion past it. Assuming a certain total probability of random failure or a total cost of tampering, the C/S system may be evaluated to determine maximum undetected flow through the system.

Standard techniques for evaluating fluid flow problems can be used to evaluate the networks described above. Various C/S systems may then be ranked according to overall systems effectiveness in indicating discrepancies possibly associated with diversion.

As a general comment, the phrase "detect diversion" probably should not be used when describing containment/surveillance measures alone. While in INFCIRC/153 the meaning of detection is not defined, it is stated that the "technical conclusion of the IAEA's verification activities shall be a statement of the amount of material unaccounted for." In general, a C/S system will not provide this information, but must depend upon inventory information. The role of a C/S system is to indicate anomalies possibly associated with diversion. Based on such indications and available information from a materials accounting system, the IAEA would have to decide what further actions (physical inventory or other accounting measures not routinely performed) are required to determine whether or not diversion has actually occurred. As larger plants are built in the future, however, indications from C/S and from monitoring of a facility's near-real-time materials accounting system may have to be used to provide the required detection sensitivities because conventional inventory methods may not be sufficient.

D. The NBS Approach

Diversion Path Analysis (DPA), developed at the National Bureau of Standards, is a safeguards evaluation tool that is used to determine the vulnerability of the materials control and materials accounting (MC&MA) subsystems to the threat of theft of nuclear materials by a knowledgeable insider. DPA specifically addresses diversion of nuclear materials from its authorized location within the plant by a person who has access to the process area and/or the material. It is used to evaluate the ability of the MC&MA subsystems to detect the loss of a fraction of the amount of nuclear materials needed to construct a clandestine nuclear explosive. Using the methodology, facility personnel systematically determine: (1) how, from a divertor's viewpoint, to acquire nuclear materials covertly and conceal the theft from the MC&MA subsystems; (2) how soon, if ever, the MC&MA subsystems would indicate the theft; and (3) what modifications to the plant's safeguards system would be necessary to eliminate, or reduce the severity of, the identified vulnerabilities.

DPA is a team effort and the team should consist of DPA analysts and facility personnel who have technical backgrounds. Detailed knowledge of the DPA methodology is less important initially than a knowledge of the process being analyzed. By having a technical background, a person is better prepared to do a more thorough analysis in a shorter period of time.

The implementation of DPA is divided into five basic steps including (1) process characterization, (2) analysis of diversion paths, (3) compilation of diversion path characteristics, (4) safeguards system modification recommendations, and (5) documentation of the results. It is assumed that the DPA team is sufficiently knowledgeable of the process to analyze it and to document its characteristics. The objective of the "Process Characterization" step is to examine details of the process according to: (1) the materials handled; (2) the information received, utilized, and generated; and (3) the responsibilities of the personnel who work in the process area. During the "Analysis of Diversion Paths" step, the DPA team mentally assumes the role of the divertor and, using each of 16 General Diversion Paths (GDP's)* in turn as a guide, determines specific ways to remove nuclear materials from the process. Having identified a diversion path, the DPA team also determines: (1) what abnormal situation would occur and who would observe it; (2) the length of time before the diversion is detected via the MC&MA subsystems; and (3) a possible low-cost or procedural modification that would eliminate the vulnerability or reduce the detection time. After determining all the diversion paths, the DPA team uses two computer programs that have been written to assemble the results and prepare tables for documentation of the DPA. The DPA team also analyzes the results to determine some possible major modifications (e.g., requiring additional personnel or hardware procurement) that will improve the general response capability of the safeguards system and may reduce the detection time for a number of identified vulnerabilities. Finally, the DPA team documents the results of the analysis for management review.

It is intended that the results of DPA will provide plant management with guidance concerning procedural changes in the MC&MA subsystems that will enhance detection of diversion of nuclear materials by a knowledgeable insider using strategies of stealth and/or deceit.

The DPA methodology has been field tested for domestic U.S. safeguards and is fully documented in Refs. 20-23. The applicability of DPA methodology for IAEA safeguards has not been demonstrated.

E. The SAI Approach

Science Applications, Incorporated, is working on a technique called diversion analysis.[24] The purpose of a diversion analysis is threefold. First, it helps to identify, and to describe in an organized way, all the concerns of international safeguards for a particular facility or fuel cycle. Second, it forms the statement of the problem and guides inspectors in designing safeguards approaches. Third, it calls attention to critical limitations in a particular safeguards approach and helps define technology development needs.

The analysis can be viewed as a model of similar analyses that could be done for actual facilities. Where possible, details similar to those found in an actual analysis have been incorporated. To be realistic, the safeguards approaches are limited to methods and equipment that are currently in use, or readily available. Also, the inspection effort is constrained by considering limits such as those in INFCIRC/153 on inspector manpower and the general guideline to minimize intrusion.

The approach is to state the objectives of safeguards, describe a generalized model facility, summarize the diversion possibilities that are of concern, describe realistic safeguards approaches that address these concerns, summarize the concealment possibilities that would hide diversion from the safeguards system, and assess these results in both a qualitative and quantitative way. The safeguards objectives are derived from IAEA papers.

The assessment is intended to put focus on the important parts of the analysis. These are: (1) safeguards coverage; (2) safeguards performance; (3) difficulty of concealment or risk of detection; and (4) technology needs. A quantitative assessment is attempted based on a formulation of overall attractiveness of each diversion possibility as a product of several factors, such as target appeal and safeguards effectiveness.

F. The LLL Approach

Lawrence Livermore Laboratory has developed the Structured Assessment Approach (SAA)[25-33] for the U.S. Nuclear Regulatory Commission (NRC), which is pursuing the establishment of safeguards assessment tools for the analysis of materials control and accounting systems. The SAA is designed to assist in verifying safeguards systems design compliance with NRC regulations. The SAA establishes specific and well-defined inputs and outputs and offers the efficiencies associated with controlled and guided analysis via computer automation with NRC analyst interaction.

The Structured Assessment Approach has a staged methodology that subjects the facility to a series of increasingly stringent performance tests, ranging from a determination of whether a non-tampering adversary can defeat the system with no risk at all, to subtle questions dealing with the availability of the detection system and the dynamics of the diversion sequence. One advantage of the staged approach is that it allows a great deal of analysis to be done with a minimum of judgmental input from the analyst. To the extent possible, the procedures are based directly upon data from License Submittal Documents and from NRC data bases. Because each stage subjects the facility to more exacting criteria, passing a given stage does not mean that the facility is acceptable, but failing at any point means that the facility should be rejected. One of the main advantages of a staged approach is that sensitivity analyses can be performed at each stage to identify the weakest

*The 16 GDP's serve as the basis for ordering the analysis. Each GDP is characterized in terms of six Diversion Path Parameters: material attractiveness; diverted amounts; deceit by records; deceit in removal; number of insiders; and type of insider. Each parameter has several attributes, and each attribute has been assigned a relative weight factor. The Office of Safeguards and Security, DOE, has specified the parameters, attributes, and relative weight factors to be used to ensure uniformity among analyses.

points in the system. This insight allows the analyst to focus the detail in the next stage of the analysis on those areas where it is more likely to uncover systems problems.

Some parts of the SAA are more fully developed than others. At each stage of the analysis, at least a "prototype" computer code exists. This means that although more efficient computer codes may be developed in the future, the key systems performance measures at each stage have been defined, and algorithms have been developed to measure them.

Both the methodology and the conclusions from the staged assessment approach are subdivided into four levels that are characterized by four basic adversary models. These levels are:

- Level 1 — Can a non-tampering adversary divert nuclear materials with no risk of detection?
- Level 2 — Can a non-tampering adversary divert nuclear materials with some level of risk, and does the probability of detecting that adversary meet the NRC criteria?
- Level 3 — What systems properties, such as failed components or collusion amongst employees and adversaries, would allow the adversary to divert nuclear materials? Does the system meet single-failure criteria?
- Level 4 — Can the adversary tamper with the system — both through altering physical systems and through collusion with others — to divert nuclear materials without detection?

The SAA seems to offer several advantages, primarily because of its systematic staging methodology and its automation with NRC analyst interaction. These advantages are:

1. The staged approach provides for sensitivity analysis to be performed at each stage to identify the weakest points in the system. Subsequent stages therefore have a tendency to "focus in" and uncover systems problems.

2.The staged approach allows a great deal of analysis to be done with a minimum of judgmental input from the analyst.

3. The staged approach allows a poorly designed system to be rejected at early stages, thus conserving assessment resources.

4. SAA automation provides for automatic documentation of assessment results and analyst assumptions, thus providing a defensible platform for rejecting a facility safeguards design.

5. SAA automation provides for comprehensive analysis where the computer is saddled with exhaustive tasks and the analyst can perform a more important decision-making role.

6. SAA automation provides for timely facility design assessment, incorporating design changes readily, according to a specific well-defined License Submittal Document input content and format.

Although the SAA can perform analyses given limited input data, a possible disadvantage of the approach is that is requires a great deal of input data to do a thorough and comprehensive analysis of the facility system. One must keep in mind, however, that such systems are large and complex by their very nature, and necessarily require a complete description to accomplish a complete analysis.

IV. SUGGESTIONS FOR FUTURE RESEARCH AND DEVELOPMENT

Although much work remains to be done, the development of the basic technology (e.g., instrumentation) necessary for international safeguards has made tremendous strides in recent years. On the other hand, synthesis of the basic technology into coherent, effective safeguards **systems** is still in its infancy by comparison. Further work is needed both on evaluation methodologies and system studies. Some of the major areas where effort is urgently needed are:

1. Evaluation methodology

a. Comprehensive, standarized techniques for diversion vulnerability assessment.

b. Standardized methods for quantitative performance assessment.

c. Adaptation and extension of advanced data analysis and handling techniques to the special problems of international safeguards.

2. Systems studies

a. Systems studies to extend existing advanced concepts to the international arena, including types and sizes of facilities now operating.

b. Development, testing and demonstration of advanced international safeguards systems.

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Erwin Inventory Difference Report

The Nuclear Regulatory Commission's Director of the Division of Safeguards, **Robert F. Burnett**, said recently that initial reinventory efforts at the uranium fuel fabrication plant, operated by Nuclear Fuel Services, Inc., at Erwin, Tennessee, have resulted in partial reconciliation of a nuclear material inventory difference reported to the NRC on September 17.

However, Burnett said an unresolved inventory difference, in excess of regulatory limits for continued operation, remains and that NRC's investigation into possible causes is continuing.

Additional efforts may include temporary resumption of limited plant operations to convert selected material to a different chemical form for remeasurement and extensive chemical analysis of other material on hand.

Resin Bead Mass Spectrometry — An Analytical Technique For Safeguarding Pu and U

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Abstract

Single anion resin beads have been used to extract Pu and U from spent fuel dissolver solutions and to serve as sample-loading devices for isotopic mass spectrometric analysis. Because of the small quantities involved (1-3 ng), shipping and handling of the samples are much simplified in comparison to more conventional techniques. The technique is described in some detail and results of a series of evaluative experiments are given. The technique gives results comparable to those obtained by conventional mass spectrometry.

