VOLUME XIV, NUMBER 1

NUCLEAR MATERIALS MANAGEMENT

INMM

INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT

JOURNAL OF THE INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT

FEATURE ARTICLES

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EDITORIAL

DR. WILLIAM A. HIGINBOTHAM
Brookhaven National Laboratory
Upton, New York

The design, operation, and improvement of safeguards systems take place in a political environment. A national safeguards and physical protection program should satisfy the citizens of that nation. International safeguards should appear to be valuable to the nations that subscribe to them. In both the national and international situations we find those who consider the safeguards as now applied to be reasonable, overly restrictive and costly, or not nearly effective enough. It may be useful, now and then, to try to understand why there are such divergent views.

One important factor is the impression different people have of the benefits of nuclear power as compared to the risks that inevitably derive from it. In the United States, for example, nuclear power does not appear to be very important to the general public, today. There is a vocal minority which has concluded that the risks of nuclear accidents and nuclear theft and sabotage far outweigh the possible benefits of nuclear power. In the safeguards area these nuclear opponents have complained that nuclear materials were not adequately protected from theft and that nuclear power reactors were not adequately protected from theft and that nuclear power reactors were not adequately protected against sabotage. In response, the government developed elaborate and expensive physical protection systems. Then, the anti-nuclear groups complained that these measures had become a threat to our free society by constraining the freedom of individuals and sanctioning armed fortresses, thus confirming their view that nuclear power should be abandoned.

In a somewhat similar fashion, there are individuals who consider that the threat of proliferation of nuclear weapons is so great that nuclear power should be denied to non-nuclear weapon states or limited to the use of light-water moderated reactors with low-enriched uranium fuel. For such individuals, international safeguards are not enough.

Those of us who are involved with safeguards consider that nuclear power is important now and that it will become more important in the future. We recognize that safeguards and physical protection systems can never be perfect, but that they are reasonably effective now and can be made more efficient and effective. We are as concerned for the preservation of civil liberties and for the rights of nations to develop the peaceful products of nuclear energy as are those who oppose nuclear power. What we must continue patiently to do is to explain the needs for domestic and international safeguards to those who question these needs and to explain to the general public how reasonable goals for domestic and international safeguards can indeed be achieved.

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CHAIRMAN'S COLUMN

YVONNE M. FERRIS
Rockwell International
Golden, Colorado

One of the features of the Journal I really enjoy is the book review. I have often recommended books to friends and business acquaintances based on the review. I have often bought the book because the reviewer so aroused my interest. What I have never done is thank the people who so faithfully review the books, issue after issue. The ones to whom we owe our gratitude are Gene Weinstock, Jack Allentuck, Jim DeMontmollin, Tony Fainberg, Les Fishbone, Doug Reilly and Karl Swyler. Each of these men does an in-depth review of books written on timely and thought provoking themes. For example, past reviews have included:

- Social and Economic Aspects of Radioactive Waste Disposal
- Born Secret—The H-Bomb, The Progressive Case, and National Security
- Before It's Too Late: A Scientist's Case for Nuclear Energy
- The War Against the Atom
- The Atomic Complex: A World-wide Political History of Nuclear Energy

Notice the wide range of material covered. Notice the complex subject matter. I urge you to read the book reviews if you are not in the habit of doing so. I also encourage you to join me in thanking each one of the above gentlemen for being so faithful in filling a journalistic need that most of us take for granted.

PUBLIC AWARENESS COMMITTEE FORMED

A Public Awareness Committee has been formed by the INMM Executive Committee. The purpose of the committee is to produce informative monographs on items of concern to the general public in nuclear affairs. Richard F. Duda, The Ralph M. Parsons Company, has been selected as chairman of the new committee. G. Robert Keepin, Los Alamos National Laboratory, will have oversight responsibility.

The initial plan of work for this committee includes identification of appropriate topics for publication, author agreement on detailed subject matter and obtaining grants dollars from the NRC's federal assistance program.

INMM FELLOWS

JAMES E. LOVETT
Chairman, Examining Committee
International Atomic Energy Agency
Vienna, Austria

The grade of INMM Fellow was accorded to Carl A. Bennett, Glenn A. Hammond, Sheldon Kops and Fred H. Tingey during the Awards Banquet in Albuquerque on July 23, 1985. This brings the total number of Fellows to ten, the other six being William A. Higinbotham, G. Robert Keepin, James E. Lovett, Ralph F. Lumb and Richard A. Schneider.

The grade of INMM Fellow is awarded to those INMM Senior Members who are considered to have made outstanding contributions to the fields of nuclear material management, safeguards or security over a period of at least fifteen years. It is not something one applies for; it is an honor granted after a three step process which includes nomination by at least five INMM members, recommendation by an Examining Committee and final approval by the INMM Executive Committee.

The Examining Committee welcomes nominations at any time. However, the examining process takes time, and nominations received after January 31 cannot be acted on in time for that year's meeting. Adherence to the following guidelines will help to assure that your nominations are processed efficiently and favorably.

1. Verify that the person you wish to nominate is a Senior Member. The By-Laws specify five years. This requirement can be waived until the grade of Senior Member has existed for five years, but the Examining Committee believes that even in this transition period a person should have been a Senior Member for a year or longer in order to be considered for the grade of Fellow.

2. Prepare a letter stating in at least moderate detail what the person has done which you think qualifies as outstanding achievement. The Examining Committee cannot act on statements such as, "John's record is widely know," even if it happens to be true. Also note that simply working in the field for 15 years (the minimum period required for consideration) is not itself an outstanding achievement.

3. Send your letter to at least four other INMM Members with a request that they endorse your recommendation. Invite these people to add their own statements as to the nominee's achievements if they wish to do so. The more information you provide, the easier it is for the Committee to accept your recommendation.

4. When you have at least five recommendations (your own plus at least four others) send the complete package to:

   James E. Lovett
   c/o IAEA, Box 200
   A-1400, Vienna, Austria
   Europe

Remember to mark your letter airmail and to use the required postage; otherwise allow an extra month for delivery.

SECRETARY'S REPORT

VINCENT J. DeVITO
Goodyear Atomic Corporation
Piketon, Ohio

As provided for in Article III, Section 4 of the INMM Bylaws, I hereby notify each member of the results of the FY86 election ballot. The following officers were elected:

Chairman	Yvonne M. Ferris
Vice Chairman	Charles M. Vaughan
Secretary	Vincent J. DeVito
Treasurer	Robert U. Curl

The following two individuals were elected as members of the executive Committee:

John F. Lemming
Nancy M. Trahey

ANNUAL MEETING PROGRAM COMMITTEE FORMED

A coordinating group to administer the activities of the Technical Papers Committee is being established for the 27th Annual Meeting, June 22-25, 1986 in New Orleans, Louisiana. Charles E. Pietri, U.S. Department of Energy, is chairman. Members at this time include Don Six—Rockwell Hanford Operations, Dee Sherrill—Rockwell Rocky Flats Plant, James A. Tape—Los Alamos National Laboratory and Dennis L. Mangan—Sandia National Laboratory.

This group will assist in the review of contributed papers and will monitor the efforts of technical specialists who are selected to solicit papers for the technical program.

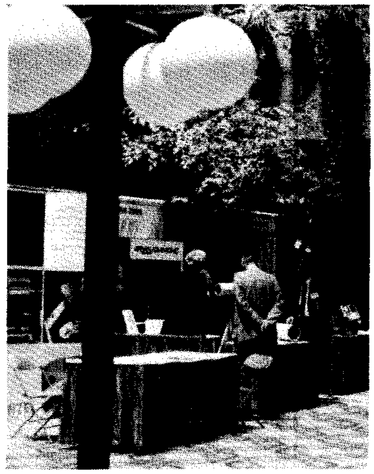
The technical specialists group is based on the INMM Committee on Communications and others who have volunteered their expertise. A substantial number of specialists will be added. Members now include E.R. Johnson, J.W. Arendt, D.B. Smith, J.D. Williams, D.L. Mangan, M.T. Franklin, K. Gaertner, G.R. Keepin, L. Green and M. Cuypers.