Introduction

One of the crucial requirements of any safeguards program is knowledge of the isotopic compositions of fissionable elements. This knowledge, along with the total quantity of that element present, allows calculation of the amount of each fissionable isotope. The material balance thus established for fissionable isotopes is one bookkeeping base upon which safeguards is built.

Mass spectrometry has always been the method of choice for determination of isotopic compositions of U and Pu. Through use of the technique of isotope dilution, mass spectrometry can also be used to measure the quantities of these two elements as well. Conventional mass spectrometry requires U and Pu samples several micrograms in size. Due to the hazardous nature of Pu, restrictions on quantities of that element permissible for shipping have recently been enacted at both domestic and international levels. One of the results seems to be that shipment of Pu samples of the size necessary for conventional mass spectrometry and some other techniques will be very difficult, if not impossible.

The Mass Spectrometry Section of the Analytical Chemistry Division of Oak Ridge National Laboratory has developed a technique of isolating U and Pu from solution onto single anion resin beads, each of which then serves as a sample for mass spectrometric analysis.[1,2] Each bead contains about one nanogram each of U and Pu, and shipment of samples of this size is not nearly so difficult as it is for larger ones. Indeed, attempts are being made to have U. S. legislators declare such samples to be "special cases" to facilitate ready transportation.

This report describes the resin bead technique itself and presents results obtained from a series of experiments designed to evaluate its utility in safeguards applications. Although analysis of spent fuels is used to demonstrate the resin bead technique, the reprocessing step of the fuel cycle is only one of several to which it is applicable.

The Resin Bead Sample Loading Technique

The development of the resin bead method of loading samples for mass spectrometric analysis has been described in previous papers[1,2]; a brief description of some of the practical aspects of the technique has also been written.[3] The basis of the separation technique is the ability of an anion resin bead to separate U and Pu from rare earths and from other actinides from solutions of suitable acid strength. Figure 1 consists of plots of the distribution coefficients of selected elements of interest as functions of HNO_3 concentration. The separation of U and Pu from rare earths and other fission products is very high and they contribute negligible amounts to the final activity of a bead. The same is true for the actinides beyond Pu. The only elements besides U and Pu which adsorb appreciably are Np and Th. Neptunium is present as ^{237}Np, which, because of its long half-life, does not constitute a radiation problem; in addition, since neither Pu nor U has an isotope of interest at mass 237, Np poses no mass spectrometric problem, either. Thorium (mass 232) also causes no problems; adsorption will actually be advantageous if a Th-based breeder cycle is ever implemented. We have expanded the technique described in this report to include Th in that event.

Application of the resin bead technique is actually much simpler than conventional ones, where laborious chemical separation of the two elements, both from themselves and from reactor products, is mandatory. Figure 2 schematically outlines the various steps in the resin bead procedure. In this technique, an aliquot is taken of the solution to be assayed and adjusted to 8 M HNO_3. The aliquot is divided into two portions, to one of which is added a known amount of isotopically en-

*Research sponsored by the U. S. Department of Energy under Contract W-7405-eng-26 with the Union Carbide Corporation.

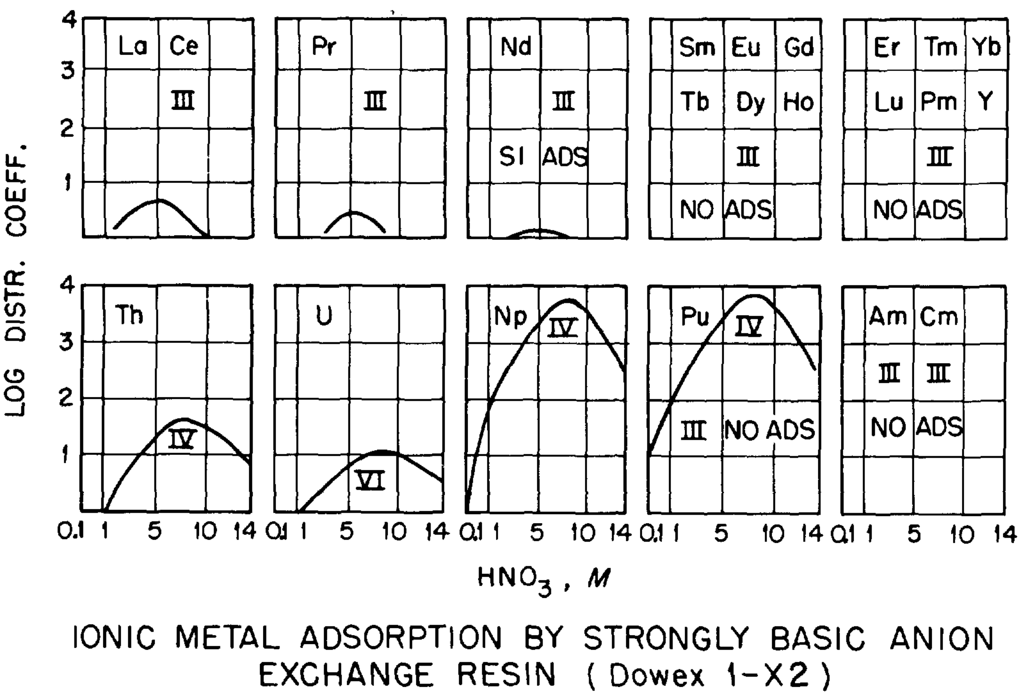

Figure 1. Plots of distribution coefficients vs HNO_3 concentration.

riched spike. Our spikes are greater than 98% ^{233}U and ^{242}Pu. The spike and sample are equilibrated; once equilibration is attained, it is unnecessary to achieve quantitative recovery at any subsequent step since the ratio of spike to sample will remain constant. The operator's data are used to estimate the amount of U present, and enough of each solution to give about 1 ug of U per bead. A number of beads (usually 10-20) is added to each solution and allowed to stand for 16-48 hours. At the end of this time, 1-3 ng of U will have adsorbed on the beads. The amount of Pu will vary with the U/Pu ratio in the solution. Burn-up for typical reactor fuels is 30,000 MW-days/ton, which results in a U/Pu ratio of about 100. Since the ratio of the distribution coefficients of U/Pu is about 1/200, approximately equal amounts of U and Pu will adsorb onto the beads.

The solution is now removed from contact with the beads, and the beads are washed to remove surface contamination. They are now ready for shipment. Each bead contains about 10^{-9} curies of Pu, which is an order of magnitude below the daily exposure allowed office workers. Hence, no special shielding is required; radiation levels outside a package of resin bead samples are below detection limits of conventional devices.

For shipment, one may affix a number of beads to a microscope slide with collodion; we prefer to use a device we have developed at ORNL. Figure 3 is a photograph showing the final shipping assemblies in both techniques. Figure 4 includes a photograph of an exploded view of this apparatus and a drawing depicting the beads resting on the filter. The apparatus is made of polyethylene and thus very resistant to breakage. The total cost is about $2 per unit. This device serves not only as shipping container, but also as a convenient ap-

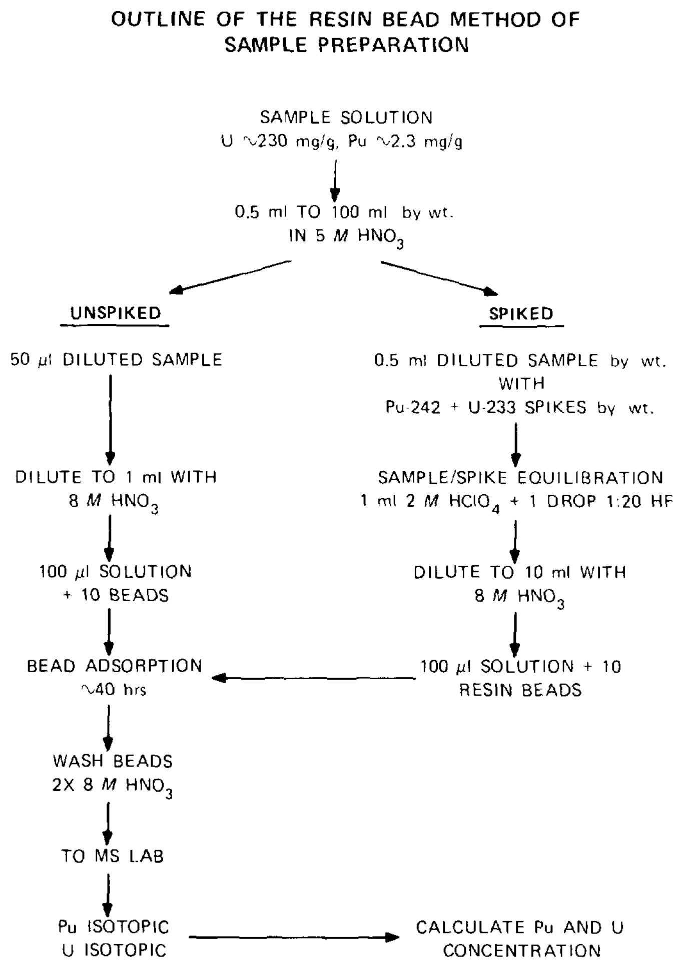

Figure 2. Outline of the resin bead sampling procedure.

Figure 3. Various kinds of shipping apparatus for resin bead samples.

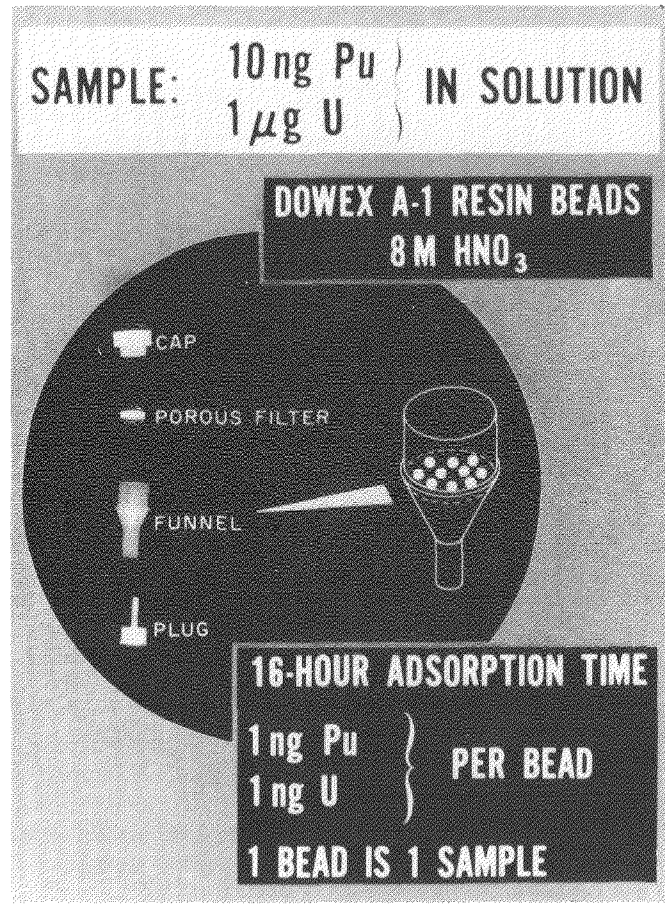

Figure 4. Exploded view of ORNL shipping apparatus.