This committee is working toward the February 15, 1986 due date for contributed papers. Authors are urged to respond early to the 27th Annual Meeting "Call for Papers."

TWENTY-SIXTH ANNUAL MEETING HIGHLIGHTS

JULY 21-24, 1985
THE REGENT ALBUQUERQUE
ALBUQUERQUE, NEW MEXICO, USA

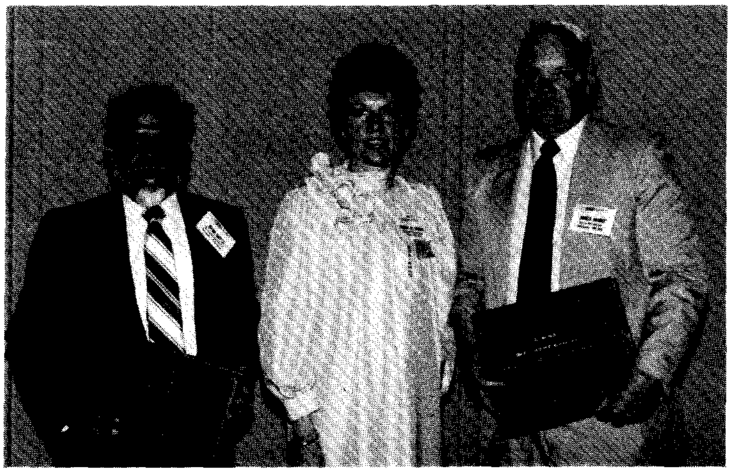
Fellows Awards were presented by James E. Lovett (right) to Carl A. Bennett, Glenn A. Hammond, Sheldon Kops (left to right). Not shown is Fellows recipient Fred H. Tingey.



Albuquerque's Mollie Trollies transported attendees to Old Town for a Mexican buffet. Sponsors for this event were Science & Engineering Associates, Inc., Integrated Security Systems and EG&G Services Safeguards & Security.

The 1985 Annual Meeting drew television coverage by local stations.

Distinguished Service Awards were presented to Dipak Gupta (left) and James Jacobs (right). Yvonne Ferris INMM Chairman congratulates them.

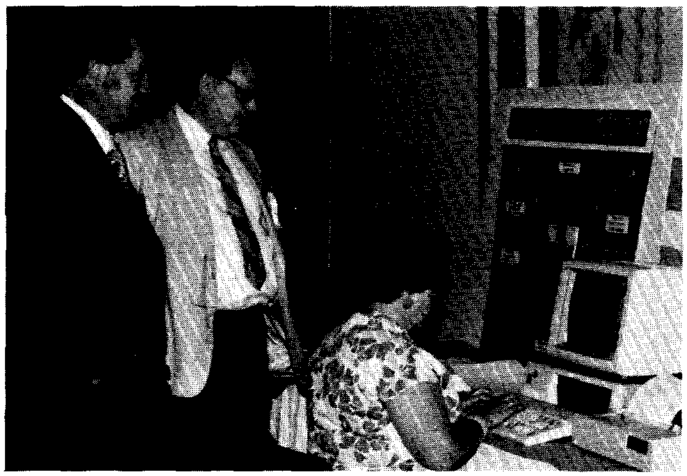


The registration area was especially busy as they welcomed over 600 attendees— INMM's largest Annual Meeting.

Twenty one exhibitors had product displays at the 26th Annual Meeting. Thirteen of our exhibitors are Journal advertisers.

Chairman Yvonne Ferris paused to talk with Sheldon Kops and Charles E. Pietri who served as Contributed Papers Chairman during one of the breaks.

The meeting included informal exchanges among attendees during breaks from the 22 sessions and 135 presentations.



The Poster Session included seven presentations. Co-chairmen were C.W. Wilson (center) and Roy G. Cardwell (not shown).

G. ROBERT KEEPIN NAMED LANL FELLOW

Dr. G. Robert Keepin has been named one of three new Fellows of the Los Alamos National Laboratory for his distinguished contributions in the field of Nuclear Materials Safeguards. To be eligible for the honor of Fellow the individual must have demonstrated outstanding contributions in a field of scientific or technical endeavor and must have shown outstanding promise for continued professional improvement.

Keepin was an Atomic Energy Commission Postdoctoral Fellow, at the University of California, Berkeley, and worked with nuclear pioneers Emilio Segre and Owen Chamberlain from 1949 to 1950. During that time he was a consultant to Argonne National Laboratory and to the Los Alamos Scientific Laboratory. Keepin came to Los Alamos in 1952 specializing in research and development in nuclear critical facilities, fission and reactor physics, and reactor kinetics and control. He was a U.S. delegate to the first United Nations Atoms for Peace Conference in Geneva in 1955 and served as IAEA Technical Advisor to the Third Geneva Conference in 1964.

From 1963 to 1965, he headed the Physics Section of the Division of Research and Laboratories with the IAEA in Vienna, Austria. Following his return to the United States in 1965, he established the Nuclear Safeguards Research and Development Program at Los Alamos. Keepin returned to Vienna again in 1982 for a two-year assignment as Special Advisor to the Deputy Director General, Department of Safeguards, IAEA.

Keepin is a Fellow of the American Physical Society, the American Nuclear Society, and the Institute of Nuclear Materials Management (INMM). He is also past National Chairman of the INMM and has received a distinguished service award from that organization and from the American Nuclear Society. Bob returned to the Laboratory from Vienna in April.

As a Laboratory Fellow, Bob will devote a significant portion of his time to research topics related to safeguards and security. The Laboratory Fellows play a key role in stimulating original research by inspiring and guiding the work of other staff members, and by advising and consulting throughout the Laboratory.

IN MEMORIAM DR. FRANK MORGAN

Dr. Frank Morgan, whose technical contributions strongly influenced the development of international safeguards, died suddenly of a heart attack on April 26, 1985, at the age of 63. He had retired in 1983 as Deputy Director for Chemistry and Materials of the United Kingdom Atomic Weapons Research Establishment at Aldermaston.

Dr. Morgan, who was by training a radio-chemist, was a key figure in the British weapons testing program and was an expert on the interpretation of debris from weapons testing. Following the moratorium on atmospheric testing, he turned his attention to other fields, notably safeguards, the monitoring of health effects and the improvement of safety standards in the nuclear industry. He formed a safeguards research group at Aldermaston in the mid-60's, was active as a consultant to the IAEA in connection with the implementation of safeguards under the Nuclear Non-Proliferation Treaty, and was a prominent member of the British delegation to the safeguards committee which prepared the model safeguards agreement. His contributions to the development of balanced criteria for safeguards implementation were particularly important. He discontinued active participation in safeguards development in the mid-70's, but kept an interest in this activity throughout the remainder of his career.

While his theoretical knowledge was profound, he was first and foremost a practical man who believed with unquenchable enthusiasm that science could help with the problems of life—from defense to cookery. This belief enhanced his outstanding virtuosity as a solver of technological problems. His house was full of gadgets and inventions of his own making, which all worked. He will be remembered by his friends and colleagues as a man of great originality, honesty and charm.

PIETRI GAINS APPOINTMENT AT US DOE ARGONNE

Charles E. Pietri has been appointed Physical Science Administrator, Office of the Assistant Manager for Laboratory Management, Chicago Operations Office, U.S. Department of Energy, Argonne, Illinois. Charles has spent all of his previous 27 years of federal service with the New Brunswick Laboratory, USDOE (USAEC and USERDA) as Chief, Plutonium Chemistry Section; Chief, Analytical Chemistry Branch; Assistant Director for Operations; and, lastly, Senior Scientist. Prior to federal service, he worked for E.I. duPont de Nemours & Co. at Oak Ridge National Laboratory, Savannah River Plant, and Savannah River Laboratory. He will be primarily responsible for the overview and coordination of activities in the development of institutional planning for all laboratories operated under contracts administered by the Chicago Operations Office. Charles will continue to be involved in safeguards work, and with professional activities and committees such as INMM, ANS, ACS, ISO, and DOE/IAEA task groups. He is currently INMM Annual Meeting Technical Papers Chairman.

INMM CALENDAR OF EVENTS

JANUARY 22-24, 1986
Spent Fuel Storage Seminar
Loew's L'Enfant Plaza
Washington, DC

Chairman
E.R. Johnson

JANUARY 22-24, 1986
Propagation of Errors Workshop
Loew's L'Enfant Plaza
Washington, DC

Chairmen
Darryl B. Smith
James Tape
Steve Baloga

FEBRUARY 11-12, 1986
Executive Committee Meeting
Chicago, IL

Chairman
Yvonne M. Ferris

MARCH, 1986
Security Force Training Workshop

Chairman
James D. Williams

JUNE 22-25, 1986
27th Annual Meeting
The Fairmont Hotel
New Orleans, LA

Chairman
Charles M. Vaughan

OCTOBER 1986
Physical Protection Workshop
on Information Display and
Control Systems

Chairman
James D. Williams

TO BE ANNOUNCED
Decontamination and Decommissioning
Seminar
Hyatt Regency Washington
on Capital Hill
Washington, DC

Chairmen
E.R. Johnson
John A. McBride

TO BE ANNOUNCED
Shortcourse on Safeguards
Certification
Chairman
Barbara M. Wilt

SUSTAINING MEMBERSHIP PLAQUES AWARDED

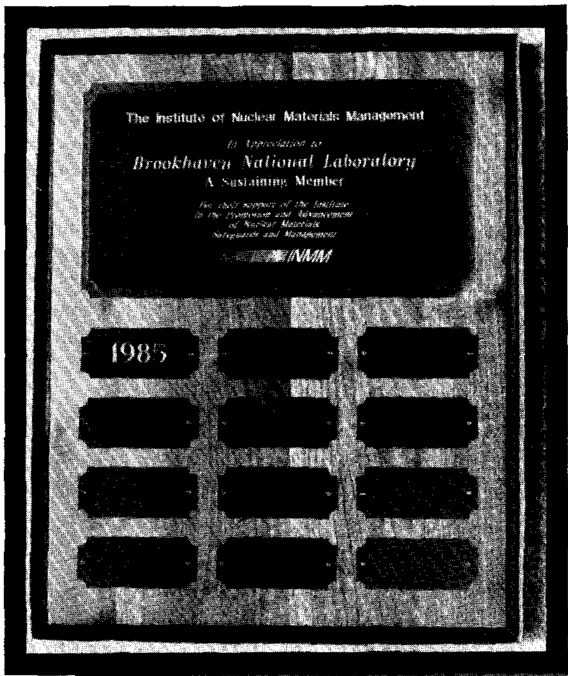
Twelve companies who now support INMM as sustaining/corporate members were awarded a recognition plaque. The plaques were presented during the 26th Annual Meeting awards banquet on July 23, 1985 in Albuquerque, New Mexico. Sustaining members are:

Battelle Columbus Laboratories
Brand Periodicals
Brookhaven National Laboratory
EG&G Idaho
International Atomic Energy Agency
Los Alamos National Laboratory
RCA Government Communications Systems
Rockwell International, Rocky Flats Plant
E.I. DuPont, Savannah River Plant
Uranium Enrichment Corporation
URATOM
E.R. Johnson Associates

Sustaining member contributions are based upon the total number of corporate employees. Annual dues are as follows:

Total Number of Corporate Employees	Annual Dues
0-19	$250.00
20-49	$500.00
50 or more employees	$750.00

In order to join as a Sustaining Member, contact Beth Perry at INMM headquarters for an application.



N14 COMMITTEE REPORT

JOHN W. ARENDT
Chairman, N14 Committee
JBF Associates, Inc.
Knoxville, Tennessee

The annual N14 meeting was held in Washington, DC on September 17, 1985. The meeting was preceded by panel discussions on September 16, 1985 with NRC, DOE and DOT personnel participating. Approximately thirty people attended.

The status of standards activities includes one draft standard being ballotted, six draft standards ballotting completed and negative comments being resolved, four draft standards in process of ANSI approval and publication and six proposed standards in various draft stages.

The committee is in the process of placing N14 members into interest categories in compliance with ANSI procedures.

Chairman Arendt gave a status report on N14 activities at the DOE Radioactive Materials Workshop, October 28-31, 1985 in Knoxville, Tennessee. He has also submitted a summary of N14 activities for a paper to be given to PATRAM '86 in Switzerland.

The next meeting of the committee is scheduled for January 9-10, 1986 in Knoxville, Tennessee.

TECHNICAL WORKING GROUP ON PHYSICAL PROTECTION REPORT

JAMES D. WILLIAMS, CHAIRMAN
The WLS Group
Albuquerque, New Mexico

The presently scheduled and planned activities of the Technical Working Group on Physical Protection are listed below:

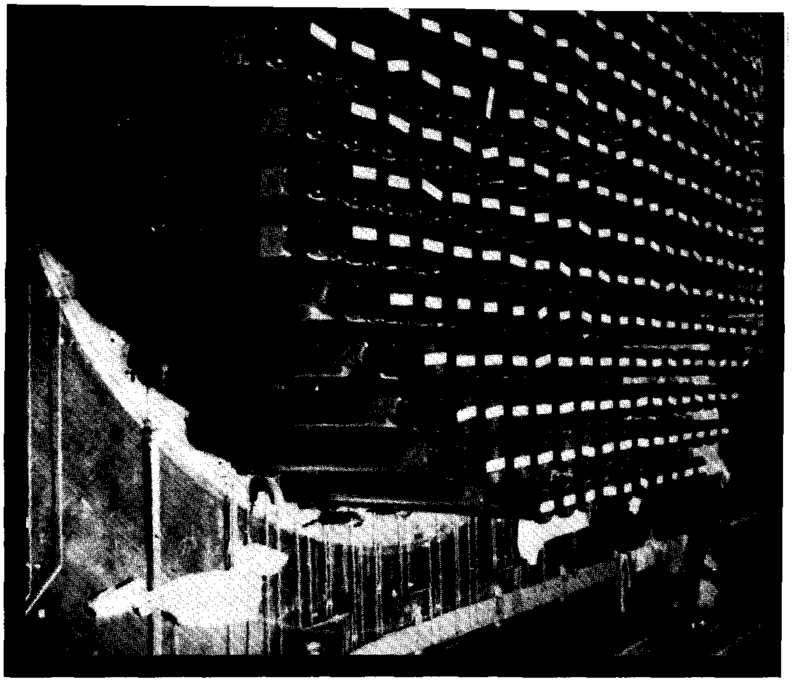
- Security Force Training—March 17-20, 1986 (Tentative). Albuquerque, New Mexico
- Information Display and Control Systems—October 1986 (Tentative).

Workshops on other subjects of interest to physical protection personnel will be considered if enough interest is expressed. Additional details about the group activities are given below.