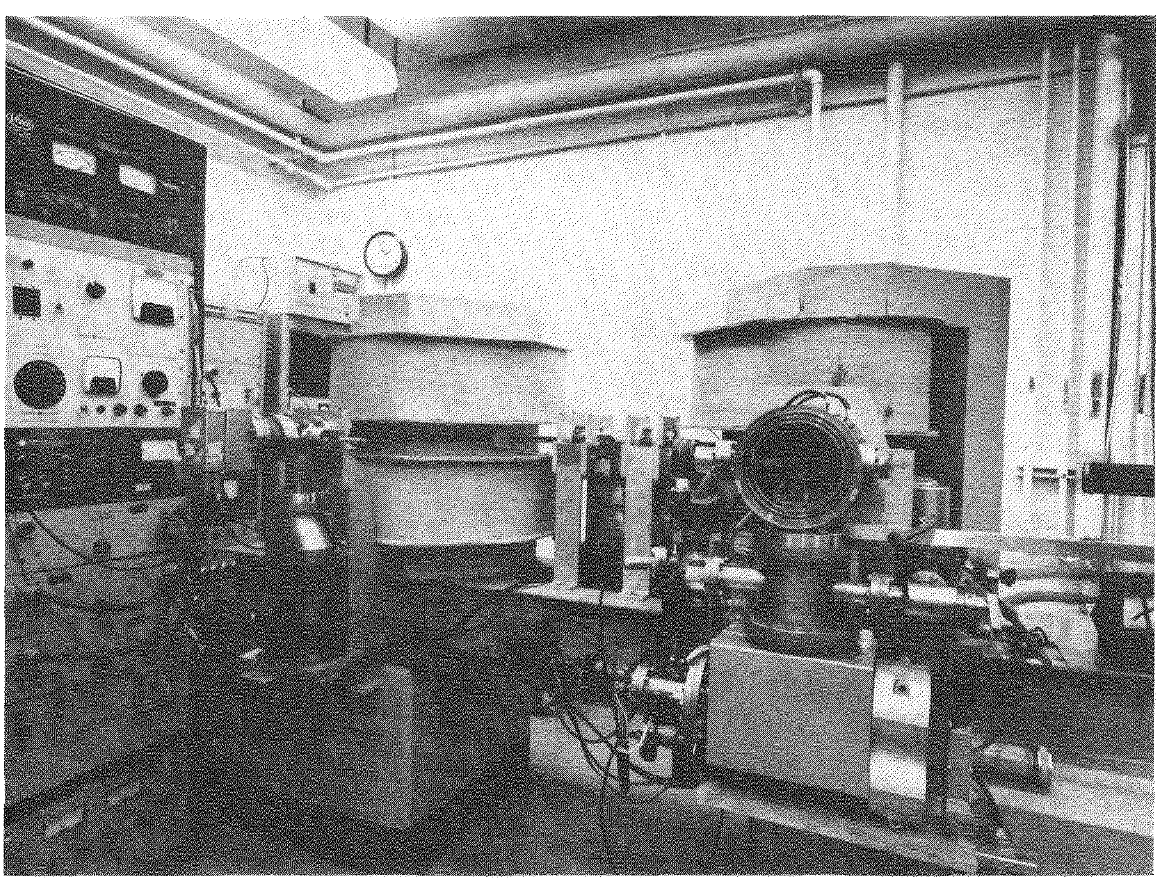

Figure 5. Drawing of Pu and U isotopic spectra showing contributions of sample and spike.

TABLE 1

Plutonium and Uranium Resin Bead Mass Spectrometric Ratios Compared to NBS Values

NBS 947 Pu Isotopic Standard

No. of Analyses	238/239	240/239	241/239	242/239
9	0.00371	0.24156	0.04281	0.01559
	0.00002	0.00057	0.00025	0.00008
NBS Values corrected to August 13, 1978	0.00370	0.24147	0.04309	0.01559

NBS 500 U Isotopic Standard

No. of Analyses	234/235	235/238	236/235
9	0.01034	0.99851	0.001522
	0.00005	0.00209	0.000005
NBS Values	0.01042	0.99970	0.001519

Standard deviations are quoted at the one sigma level.

paratus for the inspector taking samples. With the bottom plug and porous filter in place, a small volume of solution is pipetted into the funnel. The beads are then introduced and the whole assembly allowed to stand overnight. The bottom plug is then removed with the help of a special vial we have designed for this purpose, and the solution drained out. The beads are washed, and the bottom plug and cap inserted. The entire assembly is then ready for shipment; there is little chance for loss of sample. An alternative method of closure is to replace the top cap with a thermal seal. Samples taken at the Tokai reprocessing facility in Japan have been successfully shipped to Oak Ridge and Vienna by this technique; this shipping assembly is shown in Figure 3.

Mass Spectrometry

Each resin bead serves as a sample for mass spectrometric isotopic analysis; thus, the number of replicate analyses possible for any given sample is determined by the number of resin beads originally introduced to the solution. The small quantities adsorbed by the beads require pulse-counting mass spectrometers, several of which have been in operation at ORNL for over 15 years.[4,5] We at ORNL designed and built a two-stage mass spectrometer for IAEA.[6] Multistage mass spectrometers are not necessary for analyzing resin-bead-loaded samples; ORNL has obtained good results using a more conventional single-stage instrument.[7]

A bead is loaded onto a conventional mass spectrometer filament, and Pu and U are run sequentially from it. The carbonaceous material of the bead serves as an effective reducing agent for the sample, minimizing loss as oxide species. It also serves as a good approximation to a point source of ions, thus optimizing the ion optics of the instrument. Pu has a lower ionization potential than U and thus is analyzed first at a filament temperature of about 1500°C and a count rate of about 10^5 counts per second on the most abundant isotope. Excess Pu is then burned off, and U is analyzed at about 1750°C and 3×10^5 counts per second. Computer programs process the data, correcting for the isobaric interference at mass 238, and write a report.[8] Total quantities of each element are calculated from the knowledge of the isotopic compositions of spike, sample, and mixture of spike and sample, together with knowledge of the amount of spike added and the weights of sample, aliquot, and dilution. Figure 5 is a drawing depicting spiked and unspiked contributions to a mass spectrum for each element.

Experimental Results

No new technique can expect to supplant an older one unless it is demonstrably superior to its predecessor. The resin bead methodology simplifies chemistry and reduces sample handling hazards and shipping costs, but would be of no consequence if it did not achieve analytical results comparable in quality to more conventional methods. A number of experiments have been undertaken to demonstrate the utility of the resin bead technique on both international and domestic levels. Table 1 presents data we obtained from standards during our original evaluation of the technique. These nine sets of standards were analyzed over a two-month period; all data in Table 1 were obtained from sequential analysis of Pu and U from single resin beads. Agreement between our results and NBS certified values is excellent.

Another series of experiments defined the range of U/Pu ratios for which the bead could successfully adsorb quantities of each element suitable for sequential analysis. If U/Pu is too low, adsorption of Pu dominates, making it difficult, if not impossible, to burn the excess Pu off before analyzing U. In addition, quantities of U are very small, rendering analysis of that element problematic. If U/Pu is too high, U adsorption dominates. This means more U than usual will ionize at Pu operating temperatures, and correction of the 238 mass position

TABLE 2

U Concentrations (mg/ml) by Two Techniques

Sample	Resin Bead Mass Spec.	Davies-Gray
1	98.4	97.6
2	47.9	48.0
3	88.8	89.3
4	85.7	84.3
5	87.2	90.8
6	45.7	45.0

will be very uncertain. We found that U/Pu ratios between 10 and 1000 were amenable to the resin bead technique, yielding satisfactory results at the two extremes. This easily covers the range anticipated in spent fuel solutions.

Another series of experiments defined the minimum amount of Pu for which an isotopic analysis could be obtained from a bead. This was determined to be about 0.1 ng if all isotopes were analyzed and about 0.05 ng if 238 was omitted.

Results obtained from samples taken under field conditions were compared with results obtained from the same samples via more conventional techniques. Table 2 lists values for U concentrations obtained via the resin bead technique and those obtained from the Davies-Gray titration method. Agreement between the two techniques is quite good.

Perhaps a more valid test of resin bead results would be to compare them to results obtained by conventional mass spectrometry. Table 3 lists results obtained by both techniques for samples of three spent-fuel dissolver solutions. Agreement is excellent: the ratio of the concentrations determined by the resin bead technique divided by those obtained by conventional mass spectrometry is 0.9994. Isotopic abundances showed similar good agreement.

Another test of the technique lies in comparing U/Pu ratios. Table 4 lists the results obtained from the same samples represented in Table 3. Agreement is again excellent. In another experiment, a fuel rod was sampled at 24 locations along its length. The twenty-four resin bead analyses gave U/Pu ratio of 110.2 ± 0.8, while calculations made using the ORIGEN computer code gave an average value of 111.5.

Discussion and Conclusions

We are in the process of transferring the technique to various other laboratories. We have trained personnel from the International Atomic Energy Agency (IAEA), the Power Reactor and Nuclear Fuel Development Corporation (Tokai, Japan), and from several U. S. laboratories in its application. Experiments involving sampling of European and Japanese fuel reprocessing facilities have been initiated. Preliminary results from

TABLE 3

U and Pu Concentrations by Resin Bead and Conventional Mass Spectrometry

	Sample	Resin Bead	Conventional
Plutonium, ug/g	1	7.008 0.023	7.021 0.015
	2	3.591 0.006	3.597 0.007
	3	3.825 0.004	3.853 0.024
Uranium, mg/g	1	0.870 0.002	0.870 0.002
	2	1.128 0.003	1.124 0.003
	3	1.109 0.001	1.105 0.003

Standard deviations are quoted at the one sigma level.

TABLE 4

U/Pu Ratios by Resin Bead and Conventional Mass Spectrometry

Sample	Resin Bead	Conventional
1	124	124
2	314	314
3	290	287

Standard deviations are quoted at the 1σ level.

samples taken at a European facility show good agreement between results obtained at ORNL and those obtained at IAEA; a detailed description of this experiment will be published in the near future.

While there are still a few minor problems involving training to be resolved, we feel that the resin bead technique has been demonstrated to be a viable one for use in both the domestic and the international safeguards programs. Its chief benefit lies in the small amount of sample required, which results in greatly reduced health hazards and transportation costs. A second benefit is the simplified chemistry involved which will reduce chances of contamination with other samples. Both of these benefits accrue with no degradation of results.

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In Safeguards Reporting Requirements

NRC Proposes Changes

The Nuclear Regulatory Commission is considering changing its regulations to require that licensees report events which may affect their safeguards systems for preventing sabotage of a nuclear facility or theft of nuclear materials. The reports are needed so that the NRC can assess the significance of the events and determine whether a change in safeguards plans is warranted.

Licensees who would be covered by the amendments are involved in the processing, handling and transportation of special nuclear materals or in the operation of nuclear reactors. Their safeguards systems are defined in safeguards plans (required under Parts 50, 70 and 73 of the Commission's regulations) that include physical security, contingency, security personnel qualification and training plans, as well as nuclear material control programs and procedures.

The proposed amendments also cover events that may occur during the shipment of irradiated fuel. Interim safeguards requirements for such shipments were issued on June 15, 1979.