General

The Twenty-Seventh Annual Meeting of the INMM will be held next Summer in New Orleans, Louisiana. We are soliciting topics now for physical security sessions for that meeting. We also encourage all of you to be thinking about papers that you could present or that could be presented by someone you know about. If you will get that information to me I will contact the persons and provide follow-up. We received many good comments on the quality and quantity of the papers at Albuquerque and would like to have even a better meeting in New Orleans. We would like to have more physical protection papers published in this Journal. I will assist you in any way that I can. You can contact me at (505) 298-9524.

The Workshop "Integrated Physical Security System Designs For Power Plants and Other High Security Facilities," was held October 7-11, 1985 in Toronto, Ontario, Canada. This was the first time to hold one of the Technical Workshops of Physical Protection outside the United States and it was very successful. Additional information about this workshop is given below. The success of this workshop was due primarily to the efforts of Jim Hamilton, Program Chairman, Goodyear Atomic; and the efforts of Jim Jones and Chelk Jin, Ontario Hydro.



Fuel rod area at the Darlington plant.

Integrated Physical Security System Designs for Power Plants and Other High Security Facilities

The Workshop held Oct. 7-11, 1985 in Toronto, Canada was a success. We had 52 paid attendees (18 from Canada, 2 from Japan and the remainder from the United States). We were visited for one day by Mr. Ed Kerr from the Vienna Chapter.

The workshop followed the format that has been followed in previous Physical Protection Workshops. The major addition to this workshop was a one day trip to two of Ontario Hydro's nuclear power plants. The Darlington Plant is under construction and we were allowed go into the fuel rod area. The Pickering plant has been in operation for sometime and is a fully operational plant with an outstanding visitor area. Our Keynote Speaker was Mr. John Ewashko, from Atomic Energy Limited, Canada. The luncheon speaker was Mr. Mike Jonckheere, Correctional Service Canada and the banquet speaker was Mr. Sam Horton, Executive Vice President, Ontario Hydro. All of these men did an outstanding job and gave us valuable insights about physical security philosophy and implementation in Canada.

Security Force Training Workshop

The date of this workshop has been tentatively set to be held March 17-20, 1986. The meeting location has been changed from the Washington DC area to Albuquerque, New Mexico and it will probably be held in the Albuquerque Marriott Hotel. Additional details can be obtained from Mr. Fred Crane, IEAL, (202) 342-6717.

Control room at the Pickering plant.

MILTON CAMPBELL RECEIVES ASTM AWARD OF MERIT

PHILADELPHIA, PA—Milton H. Campbell, principal chemist for Rockwell Hanford Operations of Rockwell International, Richland, Washington, is a 1985 recipient of ASTM's Award of Merit.

Campbell, of Beech Avenue in Richland, received the award at ceremonies hosted by ASTM Committee C-26 on Nuclear Fuel Cycle, held 30 July 1985 in Danvers, Massachusetts. He was honored for outstanding contributions to the development of standards for the nuclear fuel cycle, and for leadership in organizing and developing workscopes for new subcommittees.

The Award of Merit, and the accompanying honorary title of Fellow of the Society, were established in 1949 to recognize productive service to ASTM, marked leadership, outstanding contribution, or publication of papers.

Campbell has been an active member of Committee C-26 since it was founded in 1969. He serves on numerous C-26 subcommittees and is the primary author of several C-26 standards. He is a past chairman of Subcommittee C26.08 on Training and Certification and currently chairs Subcommittee C26.12 on Safeguards Applications. Campbell was the 1982 recipient of C-26's Harlan J. Anderson Award, presented for distingushed and meritorious service.

A native of Billings, Montana, Campbell received a B.S. degree in chemistry in 1951 from Montana State University and an M.S. degree in engineering in 1961 from the University of Washington. He has been employed in the nuclear industry for 30 years, holding positions of chemist or nuclear engineer for General Electric, Atlantic Richfield, and Exxon Nuclear Company. He joined Rockwell Hanford Operations in 1983.

Campbell also holds membership in the American Chemical Society, the American Nuclear Society, and the Institute of Nuclear Material Management.

IAEA DIRECTOR GENERAL H. BLIX ADDRESSED VIENNA CHAPTER MEETING MARCH 26, 1985

As was expected, a fully booked luncheon group turned out for the Director General's talk. Mr. Blix's talk addressed two main areas of Safeguards—its political and administrative frame work and its outlook for the future. He began with some general remarks by stating that Safeguards is progressing well, but there is still much to do in the consolidation and development of operations, the success of which depends on us. Specifically in the political arena, there had been problems for the Safeguards image following the Israeli bombing of OSIRAK in 1981 and the ensuing negative publicity. He felt the criticism had been refuted extremely well by the then DDG of Safeguards, Mr. Gruemm.

He went on to say that the setting of Safeguards' goals is not a scientific operation. A measure of judgement also enters into it. States are critical about various things such as the number of inspections, ARIE and the burden they claim is placed on facility operators—but the important point is that the present goals have been accepted and have enjoyed a consensus. They should not be modified until a new consensus emerges. If one were to err in setting goals, it is better, however to err on the safe side. He went on to say that he was ready to expand the budget for Safeguards if necessary, but he would prefer to see improvement in the efficiency and effectiveness. In one way a zero growth budget might be healthy in that it would give us time to evaluate and improve the current operations.

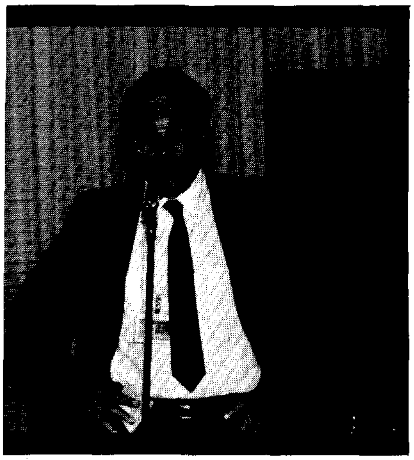
Speaking about the internal functioning of the Department, Mr. Blix acknowledged that some frictions exist in all bureaucracies. Team work was essential. To assist in achieving team work, Mr. Blix strongly advocated the "open door policy." Communication was not only desirable but a responsibility. Staff members should express their views. Quoting an old proverb, Mr. Blix said "he who listens to advice is wise." It did not necessarily mean that the boss had to go by the advice. He warned also that the approach he recommended must not deteriorate into an endless discussion club.

Concerning the Safeguards staff conduct three points were made. First, that while a CIR is needed, nothing can replace the judgment of an inspector; second, that unvarying politeness vis-a-vis Member States is required which should be practised not from a position of servility but of correctness, and third, that inspectors might be able to assist in disseminating public information by the distribution of some printed Agency documents.

Finally, looking to the future, Mr. Blix spoke about the assurance that verification brings to the international community and the possibilities that Safeguards verification may have in the area of disarmament. Speaking about the various agreements and treaties, he emphasized that it is less the particular path to non-proliferation that matters than that non-proliferation itself is to be achieved. The lack of a complete test ban on nuclear weapons is certainly a strain on NPT. However, disarmament should not be seen as a direct quid pro quo for non-proliferation. NPT could be made more attractive by the transfer of technology, thus balancing technical assistance with Safeguards.

In summing up, Mr. Blix stated that while many factors are outside the influence of the Agency, by doing our job an environment can be created for the acceptance of non-proliferation. The Chairman, on behalf of the Chapter, would again like to thank Mr. Blix for taking the time in his busy schedule to address the group.

Joe Nardi is Chairman of the Vienna Chapter, INMM.



INMM Chairman Yvonne Ferris addressed the May meeting of the Vienna Chapter.

VIENNA CHAPTER NEWS

Key speakers during last year's monthly meetings of the Vienna Chapter included Dr. Hans Blix, Director General, IAEA (see highlights of his presentation in this Journal), Dr. Peter Tempus, Deputy Director General, Department of Safeguards, IAEA and Yvonne Ferris, Chairman, INMM.