An NRC Draft Regulatory Guide, "Reporting of Safeguards Events" (SG901-4), which is being issued for public comment, provides procedures acceptable to the Staff for determining whether an event would be reportable under the proposed regulation. Examples of reportable events given in the guide include serious mishaps to security alarms and indications of tampering with security equipment.

A copy of the regulatory guide is available for public inspection at the NRC's Public Document Room, 1717 H Street, N.W., Washington, D.C. Single copies may be obtained by written request to the Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Division of Technical Information and Document Control.

DOE Establishes Uranium Registry

DOE is setting up a U.S. Uranium Registry at its Hanford site at Richland, Wash., to assess potential hazards to workers at uranium mines and processing facilities and to determine the need for further health studies.

The registry will compile data on radiological and other hazardous exposures which uranium workers face. The radiological hazard analysis will focus on uranium and on radon and its daughter products. (Radon is an inert radioactive gas emitted by uranium.) The registry will also include a review of the literature dealing with studies of uranium workers, principally miners.

Another activity of the registry will be an analysis of uranium content in body tissues obtained at autopsy. This program will be similar to that undertaken by the U.S. Transuranium Registry, an ongoing program of tissue analysis for plutonium and other transuranic elements which DOE and its predecessor agencies have operated for many years.

The registry is funded by DOE's Office of Environment and will be operated by the Hanford Environmental Health Foundation with major support from DOE's Pacific Northwest Laboratory.

ISOTOPIC INVENTORY PREDICTION EMPLOYING A MONTE CARLO DANCOFF FACTOR

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The importance of calculational speed and accuracy in reactor calculations are becoming even more significant with the present trend of regulatory requirements. In previous papers [1,2] methods were described with the intent of trying to improve isotopic inventory techniques by arriving at a compromise between the calculational techniques and accuracy. The present effort has centered around the use of the computer programs LEOPARD[3], and KENO4[5]. The subject of this paper concerns the development of a new method for the determination of the Dancoff Factor by use of Monte Carlo calculations by means of the KENO4 computer program.

Problems have existed with ^{238}U resonance cross section libraries for many years. These problems relate partially to an overestimation of neutron capture rates. In heavily self-shielded fuel rods and lattices containing ^{238}U this problem leads to an over prediction of the capture resonance integral. To compensate for this effect adjusted cross sections are used.[6] LEOPARD historically has done this type of correction by use of a nu sigma fission multiplier[7]. By interfacing the fast neutron computer code HRG3 and LEOPARD it has been possible to improve the resonance cross section and heterogeneity representation of LEOPARD and as a consequence the accuracy and consistency of isotopic inventory predictions.

The LEOPARD - HRG3 interface technique consists of inputting an L factor, which is the ratio of the heterogenous to the homogenous resonance integral, determined by HRG3 into LEOPARD, as described in the previous papers mentioned above. A Dancoff corrected fuel pin diameter is used in the HRG3 calculations since HRG3 does not do a Dancoff calculation.*

This feature of HRG3 has been found to be useful since it allows the introduction of Dancoff factors determined by various methods.

Various methods have been tried for derivation of the Dancoff factor. The most common one being based on the methods developed by Carlvick[8].

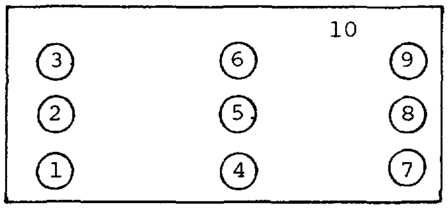
It was felt that more exact methods for determination of the Dancoff effect could help in modeling the system. This determination was done by the use of the computer program KENO4. KENO4 is a Monte Carlo program and hence gives a more direct consideration of collision probabilities. The following method for deriving a Dancoff factor by the use of KENO4 was employed.

A 3 X 3 fuel pin lattice was modeled. Each element of the lattice matrix consisted of a block of water with a concentric fuel, gap, and clad region located in the center. The 3 X 3 matrix is felt to be sufficiently large due to the weak coupling of rods that are located more than twice the lattice pitch. To test this assumption, comparisons were made with a 4 X 4 case. No appreciable difference in the results were noted.

Initially a uniform lattice, i.e. all like fuel pins, was considered. This assumption is also used in Carlvick type calculations.

Cross sections from a base HRG3 run are used as the cross sections for KENO4. The Following figure illustrates the general geometry employed.

*Correspondence with R. P. Sullivan and P. Y. Soong of NUS Corp. has been very helpful in the analysis of methods used originally for calculation of the Dancoff factor by LEOPARD.



An infinite lattice is simulated by employing reflecting boundary conditions. Materials 1 through 9 are fuel material, material 10 is water. A fission source is placed at the center of location 1 and the total number of neutrons absorbed in pins 2 through 9 and material 10 is found by using the KENO4 edit option. The number of neutrons scattered equals the source strength minus the number absorbed. In order to obtain the total absorbtion rate the total number of neutrons absorbed in each region are simply added. Results for other pins can be arrived at from symmetry considerations.

The collision probability for the lattice can be obtained as follows, by averaging the number absorbed per neutron emmitted for each element of the lattice.

The probability to escape, P_o, is found as (1)

$$P_o = \frac{\text{number absorbed in fuel}}{\text{number absorbed in all regions}}$$

hence,

$$P_c = 1-P_o \qquad (2)$$

where

P_c = collision probability

P_o = escape probability

A base HRG3 run with the scattering cross section added to the absorbtion cross section is used to generate cross section values for KENO4. This assumption is made since the edit option of KENO4 only outputs the net absorbtion probabilities by region and in this case scattering results in a net removal of neutrons. A table of values of collision probability versus rod radius is constructed in order to relate collision probability with an equivalent rod radius. This table is developed by making multiple KENO4 runs with a geometry consisting of a block of water containing a fuel rod with non reflecting boundary conditions. The collision probability was obtained from these runs as follows:

The total number of starting neutrons equals the number of neutrons that leak out plus the number of neutrons absorbed, hence,

$$\text{probability to escape} = P_o = \frac{\text{number leaking out}}{\text{number leaking out} + \text{number absorbed}} \qquad (3)$$

Also, $P_c = 1-P_o$ (4)

Where P_c = collision probability

P_o = escape probability

These values are obtained from the KENO4 output. The resulting values compare to similar values determined by Case, Hoffman and Placzek.[9]

It is possible to find an equivalent rod diameter which is Dancoff corrected by relating the value of collision probability obtained from the modeled bundle to that for the equivalent single pin. It has also been possible to take pin-to-pin variations into account by this method, by making a separate KENO4 run for each particular fuel pin type in a lattice. The net absorbtions are added up for each rod in the lattice, and a collision probability is obtained. An equivalent fuel pin diameter is then found by the method described above. Heterogeneity effects can thus be taken into account in the Dancoff calculation by this method. More commonly used methods do not allow heterogeneity considerations to be taken into account directly.

The tables developed for correlation of collision probability and Dancoff corrected fuel element diameter are almost linear for common diameter values. A collection of least square curve fits for each particular fuel type has been assembled. For small net absorbtion cross sections there is a small pin-to-pin shielding effect and hence a small collision probability. As a result of this property other least squares curve fits make it possible to predict Dancoff corrected equivalent fuel pin diameters without the necessity of continually rerunning the KENO4 system described above for configurations with similar geometry.

In order to check the accuracy of the system, comparisons were made to the CPM computer program.[10] CPM has been benchmarked against data from hot critical experiments from the Kritz reactor, TRX and ESADA criticals on uniform lattices at room temperature, and post irradiation investigations of burnt fuel from the Yankee and Saxton reactors. It was designed partially for use as a benchmarking tool and hence was felt to be an appropriate basis for comparison.

In comparison of the isotopic inventory predicted by the methods described above and

CPM, it has been found that use of these methods has reduced the error in ^{238}U isotopic inventory difference values from 15 percent to 4 percent at 25,000 MWD/T. In addition, a more accurate determination of the Dancoff factor has been accomplished by collision probability consideration through the use of Monte Carlo techniques. This method also allows the inclusion of heterogeneity directly in the calculation of the Dancoff effect.

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NBS Report

PHASE II FINAL REPORT COMPUTERIZED SITE SECURITY AND RESPONSE SYSTEM

by R. T. Moore, R. J. Carpenter, A. W. Holt, A. L. Koening, and R. B. J. Warnar

Sponsored by the Defense Nuclear Agency, Washington, D.C. 20305

The Computerized Site Security Monitor and Response System (CSSMRS) is conceived as an integrated, state-of-the-art, computer-based system to enhance and improve the overall physical security of storage sites for nuclear weapons and materials. This would result from the interconnection of all site security systems, including intrusion detection equipment, duress alarms, guard radio and telephone systems, guard activity sensors, access control equipments, meteorological and environmental sensors, and deterrent systems to a distributed processing network of computers. These would be expected to provide timely, accurate, and unambiguous information about the site security status or the progress of an attack or intrusion attempt. To the extent that is feasible, appropriate response initiatives would be preprogrammed into the system. Changes in site security status and the resulting response actions would be automatically reported upchannel to higher command levels and backup and reserve forces would be automatically called out in the event of certain identifiable threat situations, particularly those in which continued survival of local guard forces might be doubtful.

SAFEGUARDS APPLICATIONS OF FAR INFRARED RADIOMETRIC TECHNIQUES FOR THE DETECTION OF CONTRABAND

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ABSTRACT

A new safeguards system under development employs radiometers in the 100-300 GHz spectral band to detect contraband, including shielding materials (used to attenuate the gamma ray emissions from nuclear materials), weapons, or explosives covertly concealed on personnel. Clothing is highly transparent at these frequencies and imaging techniques can detect contraband by its emissivity and reflectivity differences relative to human tissues. Experimental data are presented and sample images are used as a basis to discuss system advantages and limitations.

SECTION I

Introduction

During the past decade, the need for new, versatile, personnel inspection techniques has arisen. Traditional systems employing magnetometers and x-ray imagers are now common in mass transportation centers, but because metal detectors are easily defeated and because x-ray imaging of personnel is prohibited by radiological health considerations, alternative or complementary approaches need to be developed. In this work, a new inspection technique is investigated which utilizes radiometric imaging in the so-called far infrared (FIR), or near-millimeter-wave (NMMW), spectral region extending roughly from 300-3000 μm.[1-5] This spectral region is ideally suited for personnel inspection because the attenuation of clothing is small and because the radiation does not present a health hazard. Although the same description can apply to the microwave spectrum (3-mm to 1-cm wavelength), both the resolution for a reasonable size imaging system collection aperture and contrast between the concealed object and human tissues is degraded.[6] The FIR can provide resolution on the order of 1 cm using modest antenna apertures of 10-100 cm. Human tissue can be characterized as a nearly ideal blackbody, thus providing a uniform backdrop against which radiometric imaging and detection can be accomplished. The FIR method provides a method of material (anomoly) detection not necessarily including identification. The new detection technique creates a visual display using a cathode ray tube driven by the output of a sensitive radiometer operating in the NMMW portion of the spectrum. An optical scanning system generates a two dimensional search matrix 1 m^2, or approximately 10^4 resolution elements. It is possible to distinguish between various objects at the same absolute temperature by measuring their apparent temperature (or emissivity) with a radiometer.