The new executive committee took office on July 1, 1985. Members are:

Chairman	Joe Nardi
Vice Chairman	Samir Morsey
Treasurer	Hattie Carwell
Secretary	Tom Shea
Member at Large	Tom Canada
Member at Large	Winston Alston
Past Chairman	Tom Beetle

Two addresses are used by IAEA. They report that P.O. Box 100 is for official business and P.O. Box 200 is for private mail. Mail addressed to P.O. Box 100 is opened by the Registry and then forwarded to the addressee. The private mail is not opened by the Registry.

Vienna Chapter meeting attendees: Maija Asunta-Johnson, Marta Tarko, Ray Parsick, Yvonne Ferris, Syl Suda, Joe Nardi.

PACIFIC NORTHWEST CHAPTER HOLDS SYMPOSIUM

The Pacific Northwest Chapter held its annual safeguards symposium on October 3, 1985. The symposium was chaired by Dean Scott, Manager, Safeguards, Battelle, Pacific Northwest Laboratories. This year's symposium featured eleven speakers covering such diverse topics as statistics, physical security, waste management, IAEA and general topics on safeguards.

The keynote speaker was Mr. Harold W. Ransom, Branch Chief of Safeguards from DOE's Hanford Field Office. His topic title was "Safeguards—You've Come a Long Way Baby" and reflected upon the progress safeguards has made at Hanford during the past twenty years.

Other topics that were of particular interest:

"Hanford Patrol TRT Training Programs"—R.E. Marshall
"IAEA Physical Inventory Verification Program for Mixed Oxide Fuel Fabrication Facilities"—A.W. deMerschman
"When the Same is Difference"—A.W. Wilson
"Low Enriched Uranium Safeguards Reform Rule"—R.A. Schneider

Attendance at the symposium was around sixty people and represented the four major Hanford contractors and Exxon Nuclear.

The symposium was established as an information exchange between DOE, the various contractors, the safeguards community, operations personnel, and technicians in related fields. Each year the symposium has grown in the number of papers presented, their quality and expertise of the presenters. The symposium has now been held four years and has been chaired each of these years by Dean Scott.

N-15 COMMITTEE REPORT

OBIE P. AMACKER, JR.
Chairman, N15 Committee
Battelle Pacific Northwest Laboratories
Richland, Washington

SUMMARY OF N15 ACTIVITIES

In September 1985, Obie P. Amacker, Jr. assumed the chairmanship of the N15 Committee replacing George Huff. The position of vice-chairman is vacant (needed), and D.J. (Jim) Frank is the secretary.

Currently there are eight "current" approved standards. Three of the eight are due for review in the coming year and a conserted effort will be made to complete the review process on time.

Thirteen of the approved standards developed by N15 are out of date and need to be reviewed (reaffirmed, revised, or withdrawn): five of the standards have received extensions to 11-85; six have extensions to 11-86; one is in need of an extension; and one needs to be withdrawn.

There are nineteen "proposed standards" in various stages of development that fall under N15. The development of some of the proposed standards is progressing very well and hopefully several of them will be approved in the coming year. Three of the proposed standards are candidates for withdrawal and decisions regarding withdrawal need to be made.

STATUS OF STANDARDS

Subcommittee	Current	Out of Date	Proposed
INMM-1		N15.8-1974 N15.9-1975 N15.13-1974	P/N15.25
INMM-2		N15.10-1972	
INMM-3	N15.15-1981	N15.5-1972 N15.16-1974 N15.17-1975	P/N15.29 P/N15.30 P/N15.31 P/N15.32
INMM-5	N15.41-1984		P/N15.? P/N15.? P/N15.? P/N15.?
INMM-6		N15.3-1972	
INMM-7	N15.11-1983 N15.38-1982		P/N15.24 P/N15.38a P/N15.?
INMM-8		N15.18-1975 N15.19-1975 N15.20-1975 N15.22-1975	
INMM-9	N15.35-1982 N15.36-1983 N15.37-1981	N15.23-1979	P/N15.33 P/N15.34 P/N15.39 P/N15.45
INMM-10	N15.40-1981		P/N15.43 P/N15.44 P/N15.48
INMM-11			P/N15.28
INMM-14			P/N15.46 P/N15.47
TOTALS	8	13	19

ACTION PLAN

Submit an extension request for N15.23-1975 immediately.

Complete the review process of standards with extensions until 11-85.

N15.10-1972
N15.5 -1972
N15.18-1975
N15.19-1975
N15.20-1975

Resolve the "lost" charters from INMM-5, Measurement Controls, and number assignments.

Complete the withdrawal of N15.3-1972.

Initiate the review process (reaffirm, revise or withdraw) for standards that are due in 1986 and initiate extension requests if necessary.

N15.15-1981
N15.37-1981
N15.40-1981

Resolve the withdrawal questions regarding the proposed standards.

Secure and distribute copies of the new ANSI Manual to all Subcommittee Chairman—"STYLE MANUAL for the Preparation of Proposed American National Standards" (9-85)

Promote the timely completion of the review process for standards with extensions to 11-16.

N15.8 -1974
N15.9 -1975
N15.13-1974
N15.16-1974
N15.17-1975
N15.22-1975

Encourage the completion of the "proposed standards"

Encourage the early review of standards that will be due for review in 1987.

N15.38-1982
N15.35-1982

SAFEGUARDS COMMITTEE REPORT

LEON D. CHAPMAN
Chairman, Safeguards Committee
BDM Corporation
Albuquerque, New Mexico

The INMM Safeguards Committee met at the Annual INMM meeting in Albuquerque, NM on Monday, July 22, 1985. The following topics of discussion prevailed at the meeting:

1. Risk Assessment and Methodology for Safeguards Systems
2. Recent IAEA Experience—Combustion Engineering
3. Elimination of Uranium Category Accounting for LEU Exxon Nuclear Company, Inc.
4. Future regulatory changes
5. Subcommittee reports.

In the first area of Safeguards methodology, the issue was: should INMM be involved in setting any standards in this area? DOE is moving to standardize their inspection methodologies. The Safeguards Committee felt this area should not be addressed by the INMM at this time.

Tom Bowie, Combustion Engineering, provided a detailed update on the experiences Combustion Engineering (CE) has had during the recent IAEA inspections. CE is getting ready for their final audit in September by the IAEA, there were some problems to convert the current inventory information to the format required by the IAEA inspectors. There was sometimes a language barrier with inspectors and when different inspectors came to the site, the facility information had to be retold to the IAEA. Fuel rod assemblies were checked with counters and scanned for enrichments. The IAEA will have accomplished three physical inspections and ten record audits by the end of the inspection phase. In all, the IAEA inspection was a good experience for CE.

Dick Schneider presented the Exxon problems with the accounting of LEU by category and the corresponding MUF problems. Other industry representatives thought the category accountability was necessary for their financial controls regardless of any NRC requirements and, therefore, did not see any problem with the current regulations.

NRC was represented by Mike Smith. He provided an update on the reorganization of the Safeguards Division under Burnett. In addition, Mike provided updates on current rule activities in all safeguards areas of the NRC. A change on clearance requirements is coming in September, 1985, for Category I fuel facilities. A change to the reporting requirements on 10 CFR 73.70, and 71 is in progress. The MC&A reform amendment is still alive and is scheduled to be sent to the Commission in April, 1986. The status of the physical security concerns on non-power reactor facilities was discused. A study is being performed and any changes to 10 CFR 73.40 will be on hold until further information is available. The Insider Rule for power reactors will be submitted to the NRC Commission for action in August 1985. A final rule on spent fuel shipments will be sent to the Commission late this year. The NRC is apparently reducing the requirements of 10 CFR 73.50 in the storage of spent fuel. An advanced planning package will be sent to the Commission in March 1986.