Because human tissue is characterized by an emissivity close to unity at FIR/NMMW frequencies of 100 GHz (3 mm) and higher, a radiometer at these wavelengths will measure body temperatures that are roughly 10-15°C above room ambient. Concealed metallic objects will

This work was supported by Sandia Laboratories

reveal themselves as regions of moderate-to-low emissivity against the uniform high emissivity background of human body tissue. These concealed objects will also shadow the radiated signal from human tissue and reflect some ambient background into the radiometer.

At the present time, radiometric detection against a human tissue background has been investigated for metallic objects, special nuclear shielding materials, and some explosives. Careful measurement of attenuation for clothing and other common concealment materials indicates only a small loss at far infrared wavelengths. Metallic objects 2 cm^2 in area were easily detected against a human backdrop with several layers of intervening clothing. The detection of nuclear shielding materials is more difficult and strongly depends on the manufacturing details of the material and the placement and contact on the subject. Explosives are very difficult to detect; however, only a small effort has been dedicated to this subject.

This paper describes the details of an FIR radiometric imaging inspection technique. Images will be used as a basis for discussing present performance and ultimate system potential.

SECTION II

Radiometry Fundamentals

All objects at temperatures above absolute zero radiate energy in the form of electromagnetic waves and absorb and reflect energy that is incident upon them. A perfect absorber is called a blackbody which is a perfect radiator and has an emission spectrum completely governed by the absolute physical temperature T. The brightness of the radiation is given by Planck's radiation law as follows:

$$B = \frac{2h\nu^3}{c^2} \frac{1}{e^{h\nu/kT}-1} \qquad (1)$$

where

B = brightness (watts m^{-2} Hz^{-1} rad^{-2})

h = Planck's constant (6.63×10^{-34} joule-sec)

ν = frequency (Hz)

c = velocity of light (3×10^8 m sec^{-1})

k = Boltzmann's constant (1.38×10^{-23} joule$^oK^{-1}$)

T = temperature (^oK)

If Eq. (1) is integrated over all frequencies, the familiar Stefan-Boltzmann relation is obtained

$$B = \varepsilon\sigma T^4 \qquad (2)$$

ε = emissivity

σ = constant (1.80×10^{-8} watts m^{-2} $^oK^{-2}$)

In Fig. 1, several brightness curves are plotted as a function of frequency and temperature using Eq. (1). The spectral region of interest in this work includes frequencies of 100-300 GHz. In this region $h\nu << kT$ so that the exponential factor in Eq. (1) is given to a good approximation by $kT/h\nu$. Thus

$$B = \frac{2\varepsilon kT}{\lambda 2} \qquad (3)$$

where λ is the wavelength in meters, and the apparent brightness is a function of the absolute temperature T and emissivity ε. Two objects at the same temperature but with different emissivities, or two identical objects at different temperatures, will radiate different amounts of energy. By using very sensitive detectors of this incoherent thermal emission it is possible to discriminate between objects at different apparent temperature (εT). The apparent temperature difference arises from emissivity or real absolute temperature differences. State-of-the-art detectors in the NMMW portion of the spectrum (100-300 GHz) can differentiate apparent temperature differences of a fraction of 1 degree for a 1-second integration time.

In radiometric systems, detection can be accomplished with the use of either coherent (heterodyne) or incoherent (video) techniques. The incoherent approach at NMMW frequencies requires liquid-helium-cooled detectors with little performance advantage relative to heterodyne detection. In the coherent approach as used in this program, the radiometer incorporates a room-temperature Schottky barrier diode mixer. The intermediate frequency (IF) is amplified by a low-noise, gallium arsenide, field-effect transistor (GaAs FET) amplifier. For a heterodyne system the minimum detectable temperature difference is given by:

$$\Delta T = \frac{T_{sys}}{(B\tau)^{\frac{1}{2}}} \quad (4)$$

where B is the IF bandwidth, τ is the post-detection integration time, and T_{sys} is the equivalent noise temperature of the receiver.

The range of minimum detectable temperature, as a function of IF bandwidth and receiver equivalent noise temperature, is illustrated in Fig. 2. Low noise IF amplifiers are now available with frequencies up to 10 GHz, and 3000°K is a reasonable system noise temperature for receivers of 100 to 300 GHz. Temperature differentials of a fraction of a degree should therefore be readily detectable.

Passive detection systems are the most desirable because the signal is derived totally from the self-emitted radiation. However, the inspection of large areas (1 m^2) at reasonable frame rates (i.e., a few seconds) may require illumination for increased contrast. This can be accomplished using incoherent sources such as mercury arc lamps with effective brightness temperatures of a few thousand degrees in the NMMW portion of the spectrum. The UV, visible, and near-infrared emissions are filtered out so that the subject is totally unaware of the illumination and, because the flux is much less than the normal level received from the sun, the radiation hazard is negligible.[7]

SECTION III

Transmission Characteristics of Clothing and Other Common Concealment Materials

The key idea in utilizing FIR/NMMW detection and imaging is that many materials, especially clothing, become transparent in this spectral region. Visual images and infrared thermal images (thermograms) will only indicate features of the outer layers of clothing or other concealment materials.

To assess the utility of FIR/NMMW imagery, it was first necessary to investigate the transmission characteristics of materials.[1-4] Absorption coefficients are available in the literature for many materials.[8] The intent was not to repeat these careful measurements, which are generally performed on pure materials, but rather to indicate the gross transmission features of common materials which include contributions of reflection and scattering.

The transmission data are summarized in Fig. 3. As the wavelength increases beyond 1000 μm (1 mm), the transmission of even dense materials, like leather and wood, is sufficiently high to permit inspection through these materials. The data should be used as trend indicators and not for absolute numbers. The optimum region for minimum loss and maximum resolution occurs between the wavelengths of 1 and 3 mm, and actual system operating wavelength will be dictated by these conditions, the status of components, and the achievable sensitivity of detectors and radiometers.

SECTION IV

Experimental Radiometric Imaging/Detection System

The NMMW, passive imaging system, Figure 4, consists of four major subsystems; an optical-type scanning system, a radiometer for signal detection, electronics for scanning system control and signal processing, and a visual display and recording system.

The scanning system has a fixed elliptical primary mirror with focii at 1 and 3 meters. Thermal energy emitted by a body at the focus in the object plane is reflected by the vertical scan mirror, the horizontal scan mirror, the elliptical primary mirror, and finally, into radiometer horn antenna at the image-plane focus. The scanning mirrors, therefore, sweep the 3-meter focus over the object plane while the 1-meter focus remains fixed at the radiometer.

A block diagram of the radiometer is shown in Figure 5. The thermal radiation emitted by a target is focused, through the chopper, into the radiometer horn. The radiometer is a Dicke receiver;[9] i.e., the chopper alternately blocks the signal from the target and reflects a reference signal from an ambient load into a horn antenna. The signal is squarewave-modulated at the chopper frequency, heterodyned in the mixer, amplified in the IF amplifier, and square-law detected by the diode detector. The amplitude-modulated video signal is then amplified and synchronously detected in the correlator. The resultant DC signal is integrated, amplified, and sent to the data collection system for proper display formatting. The 3-mm radiometer and imaging system has a double sideband system noise temperature of approximately 1700°K and a minimum detectable input temperature (ΔT) of approximately 0.1°K for 1-sec integration.

SECTION V

Experimental Results

The 3-mm radiometer was used to obtain single-line, horizontal scan data prior to implementation of the full scanning operation. Figure 6 shows a scan of a 2-cm-wide lead target (nuclear material shielding) against a human body with the view both unobstructed and through a 2.4-mm-thick leather jacket material. Also included is a similar scan using incoherent illumination from a mercury lamp. The detected signal is enhanced and now appears hotter than the ambient background. The results indicate that metallic objects will appear several degrees cooler in a passive detection scheme and will be detected through normal layers of clothing. As observed previously, metallic objects reflect the room ambient thermal radiation and this is compared to radiometric skin temperature. The emission temperature from the skin surface at 3 mm is approximately 205°K, and preliminary measurements at 1.4 mm indicate an emission temperature of approximately 307°K. These values vary by 2-3°K on a given subject, probably as a function of skin thickness, skin moisture, body fat layers, and other body characteristics. Typically, the emission temperature of the human body ranges from 7-10°C above ambient in the laboratory environment.

Typical passive radiometric signatures for a variety of composite shielding materials appear in Figure 7. The differential radiation, ΔT, is plotted versus real physical temperature because the latter value can vary depending on the location of the contraband sample on a human. For certain samples and physical temperatures, the differential radiance can be zero and thus the sample is radiometrically indistinguishable from the background. This ambiguity is unlikely and, in any event, can be resolved using active inspection or by comparing radiometric signatures at two wavelengths, e.g., 3 and 1.4 mm. These studies are now in progress.

Preliminary signature data for three available explosive samples (C4, detasheet, and TNT) indicate that these bare materials are difficult to detect using only passive radiometry at the 3-mm wavelength. However, explosives appear very amenable to detection using active/passive, dual wavelength radiometry, or FIR/NMMW spectral line detection.

Imaging has also been accomplished using the system illustrated in Figure 5. The first image is designed to test spatial resolution as shown in Figure 8. The target is a variety of metallic geometric shapes, with the dimensions indicated, mounted in front of a 77°K cold surface. The 3-mm image clearly indicates the presence of the smallest object (1 cm^2), although squares and circles appear the same. This is acceptable because our present goal is to detect, not necessarily identify, contraband. The data presented were recorded photographically from the display monitor without the use of image processing.

The second image, Figure 9, is the 3-mm wavelength reproduction of a handgun. The shape is readily discernible. The presence of a heavy layer of cloth over the object does not degrade the image as shown in Figure 9d.

Both of the previous figures illustrate the potential of the imaging techniques; however, the target geometry is idealized by the presence of the 77°K background. Because the metal objects mask the 77°K background and reflect the room ambient background, $\Delta T \approx 230°K$. If an active imaging system were developed, the anticipated signal level would be comparable to 200°K. However, for passive detection, the ΔT is an order of magnitude lower and, thus, is less conclusive at this point.

Figure 10 demonstrates the present prototype passive system operation for a real human subject with a concealed weapon. The weapon is detectable, but not easily identifiable, and only relatively large objects would be seen. It will be necessary to improve the performance of the radiometer (a factor of 10 is within present capability) and to use illumination to insure large signals ($\Delta T \approx 200°K$) for the detection of small (2 to 4 cm^2) objects.

SECTION VI

Conclusions

It has been demonstrated that radiometric detection of metallic objects is feasible in the 100-220 GHz band. Data obtained with a prototype, passive radiometric imaging system operating at 100 GHz indicates that target signatures (5-10°K ΔT and 2 cm^2 resolution) are adequate to detect contraband covertly carried by personnel - especially SNM and weapons. Clothing and other common nonmetallic materials of concealment present only a small transmission loss.

The detection of composite nuclear shielding materials is more difficult than solid materials and presents a complex set of problems that is strongly dependent on the manufacturing details of the material and the placement and contact on the subject; however, a sensitive, high-resolution scanning system should detect the object. A preliminary evaluation of explosives (C4, TNT, detasheet) at 3-mm wavelength indicates low contrast relative to human tissue background.

Radiometric improvements and illumination schemes will be implemented to increase the signal-to-noise ratio and/or inspection rate. The results to date are encouraging and work is proceeding to improve performance and address real detection scenarios.

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The Experience of Statistical Accountancy Within the Euratom Framework

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Introduction

This paper describes the experience gained from the implementation of an EDP system fpr statistical accountancy of nuclear material within the Euratom Framework. The EDP system (NUMSAS) was developed by the Joint Research Centre of the Commission of the European Communities at Ispra in collaboration with the Euratom Safeguards Directorate of DG XVII. The implementation of NUMSAS involves ongoing cooperation between the Safeguards Directorate, the Safeguards Research Program of the JRC and plant operators in different European countries. NUMSAS is designed for use in accordance with the accountancy regulations established by Euratom Safeguards. These regulations and the accounting provisions required to meet them have been published by the Commission of the European Communities.[1]

The NUMSAS system is valuable to Safeguards Authorities as a tool for material control within the framework of Euratom safeguards. NUMSAS, however, was not designed for the exclusive use of Safeguards Authorities. The system is freely available to plant operators and can be used as part of the internal management information system of a plant. It provides facilities useful to operators in appraising their own plant measurement system.

The Euratom Accountancy Framework

The Euratom regulations require operators to maintain an accountancy system of nuclear materials. The measurement system on which the accountancy records are based must comply with international standards. The physical inventory is periodically verified for comparison with the book inventory. By this means the Safeguards Directorate is kept informed of all stocks and transfers of nuclear material.

The reports supplied by operators give a detailed picture of the accountancy records of the plant. For example, the inventory change reports give details of,

- all inputs and outputs from each MBA
- transfers of material from one category to another; e.g., natural uranium to low enriched
- transfer of material from one batch to another when batch follow-up is required
- nuclear transformation of material
- shipper-receiver measurement differences
- "new measurement" of existing batches as for example during physical inventory taking.

The accountancy is designed to allow material balances to be calculated in terms of element weight and mainly in the case of enriched uranium, in terms of isotope weight. The main emphasis to date in EURATOM Safeguards has been the provision of accounting information for the material balance calculation. The Euratom regulations, however, also envisage the operator supplying information about the measurement system used to generate the Euratom declarations. This is required to calculate LE-MUF. Until the development of NUMSAS there has been only a limited emphasis on this kind of data.

In comparison with the requirements of a classical nonstatistical accountancy, NUMSAS requires

- detailed information about the measurement history of each batch of nuclear material
- quantification of the error distributions arising in those measurement

activities of the plant which generate the Euratom accountancy delcarations.

Measurement histories are important, for example, in LE-MUF calculations for a fabrication plant since many statistical correlations will arise from batches sharing common determinations of element or isotope factor. These correlations can be correctly accounted for only if the measurement histories of batches are recorded. That this information about the measurement activities has been readily available is due to the interest and participation of plant operators. Before discussing in detail the experience of implementing NUMSAS it is necessary to give an outline of the principal features of the system.

The Data Processing Features of NUMSAS

The principal feature of NUMSAS is that, in addition to an ordinary material balance calculation, NUMSAS can calculate an estimate of the standard deviation of the measurement error accumulated in the balance calculation. The design of a statistical accountancy system in the present Euratom context must take account of the following characteristics,

- plant data contains clerical errors which must be removed before results can be obtained

- the Euratom accountancy provisions are complex. In some cases, the interpretation of one declaration depends on its relationship to other declarations. This requires a complex algorithm for automatic interpretation of inventory change declarations.

- The MUF which is calculated under EURATOM accountancy is expressed in terms of the weight of a particular element (e.g., uranium) and when applicable, the weight of a particular isotope (e.g., U^{235}). In order to do the LE-MUF calculation in this form of accountancy, the system must link together batches whose measurement histories involve common error sources or shared determinations of element factor or isotope factor.

NUMSAS performs five major data processing functions. Each of these is summarized below,

<u>data selection</u>: the data processing facilities provided by NUMSAS allow the user to perform material balance calculations on subsets of the data. The selection criteria which can be used include material balance area, element category (or categories when several are to be included), isotope type (if isotope MUF is being calculated) and the material balance period.

<u>data editing and correction</u>: the data editing which is carried out by NUMSAS includes both syntax and consistency checks. These are carried out where appropriate in each phase of the data processing. Any data errors detected in this way are reported by the system to the user. To help the user correct errors, the system provides facilities for altering any selected file of declarations. These facilities include addition of new records, substitution of records and deletion of records.

<u>automatic interpretation of inventory change declarations</u>: The Commission Regulation on Euratom Safeguards defines twenty-three types of inventory change declarations. To calculate MUF and the variance of MUF these must be interpreted as either inputs or outputs to the material balance. NUMSAS provides automatic interpretation of all types of inventory change declarations.

<u>provision of accounting reports</u>: the NUMSAS system can provide a wide variety of reports. These are designed not only to provide the final statistical analysis of the material balance but also to provide a complete log of the NUMSAS data processing and a record of the data. The system can, for example, be used to report data errors and inconsistencies or for printing of physical inventories. Efficient usage of the system is facilitated by optional suppression of many reports. For a full account of the reports which can be generated, see the JRC-Ispra report.[2]

<u>statistical analysis of material balance</u>: the primary function of NUMSAS is to provide a statistical analysis of the uncertainty in the material balance. The system can provide this analysis based either on element weight or isotope weight. The analysis includes calculation of MUF, estimation of the standard deviation of MUF and a break-down of the total variance of MUF into contributions from each source of measurement error in the plant measurement system. The types of measurement error sources which NUMSAS can represent are discussed in more detail below. Figures 1 and 2 show a printout of

this statistical analysis taken from a demonstration run of NUMSAS.

The NUMSAS system is a suite of four computer programs. These programs are available in PL/1 and in Fortran. Each program performs a particular phase of the data processing. The programs which implement the separate phases are independent and can be executed separately. The execution of each phase creates a new set of material declarations as an external file. This file is then an input to the next phase. The repeated execution of a later phase does not require repetition of earlier phases. The way in which the five basec functions, summarized above, are carried out by the four programs is described in the JRC-Ispra report.[2] Figure 3 gives an outline description of the structure and data flow of the NUMSAS system.

The Statistical Features of NUMSAS

The NUMSAS system is based on a statistical model of error propagation in a plant. This model is one which has been applied already by J.L. Jaech[3] to the accountancy of nuclear material. The model allows for five kinds of error source which may be involved in the measurement of a single batch. These include,

- weighing scales or volume determination techniques
- sampling techniques for element factor determination
- analysis techniques for element factor determination
- sampling techniques for isotope factor determination
- analysis techniques for isotope factor determination.

For each error source in the plant measurement system, the model takes account of both systematic and random error. With suitable reinterpretation, the model can be used to represent any type of measurement whether wet chemistry or NDA.

The model equations for error propagation in weighing and in element and isotope factor determinations are given briefly below.

The model of measured weight is,

$$\hat{W} = W\,(1 + \lambda_i + \bar{\varepsilon}_i(n)); \qquad (1)$$

$$\text{with} \quad \bar{\varepsilon}_i(n) = \frac{1}{n} \sum_{j=1}^{n} \varepsilon_{ij}$$

where W is the true weight of the batch,

λ_i is the value of the systematic error for sacle i

n is the number of replicate weighings

ε_{ij} is the value of the random error of the j^{th} weighing of this item using scale i.

The model equation describing element factor determination is more complicated since there are both sampling and analysis errors. The model of measured element factor is,

$$\hat{P} = P\,(1 + \theta_i + \bar{\eta}_i(m) + \xi_j + \bar{\gamma}_j(d)); \qquad (2)$$

where P is the true value of the element factor for the batch

θ_i and ξ_j are the values of the systematic errors for the i^{th} sampling method and j^{th} analysis technique respectively

$\bar{\eta}_i(m)$ and $\bar{\gamma}_j(d)$ are the averages of random errors in sampling and analysis respectively.

The model equation for isotope factor determination is similar in structure to that for element factor.

In this model the standard deviation of measurements are assumed to be a linear function of the true value being measured. It can be argued in some cases that other models would be preferable. For example, a scale may have the same error distribution no matter what is the true value being measured. Future releases of the accountancy system will offer the user a choice of models for the LE-MUF calculation. It will be possible, for example, to treat a scale according to whichever model is felt to be appropriate.

The NUMSAS system provides an estimate of the standard deviation of MUF. The standard deviation calculation is a first order Taylor series approximation based on the above equations. The standard deviations of the systematic and random error variables in these equations represent the error distributions being generated by the plant measurement activities. These standard deviations are the parameters of the statistical model which must be provided as a prerequisite for NUMSAS calculations. These parameters must be representative of plant operating conditions as opposed to idealized laboratory conditions.

It is unlikely that international safeguards will ever be in the position of having experimentally established estimates of all such parameters. This would require experimental designs which are not just costly but in some cases impossible. In some cases, estimates may be used which are crude and/or subjective. However, to the degree that there is consensus about their validity, their use in NUMSAS will still provide guidelines for decisions about material control. This is less than the perfection of experimentally established estimates but it is better than nothing. The risk with crude estimates is that the sophistication of the subsequent data processing may lend spurious validity to the estimates and thereby bias decisions. This situation can be guarded against if uncertainties about input data are carried forward into the interpretation of the statistical analysis of MUF. Over a series of balance periods, the exploratory use of crude estimates may provide clues as to how they should be revised.

The previous paragraph shows the degree of consensus in technical methods which must underpin an international safeguards system. This consensus will only emerge from participation and collaboration. For this reason, the Joint Research Centre, the Safeguards Authorities and technical experts representing plants, have taken part in a program of work aimed at comparison of plant measurement techniques.[4] This program is aimed at identifying differences between techniques and obtaining consensus on standard deviation values for certain types of errors. This work has identified priorities for future research in experimental estimation, particularly for certain systematic errors.

Apart from the error source standard deviation values, the validity of the LEMUF also depends on the adequacy of the equations (1) and (2) as a description of the error propagation in the plant measurement system. The sources of error in any plant measurement system are numerous and the detailed equations describing their propagation will differ from one plant to another. However, a general accountancy system for application in international safeguards must, if it is to remain practical, be based on an error propagation model which is a reasonable approximation to a variety of different situations. The model described in (1) and (2) can with suitable reinterpretation provide a good linear approximation to many more complicated models. For different plants, the standard deviations used to describe the plant measurement activities will represent different aggregates of small error sources.

Experience to Date

The Safeguards Authorities are involved with plant operators in applying NUMSAS to certain existing European facilities. To date, the major experience on implementation has been derived from the application of NUMSAS to two plants. Both of these are fuel element fabrication plants, one high enriched, the other low enriched. For both of these plants, the number of batches in a material balance calculation can be many thousands.

For the first of these plants this implementation involved two tasks. These were:

- to record for each batch the plant error sources which were involved in the measurement of that batch. This measurement history for the batch was not recorded by the existing record keeping activities.

- to quantify the systematic and random error standard deviations for each error source in the plant measurement system.