SAFEGUARDS CERTIFICATION PROGRAM REPORT

BARBARA M. WILT
Chairman, Certification Committee
Westinghouse Electric Corporation
Columbia, South Carolina

Each year, in conjunction with the national meeting of the INMM, the SAFEGUARDS CERTIFICATION examination is offered to those individuals who desire to become certified. Participation in the CERTIFICATION PROGRAM is voluntary. It constitutes a strong professional committment to our industry. The rewards of the achievement are various. Presently twenty-one (21) individuals have achieved the "Specialist" status; fifteen (15) have achieved the "Intern" status. The REGISTRY is given with this article.

In addition to the examination offered at each annual Institute meeting, the SAFEGUARDS SHORT COURSE will also be offered. This year it is anticipated to be given in the winter of 1986 and the facilities to be used will be the Brookhaven National Laboratory located in Upton, New York. Formal announcements will be made to the membership describing the topics to be covered and the specific dates when the program is finalized. The SHORT COURSE is an excellent opportunity to review the various subjects which are covered in the examination process just prior to taking the exam.

If you have any questions or comments regarding the INMM SAFEGUARDS CERTIFICATION PROGRAM, please don't hesitate to contact me at the address below:

Barbara M. Wilt, Chairman, Certification Board
WESTINGHOUSE ELECTRIC CORPORATION
Nuclear Fuel Division
Bluff Road—P.O. Drawer "R"
Columbia, South Carolina 29250
(803) 776-2610, extension 313

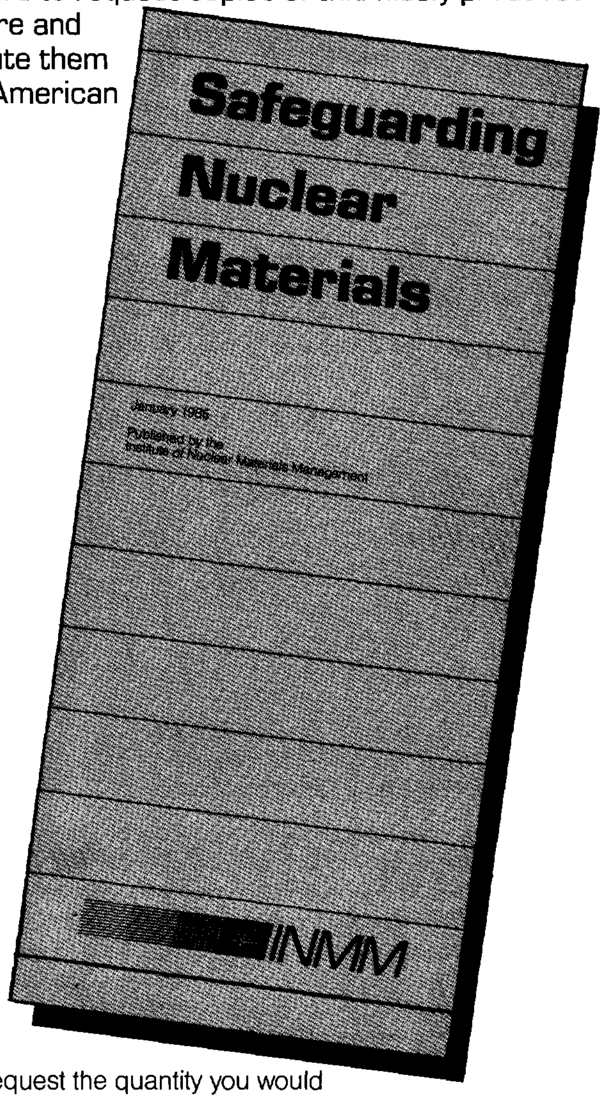
THE CERTIFICATION REGISTRY

CERTIFIED SAFEGUARDS SPECIALISTS
Eggers, Robert L.
Ferris, Yvonne M.
Hawkins, Ronald L.
Jaech, John L.
Jones, Ralph J.
Keepin, G. Robert
Kneip, Robert C.
Kops, Sheldon
Laidlow, Mark S.
Lumb, Ralph F.
Mangan, Dennis L.
Meadors, Orville L.
O'Hara, Francis A.
Prell, James A.
Tingey, Fred H.
Turel, Stanley P.
Vaughan, Charles M.
Wilson, Dennis W.
Wilt, Barbara M.
Wolvendyk, Arnold A.
Young, Edward R.

CERTIFIED SAFEGUARDS INTERNS
Carnival, Gary J.
Davenport, Leslie C.
East, Larry V.
Huggin, Benjamin A.
Ikle, David N.
Jewell, Don L.
Lu, Ming-Shin
Lyons, Fred L.
Meredith, Edwin M.
Powers, William
Robledo, Paul Jr.
Shapard, William J.
Streightiff, Jack E.
Veatch, John D.
Wyant, Richard D.

Safeguarding Nuclear Materials

Safeguarding Nuclear Materials This pamphlet is published by the Institute of Nuclear Materials Management (INMM), a private international, non-profit organization open to all professionals engaged in nuclear activities. The pamphlet is intended to provide an understanding of the measures employed in safeguarding peaceful use of nuclear energy. It focuses on facts and issues connected with domestic safeguards and international safeguards as embodied in the verification activities of the International Atomic Energy Agency. INMM would like to urge you, our current INMM Members to request copies of this nicely produced brochure and distribute them to the American public.



Simply request the quantity you would like to distribute by calling us at the INMM Headquarters:

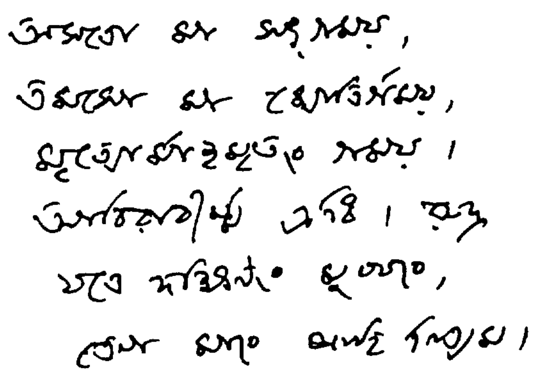
INMM
60 Revere Drive
Suite 500
Northbrook, Illinois 60062 U.S.A.
312/480-9573 or 9080
Telex: 910-221-5870

D. GUPTA'S COMMENTS

Acceptance Speech by Dipak Gupta on the occasion of the Distinguished Service Award given to him on the 23rd of July 1985 in Albuquerque, NM, USA, by the Institute of Nuclear Material Management

This is rather a moving moment for me. On such occasions I do not know why, but my mind always goes back to my childhood. I used to sit in the evenings on the banks of the Ganges, the holy river in India, and listen to the chantings of the Priests from a nearby temple. They were reciting the slokas, the verses from the Vedas. These slokas were written and collected by wise men of the past, many centuries ago. The oldest of these slokas dates back to the 12th century before Christ. Their lustre has not tarnished over the ages. They have retained their validity even today, almost all over India.