This work was undertaken by the plant and Euratom Safeguards Authorities in collaboration. The NUMSAS analysis of the data from this plant provided plausible limits of error for MUF and an analysis of the plant measurement system showed quantitatively how the different error sources in the plant contributed to the overall uncertainty in the accountancy. This analysis of the plant measurement system is particularly useful to plant management as it can provide a basis for judging the cost effectiveness of any proposed improvements in the measurement system.

The effect of implementing NUMSAS in this plant has been to provide both the operator and the Safeguards Authorities with a better understanding of the performance of the measurement system.[5] As a result of the encouraging results, subsequent meetings have focused on improving the standard deviation and measurement history data. Thus, the process of analysis is one of successive stages of refinement of the statistical modeling of the measurement system. To date, the NUMSAS accountancy has been used to analyze the material declarations from three balance periods. Each balance period spans six months operation of the plant.

The experience of implementation in the second plant differed significantly from that in the first plant. In the first, the existing accountancy records were compatible with a statistical accountancy system. They merely required insertion of additional pieces of information (measurement history information) into each record. However, the accountancy system of the second plant was different. In this case, a single record could represent an aggregate of material - different items of which could have different measurement histories. It was not possible to implement NUMSAS in any straightforward way on the basis of such record keeping.

The response to this situation was a combined activity on the part of the operator and the Safeguards Authorities aimed at redesigning the data recording procedures of the plant. In this activity the requirements of statistical accountancy have been taken as major design objectives. The new design will have a new basis of batch description and will incorporate a record of measurement history. This activity is currently in progress and results are expected in the near future.

The initial experience of implementation has been centered on fuel element fabrication plants. First steps have also been taken to implement NUMSAS in a reprocessing plant. No experience is yet available from this development. In implementing NUMSAS in different types of plants, the philosophy of the Safeguards Authorities is a pragmatic one. Each new type of plant in the fuel cycle may present novel features for the statistical accountancy. For each new situation the validity of the NUMSAS statistical model will have to be reappraised in discussions with plant operators. This may lead to suggestions for extension of the basic model in equations (1) and (2). Already steps are in hand to have the accountancy programs offer the user a selection of different models as a basis for the MUF variance analysis.

Conclusion

The benefits of NUMSAS include,

- an improved facility for the evaluation of MUF. This aspect is of particular relevance to the Safeguards Authorities but it is also central to the interests of the operator.[4] At an operational level NUMSAS provides plant operators with an additional check on the consistency of their book-keeping and a check on whether their accountancy is meeting international safeguards requirements.

- an analysis of the way in which different elements of the plant measurement system contribute to the overall uncertainty in the material balance. This can be used to identify priorities for improvements in the measurement system. It also provides a basis for comparing the effectiveness of the measurement systems in different plants.

- the provision of standards for the design of data recording systems in plants. The data requirements of NUMSAS provides guidelines for plant managements wishing to improve their existing recordkeeping systems as well as for designers of data systems for future plants.

The experience to date has shown that the impact of implementing NUMSAS can vary considerably. In one case, it required only the recording of some additional statistical information. In a second case, it required a fundamental redesign of the accounting system. For further plants, it will depend on the pre-existing accounting system. At a more general level, the impact of NUMSAS has been to provide criteria for a more rigorous implementation of existing international safeguards legislation.

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PROGRAM : NUMSAS3 *** N U M S A S : M U F E V A L U A T I O N ***
(* PHASE – THREE *)

DATE : 230479 MBA : MBA1 COMPONENTS AND –MUF– FOR HIGH ENRICHED URANIUM (> 20%) ELEMENT PERIOD : 180975–170376

		WEIGHT (K)
BEGINNING INVENTORY	:	762.387000
INPUT	:	48.690000
OUTPUT	:	69.920000
ENDING INVENTORY	:	740.869000

*** MUF : 0.288000 (KILOS) 288.000 (GRAMS) ***

FIG. 1 : This shows the results of a MUF calculation where the accountancy has been done in terms of element weight rather then isotope weight. This printout is taken from a demonstration run based on fabricated data.

PROGRAM : NUMSAS3 *** N U M S A S : M U F E V A L U A T I O N *** PAGE : 1
(* PHASE – THREE *)

DATE : 230479 MBA : MBA1 VARIANCE OF COMPONENTS FOR HIGH ENRICHED URANIUM (> 20%) ELEMENT PERIOD : 180975 – 170376

ERROR SOURCE	RANDOM (G**2)	SYSTEMATIC (G**2)	SUM OF WEIGHT (K)	SUM OF ABS. WEIGHT (K)
EA01	205.090	917.790	100.984000	19 8.364000
EA03	595.816	3879.048	62.202000	221.276000
EA04	565.655	1822.063	– 17.078000	19.868000
EA08	141430.408	15903.732	– 126.110000	718.470000
EA09	1223.926	2447.776	– 19.790000	19.790000
ES00	0.000	0.000	– 36.868000	39.658000
ES01	0.000	0.000	100.984000	198.364000
ES04	0.000	0.000	– 19.678000	139.316000
ES05	0.000	0.000	81.960000	81.960000
ES08	0.000	0.000	– 126.110000	718.470000
SC00	0.000	0.000	– 36.868000	39.658000
SC01	13125.787	1.020	100.9840000	198.364000
SC03	11.286	0.672	81.960000	81.960000
SC07	195.081	0.039	– 19.678000	139.316000
SC12	1553.946	35783.397	– 126.110000	718.470000

*** VARIANCE (MUF) : 0.219663 (K**2) 219663.339 (G**2) ***
*** STANDARD DEVIATION (MUF) : 0.468683 (KILOS) 468.683 (GRAMS) ***

FIG. 2 : This shows the MUF variance broken down into components attributable to the error sources. The random and systematic contribution are calculated for each error source. On the printout, the error sources have symbolic names. EA, ES and SC denote respectively, "analysis technique for determination of element factor", "sampling technique for determination of element factor" and "weighing scale". EA03, for example, denotes "analysis technique number 3 for the determination of element factor". If the accountancy had been based on isotope weight, the list of error sources would also include those involved in isotope factor determination.

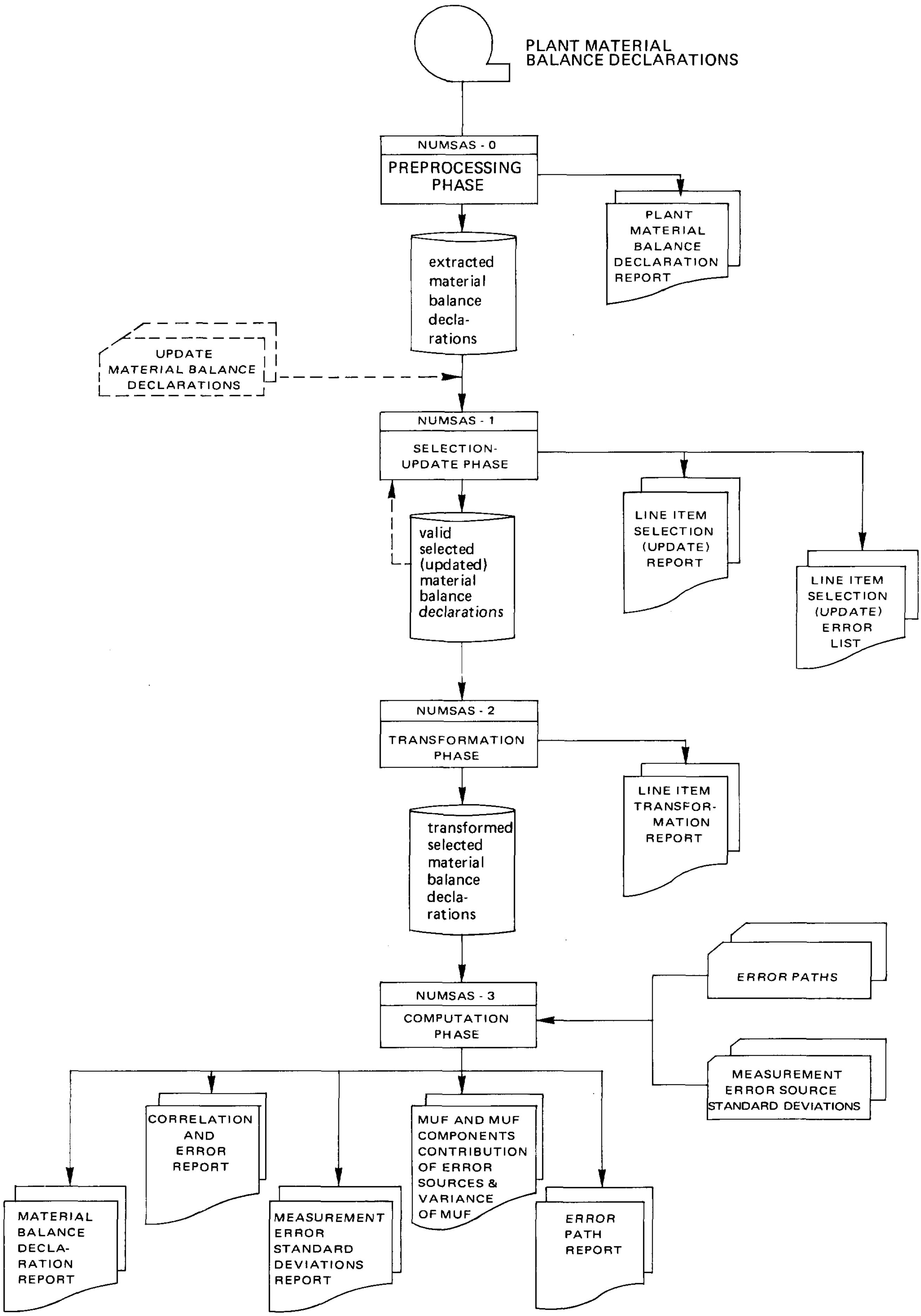

Fig. 3 : NUMSAS - system structure and data flow

INDEX OF ARTICLES (1972-1979)

AD RATES

NUCLEAR MATERIALS MANAGEMENT
Journal of the Institute of Nuclear Materials Management
Founded—1972

I. General Advertising Rates

Inside Front Cover	$280	(Full)
Inside Back Cover	$280	(Full)
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Full Page	$180	
Half-Page	$115	
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*Discount available for multiple insertions. Color rates provided on request. Ad position requests recognized as completely as possible.

II. When Published

Six times a year: Spring, Summer, Fall, and Winter, Annual Meeting Printed Program, and Proceedings of the Annual Meeting.

III. Description

The official journal of the Institute of Nuclear Materials Management published by the INMM at Kansas State University, Manhattan. The only international scholarly journal in the field of Nuclear Materials Management.

IV. Ad Deadline

Five weeks prior to publication date. Offset printing used. For Spring 1980 (Volume IX, No. 1) Issue, the deadline is Friday, March 21, 1980.

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Full-Page	44 picas by 59.5 picas
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Filler	21 picas by 8 picas
Professional Directory	14.5 picas by 7 picas deep ($35/insertion)

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765 subscriptions as of November 30, 1979. Domestic rates: Single Copy, $9.00; Proceedings of Annual Meeting, $20.00; One-Year Subscription, $30.00; Foreign Rates: Single Copy, $11.00; Single Copy of Proceedings of Annual Meeting, $35.00; One-Year Subscription, $40.00, Canada and Mexico; $50.00 (All Other Countries).