The sloka that comes to my mind now says (in Sanskrit):



The first three lines are of relevance today. Freely translated they mean:

'Let us have the wisdom
to discern truth from untruth
'Let us have the capability
to proceed from darkness into light
'Let us have the vision
to generate values in life which are independent
of time and space and therefore immortal'

I feel that the ideas contained in the sloka are in a way, being realized by the Institute of Nuclear Material Management. You will agree with me that nuclear energy is going through a very critical phase. I do not know when it will overcome this, but I am sure that it will overcome this crisis some day. And when it does, it will be among others, because of the untiring efforts of organizations like the Institute. The Institute always provides assistance to many people in such a way that they are able to produce ideas which have enabled us over and over again to discern truth from untruth. It has always attracted and motivated dedicated people, since its inception 26 years ago, who have converted ideas into practical measures, which have enabled the society involved in nuclear energy, to proceed from darkness into light. And of course it has assisted in generating visions, in developing values which are independent of time and space. Consider for a moment the program of this year. A program with unlimited frontiers! The program has not only trascended the boundaries of different scientific disciplines, it has also attracted persons from many nations. Just look at the colorful array of national flags, which form such a brilliant backdrop for the present occasion!

I feel elated, I feel deeply esteemed—
—A number of years ago I attended a conference on the Separation of Stable Isotopes in Amsterdam. Harald C. Urey was also present there. Harald C. Urey as you know discovered Deuterium and obtained the Nobel prize for this discovery in 1934. I met him once during the conference. On that occasion he came to me, looked at my coat lapel with my name tagged on it, took off his specs, and said 'Gupta? never heard of you before!' put on his specs and went away—

I feel elated, I feel deeply esteemed that the Institute has decided to reward such an insignificant person.

Thank you.

TWG ON RADIOACTIVE WASTE MANAGEMENT LOOKS FOR NEW MEMBERS AND PAPERS

The Technical Working Group (TWG) on Radioactive Waste Management is looking for new members to take an active part in its seminar and publication program. Areas of coverage by the TWG include

- Spent Fuel Storage
- Spent Fuel and High Level Waste Disposal
- Defense High Level Wastes
- TRU Wastes
- Decommissioning and Its Wastes
- Low Level Wastes.

If is preferable that members of the TWG have a current involvement in waste management activities or have experience/expertise in the management or technical aspects thereof.

The TWG sponsors 1-2 major seminars each year. For the last two years it has sponsored a seminar on spent fuel management in Washington, D.C. and is planning another for January 1985.

The TWG is also encouraging INMM members and others to submit papers on waste management for publication in the INMM Journal.

To obtain further information on the activities of the TWG, membership therein, or to submit a paper for publication—contact E. R. Johnson at 703-471-7880.

AWARDS COMMITTEE REPORT

RALPH E. CAUDLE, CHAIRMAN

The 26th Annual Meeting Banquet provided the opportunity for Chairman Yvonne Ferris to present INMM Distinguished Service Awards to Dr. Dipak Gupta of Karlsruhe Laboratory and James Jacobs of Sandia National Laboratories.

There are very few people anywhere in the world who can approach Dr. Gupta's contributions to nuclear safeguards. His work, beginning in 1967, has included the technical development of international safeguards systems; the management of a principal safeguards R & D program in the Federal Republic; a leading role in the IAEA Safeguards Committee in 1971-72, which developed the system that is the basis for NPT safeguards; active participation on the IAEA Standing Advisory Group for Safeguards Implementation, as the FRG representative from its inception through 1983; and a founder and 1979-1980 Chairman of the European Safeguards Research and Development Association. He has been very active in INMM affairs, contributing numerous papers and serving as session chairman. Dr. Gupta is an author of more than 80 technical papers dealing with safeguards and the nuclear fuel cycle. The impact of Dr. Gupta's work on international safeguards is evident throughout the worldwide international safeguards community.

James "Jim" Jacobs, an INMM member since 1977, was recognized for the highly successful role he has fulfilled in taking physical security technology from the simplistic "guards, guns, and gates" approach of the early 1970's to the highly integrated technical system posture that it has today. This evolution process and Jim's involvement began in the early 1970's, with the DOE Safe Secure Transportation System—a sophisticated system involving specially designed transporters, communications, and couriers that is used to protect all DOE shipments of special nuclear material. His next major assignment was to manage the design, development, procurement and installation support of the first advanced technology complete physical protection system. It was installed at the DOE's Pantex Facility in 1977. Subsequent to Jim's promotion to Manager of Facilities Protection Department I, he was given the responsibility of program manager at Sandia for the DOE/OSS Physical Protection Program. Under his direction and leadership, the program has provided invaluable assistance to the various DOE field offices and contractors and the nuclear industry across the board.

The contributions of Dipak and Jim reflect great credit upon themselves, their parent organizations, and the Institute.

1985 AWARD NOMINATIONS (S)

I nominate:____________________

of:____________________

Company Name/Address

____

____

for the: ☐ Distinguished Service Award
☐ Meritorious Service Award

Justification: (Qualifications/Contributions)

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____

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Signature

Return to: INMM
60 Revere Drive
Suite 500
Northbrook, Illinois 60062 U.S.A.

I nominate:____________________

of:____________________

Company Name/Address

____

____

for the: ☐ Distinguished Service Award
☐ Meritorious Service Award

Justification: (Qualifications/Contributions)

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Signature

Return to: INMM
60 Revere Drive
Suite 500
Northbrook, Illinois 60062 U.S.A.

It is now time to begin the nomination process for the 1986 awards. Each member is encouraged to think about individuals who are qualified to be considered for a Distinguished Service Award or a Meritorious Service Award. Nominations should be in letter form, explaining why the proposed individual should be considered. Specific references to publications, activities, etc. are helpful. Letters from many members in support of a nomination carry more weight than one or two endorsements. If you know of someone who deserves recognition, sit down and write the Awards Committee NOW. All nominations should be received by March 1, 1985.
Address them to:

Ralph E. Caudle, Chairman
INMM Awards Committee
c/o Wackenhut Advanced Technologies Corporation
1850 Samuel Morse Drive
Reston, Virginia 22090
(703) 471-0900

Chronology of Awards

Distinguished Service Awards
1979—W.A. Higinbotham
1980—Louis Doher
1981—Roger M. Smith
1982—G. Robert Keepin
1983—International Atomic Energy Agency, Department of Safeguards
1984—Bernard Gessiness
1985—Dipak Gupta and James Jacobs

Meritorious Service Awards
1979—None
1980—Douglas E. George
1981—None
1982—Ronald D. Smith and John H. Ellis
1983—Edward Owings and Duane A. Dunn
1984—Carl A. Bennett and Vincent J. DeVito
1985—None

Student Awards
1979—Mark H. Killinger
1980—Mohammad Sharafi, M.I.T.
1981—Houng Y. Soo, University of Washington
1982—Paul E. Benneche, University of Virginia
1983—Terry L. Zimmerman, Idaho State University
1984—None
1985—None

One-Time Awards
1978—Industry Award, presented to Tri-State Motor Transit, Inc.
1982—In Appreciation, presented to E.R. Johnson and Associates

JAPAN CHAPTER REPORT (September, 1985)

RYOHEI KIYOSE
University of Tokyo
Tokyo, Japan

The meeting of Executive Committee was held in Tokyo on October 1, 1985. The officers and the executive committee members for FY 1985-86 are as follows:

Chairman:	Ryohei Kiyose	(Univ. of Tokyo)
Vice Chairman:	Mitsuho Hirata	(JAERI)
Secretary:	Yohko Iwamatsu	(NMCC)
Treasurer:	Reinosuke Hara	(Seiko)
Ex Officio:	Yoshio Kawashima	(JAERI)
Members at Large:	Tohru Haginoya	(NMCC)
	Kazuhisa Mori	(JAIF)
	Hideo Kuroi	(JAERI)
	Masumichi Koizumi	(PNC)

Members of the Japan Chapter as of August, 1985, are 94 in number, compared to 90 in the previous year. The members are from the following organizartions:

(1) Nuclear Energy Organizations (NMCC, JAERI, PNC, JAIF)	37
(2) Government Office (STA)	2
(3) Universities	7
(4) Utility Companies	10
(5) Other Industries	38

The 6th Annual Meeting was held in Tokyo on Friday, May 31, 1985. 121 persons participated in the meeting, including 45 Japan Chapter members and 76 non-members. The program of the meeting was as follows:

Opening Remarks	M. Koizumi	(Program Chairman)
Chapter Chairman's Speech	R. Kiyose	(Chairman)

Invited Special Session — Chairman: Y. Kawashima (JAERI)

(1) Convention on the Physical Protection H. Yamada	(Foreign Ministry)
(2) Present Status and Future of NPT K. Kaneko	(JIIA)
(3) Technical Problems in Safeguards under NPT T. Haginoya	(NMCC)
(4) International Situations on Safeguards Y. Orita	(EPA)

Session 1 Reprocessing
Chairman: H. Wakabayashi (Univ. of Tokyo)
3 technical papers were presented by T. Nakai (PNC), H. Ihara (JAERI), and S. Takahashi (PNC).