VIII. Subscription Analysis

Practitioners and educators in the field of Nuclear Materials Management. Employed by Industry, Government, the University Community.

IX. Book Reviews and Product Publicity

Yes. Write to Editor. (See below).

X. For Further Information

Mr. Thomas A. Gerdis, Editor
NUCLEAR MATERIALS MANAGEMENT
Journal of INMM
P.O. Box 6247
Louisville, Kentucky 40207
Phone: 502-895-3953

Editor's Note: For years 1972-1977 (Volumes 1-6 of **Nuclear Materials Management**), No. 3 is the proceedings issue of that year. Beginning in 1978 (Volume VII), No. 3 becomes a regular issue of the Journal. The proceedings of the 1978 annual meeting is designated, Volume VII, Proceedings Issue. Future issues of the INMM Proceedings will be designated similarly, i.e., in 1979 it will be designated Volume VIII, Proceedings Issue. Copies of the tables of contents for INMM Proceedings issues are available on written request to the editors.

Organization of DOE-OSS

(Continued from Page 49)

installations under the cognizance of the Department. Specifically, this Division engages in activities to assure the proper implementation of security standards and systems at Headquarters and in the field. These responsibilities are carried out through the management of systematic programs for personnel security, internal security, visitor control, physical security, security education and awareness, document and information control, and the coordination of activities associated with violations of Federal statutes affecting the security of Restricted Data, National Security Information, strategic resources or installations.

In addition to DOE-wide oversight responsibilities, the Division manages a program for insuring the reliability of DOE Headquarters personnel in Critical/Sensitive positions, including those requiring security clearances for access to Restricted Data and National Security Information. This personnel security activity involves the maintenance of DOE-wide budget responsibility for security investigations; a computerized central personnel clearance index system; and the granting of appropriate clearances for members of Congress, Congressional staff, and employees of the Executive Branch in the Washington, D. C., area. The physical security of Headquarters operations and facilities, and the enforcement of security standards at Headquarters contractor installations is an integral part of the Division's areas of concern. The protection of program operations information and including the institution of appropriate countermeasures to preclude the compromise of sensitive data through surreptitious listening devices, emanations and/or the penetration of computer-related activities are also responsibilities of this Division.

The security programs of the Department are administered in accordance with appropriate laws and Executive Orders, including the Atomic Energy Act of 1954, as amended, Executive Orders 10450, 10865, and 12065; and DCI Directives associated with the protection of foreign and compartmented intelligence information.

Facilities Security Branch

This Branch is responsible for: (1) conducting surveys and inspections as to the suitability of security systems at DOE and DOE contractor facilities and installations; (2) conducting a program of indoctrinations, and continuing security education and awareness among employees of the Headquarters; (3) administering a program of classified document and information control for the Headquarters, and including operation of the DOE-wide Top Secret central registry; and (4) maintaining a central register of Energy facilities and installations of security interest.

Internal Security Branch

This Branch is responsible for: (1) DOE-wide counterintelligence, counterespionage and security violations procedures; (2) conducting intelligence analyses and assessments, and for coordination of intelligence and counterintelligence information affecting DOE classified and sensitive Energy programs with other agencies and within DOE; (3) providing expert technical advice on counterintelligence and counterterrorism responsibilities of the DOE; (4) maintaining liaison relationships with the FBI, CIA, Department of State, and the DOD on central intelligence and internal security matters; and (5) managing a system of control over visits by foreign nationals to DOE classified facilities, and visits by DOE-cleared employees to Communist-bloc nations.

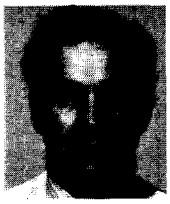
Operations Security Branch

This Branch is responsible for: (1) the development of Department-wide Operations Security procedures to insure the integrity of sensitive program logistics, plans, and developmental activities; (2) the conduct of research and analyses of activities associated with sensitive departmental programs to insure the continued integrity of such programs; (3) the direction of a Department-wide program for insuring the integrity of communications equipment used in electrical or electronic transmission of classified or official information or material; (4) the coordination of technical and computer security policy with other agency and intelligence community programs; and (5) the maintenance of appropriate technical inspection equipment and conducting inspections of sensitive Headquarters areas.

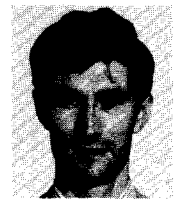
Personnel Security Administration Branch

This Branch is responsible for: (1) the development of criteria and procedures for DOE-wide application of personnel security and employee suitability policy; (2) the management of the central Personnel Security Administrative Review Program; (3) the management of the DOE budget controls for security investigative processing; (4) directing the processing of investigations, screening, analysis and adjudication of clearances or suitability for employment in Headquarters cases; (5) conducting the Headquarters reinvestigation program; (6) processing and adjudicating interim access authorization cases, Congressional and other Washington agency employee "Q" clearance actions; (7) managing the central personnel clearance index and personnel security files retention systems; (8) managing the Headquarters visitor control program; and (9) administering the Headquarters Security FOIA and Privacy Act responsibilities.


Argentesi


Carter


Foote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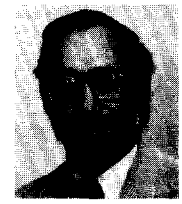
Gailar


Hodges


Kramer


Reber

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Flavio Argentesi is the Group Leader of the Nuclear Material Statistical Accountancy activity at the Joint Research Centre of the Commission of the European Communities at Ispra in Italy. This activity forms part of the safeguards project of the J.R.C. and is a support activity to the Safeguards Directorate (DG XVII) of the Commission. The accountancy activity is currently involved in development of data base systems implementing statistical analyses of accountancy declarations for the Safeguards Directorate. Dr. Argentesi is involved in J.R.C. research on reactor safety and is the author of many papers in the field of population dynamics modeling.

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Frank B. Foote (B.S., Physics, California State University at Long Beach, 1975, and currently completing work for M.S., Electrical Engineering, University of Southern California) is a Member of the Technical Staff in the Lasers and Optics Department of the Electronics Research Laboratory at The Aerospace Corporation. He has been involved in far infrared/near millimeter wavelength sources and detectors since 1973, and is a member of the IEEE.

Michael Franklin is a Statistician working in the Nuclear Material Accountancy activity of the Joint Research Centre of the Commission of the European Communities at Ispra in Italy. This activity forms part of the safeguards project of the J.R.C. and is a support activity to the Safeguards Directorate (DG XVII) of the Commission. He is directly involved in the development of data base systems implementing statistical analyses of accountancy declarations for the Safeguards Directorate.

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Dean T. Hodges (Ph.D., Applied Physics, Cornell University, 1971) is Head for the Lasers and Optics Department in the Electronics Research Laboratory at The Aerospace Corporation. He performed research in several areas with the effort centered on molecular gas lasers, the techniques for generating coherent radiation in the infrared and far infrared/near millimeter wave region (40 um - 2 mm), and new detector/receiver technology for the far infrared. An outgrowth of this research is the application of imaging in the far infrared for personnel inspection, contraband detection, and non-destructive testing. He currently supervises research in a wide range of areas including new far infrared techniques, opto-electronic and integrated optical devices, and laser communications and its related technologies. Dr. Hodges is a member of IEEE and OSA.

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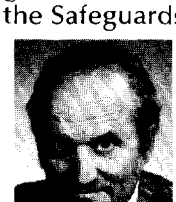
Earl E. Reber (B.E.E., Electrical Engineering, The George Washington University, Washington, D.C., 1957) is a Member of the Technical Staff in the Lasers and Optics Department of the Electronics Research Laboratory at The Aerospace Corporation. He has been involved in research on the environmental effects on millimeter and submillimeter wave propagation in the atmosphere. He is currently involved in the development of radiometric imaging systems at millimeter and near millimeter wavelengths for a variety of applications including the detection of objects concealed on personnel.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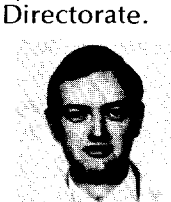
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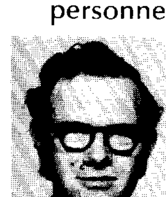
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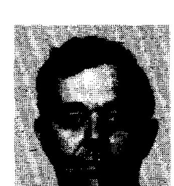
Walker

Institute Of Nuclear Materials Management

Treasurer's Report for Period October 1, 1978 Through September 30, 1979

Cash Balance September 10, 1978	**$ 29,899.96**
Receipts:	
Dues	11,204.50
Journal Income	
Subscriptions	4,636.78
Advertising	1,397.00
Page Charges	7,294.00
Reprints	1,011.50
Proceedings Income	
Annual Report	10,571.00
Page Charges	4,124.09
Advertising	675.75
Miscellaneous Income	42.50
Education—Statistics School	10,900.00
Annual Meeting	
Registration	37,437.46
Exhibitors	1,925.00
Special Activities	1,371.00
Guest Tickets	1,315.00
Refreshment Sponsors	2,100.00
Interest Income	1,489.18
IAEA Workshop	8,470.00
Transfer Funds	17,493.72
Total Receipts	**$123,458.48**
Expenditures:	
Journal Editor	11,851.90
Journal Editor—Travel	2,439.45
Editor—Moving Expense	500.00
Proceedings	
Printing	4,844.39
Postage	1,150.02
Clerical	267.17
Miscellaneous	163.60
Journal	
Printing	16,265.51
Postage	5,472.43
Clerical	2,051.77
Miscellaneous	653.83
Office Supplies	186.49
Typing Service	405.50
Telephone	223.73
Photography	196.07
Publication Support	374.80
Annual Meeting	
Chairman and Committee Expense	134.62
Registration Refunds	920.00
Reception	3,012.01
Ladies Program	2,737.77
Luncheons	5,822.10
Speakers Breakfast	510.70
Miscellaneous	72.15
Administration	1,443.43
Equipment	72.00
Publicity	194.44
Pre-Registration and Registration	4,502.83
Telephone	158.37
Exhibitors	462.50
Special Activities	142.76
Postage	394.79
Letterhead and Envelopes	150.40
Refreshment Breaks	1,955.04
Administration	2,671.31
Public Information	678.76
Education	
Committee	177.86
Statistics	9,838.63
Material Control	120.83
Physical Security	100.00
N-15 Standards	406.81
Certification	425.82
Membership	1,372.90
Safeguards	226.07
Awards	380.81
Student Awards	1,158.16
Chapter Expense	323.79
General Miscellaneous	344.41
IAEA Workshop	5,949.16
ANS-INMM Meeting	864.75
Membership Directory	
Printing	10.00
Postage	30.00
Total Expenditures	**$ 94,812.64**
Cash Balance September 30, 1979	**$ 58,545.80**
Net Gain or Loss:	
Total Receipts	$123,458.48
Less Transfer of Funds	17,493.72
Net Receipts	$105,964.76
Total Expenditures	94,812.64
Net Gain	$ 11,152.12

Ralph L. Schellenbaum (M.S., Physics, University of North Dakota, 1952) is a member of the technical staff in the Entry Control Systems Division at Sandia Laboratories, Albuquerque, New Mexico. He has been involved in far-infrared and x-ray system development and application in the Nuclear Security Systems Directorate.

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