Session 2 Measurement and Handling (I)
Chairman: M. Kajiyoshi (PNC)
3 technical papers were presented by K. Nidaira (NMCC), Y. Tsutaki (NMCC), and Y. Nakagome (Univ. of Kyoto).

Session 3 Uranium Enrichment
Chairman: S. Yamagami (MMC)
2 technical papers were presented by M. Hori (PNC), and T. Okamoto (Univ. of Tokyo).

Session 4 Measurement and Handling (II)
Chairman: K. Ikawa (NMCC)
3 technical papers were presented by K. Ohba (Hamamatsu Photonics), M. Kurihara (CRIEPI), and Y. Inoue (MMC).

Session 5 Safeguards Systems
Chairman: K. Nagasawa (NMCC)
2 technical papers were presented by H. Nishimura (JAERI), and M. Tsutsumi (PNC).

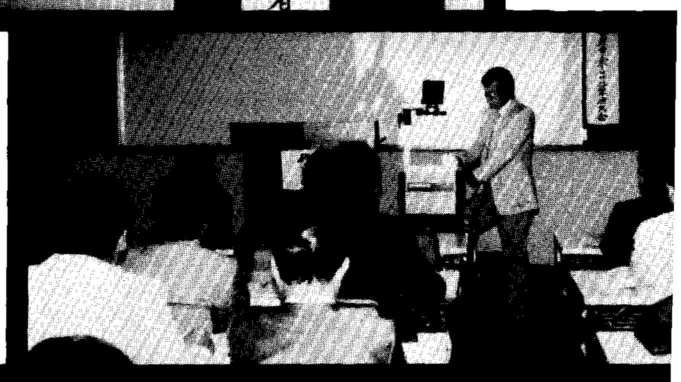
Session 6 Physical Protection
Chairman: K. Tsutsumi (PNC)
1 technical paper was presented by M. Yamada (Nippon Electronics Co., Ltd.)

General Business Meeting
Chairman: M. Hirata (Vice Chairman)
(1) Audit Report by R. Hara (Treasurer)
(2) Business Report by Y. Iwamatsu (Secretary)

Closing Remarks
M. Hirata (Vice Chairman)
The programs committee for the 6th Annual Meeting was composed of M. Koizumi (Chairman, PNC), K. Ikawa (NMCC), T. Osabe (JNF), M. Kajiyoshi (PNC), K. Shimizu (JAPCO), K. Tsutsumi (PNC), K. Nagasawa (NMCC), H. Nishimura (JAERI), S. Yamagami (MMC) and H. Wakabayashi (Univ. of Tokyo).

Opening Remarks by Program Chairman, Masumichi KOIZUMI

Chairman's Speach by Ryohei KIYOSE



Paper Presentation by a member of Japan Chapter

Closing Remarks by Vice Chairman, Mitsucho HIRATA

BOOK REVIEW

KARL J. SWYLER
Brookhaven National Laboratory
Upton, New York

FOREVERMORE–
Forevermore Nuclear Waste In America, Donald L. Barlett and James B. Steel, W. W. Norton and Co., New York, 1985
351 pp., $17.95

Messrs. Barlett and Steel are investigative reporters for the Philadelphia Inquirer. They have set out, I think, to write an expose of radioactive waste management practice in the United States. Adopting the thesis that something must be seriously wrong, rather than single out a particular group of culprits the authors offer a broad indictment of our institutions. This is put most succinctly as follows "...the federal government will build repositories to bury the fuel assemblies permanently. It will build away-from-reactor facilities to store the assemblies temporarily. It will build monitored retrievable facilities to store the assemblies for a temporarily indefinite period. It will do some combination of the three, or it will do nothing. It is this last option, inaction, that is most likely to prevail."

Why this gloomy conclusion? The authors argue that, in essence, disposal of spent fuel, low level or high level waste has not yet been successfully done; this has produced a climate such that it cannot be done. They base this argument on historical inference, and on their own analytical projections. Issues dealing with the risks involved, the state of-the-art in technology, and institutional policy are raised. One can hardly argue with the choice of topics—the difficulty is that the perspective becomes so unrelievedly one-sided that it can only be called distorted. Rather than trying to grasp the overall implications of the extensive material which the authors have collected, readers may well find themselves involved in a point-by-point rebuttal of the extreme interpretations presented.

In considering the health effects of radiation, for example, we are told that 8000 cancer deaths would occur if the U.S. population were somehow exposed at the NCRP population dose limits (170 mrem/year). This translates into about ten deaths per 300,000 people maximally exposed. We are not told that approximately 50,000 of those 300,000 people would die of cancer in any event, or that the annual death rate in automobile accidents is about 60 deaths per 300,000 people. We are not told that the EPA whole body dose limit from nuclear power operations is 25 mrem/yr, or that in 1980 the average population dose from all sources in the nuclear fuel cycle, was less than 1 mrem. Apparently current radiation protection standards and practice set levels of risk far below those which are accepted by regulatory agencies responsible for transportation safety. Does anyone seriously doubt that halving the speed limit would save more lives than halving the population dose limit?

Evidently, as many have suggested, there may be some essential difference between the way radiological risks and other risks are weighed by society. I hold no particular brief here. The idea is that any thoughtful discussion of nuclear-related safety issues must consider this point and at least try to present a balanced perspective, no matter whose views one accepts. This book does not. In fact it simply reflects this difference, and, in attempting to contrive a case for its expose', magnifies it.

Obtaining a consensus on the health effects of radiation would seem a necessary step in establishing performance standards for a HLW repository or a LLW burial ground. The book claims that such effects are not well understood, and that genetic effects associated with HLW management present a particular hazard for future generations. The arguments are not compelling.

For example, the question of genetic damage is a cornerstone of the book's sole venture on relative risk perception...i.e., that because of associated genetic effects, a low annual cancer death rate due to radiation may somehow imply more risk than a greater annual death rate due to automobiles. The authors cite one expert on the BEIR III panel as writing a strongly worded dissent to the panel report, "In part because of the genetic threat...". (According to the BEIR-III report, radiation-induced transmitted genetic effects have not been demonstrated in man. This includes studies of the Japanese nuclear bomb survivors, where radiation-induced health effects were clearly evident. From figures in BEIR-III, the unfortunate fact is that about one living child in ten is born with serious genetic defects; incremental effects due to radiation may be simply lost in this background.) Actually, the dissenting opinion in question deals with the dose-response model used to estimate the risk of cancer. There it is argued that the functional form of the dose-response curve advocated by the BEIR committee for genetic effects, i.e., the linear hypothesis, should also be used for cancer. Rather than dissenting because of the "genetic threat," the statement implicitly endorses the basic BEIR III hypothesis used to estimate human genetic risk from animal studies.

Inconsistencies of this sort cut to the heart of the matter. As the authors point out, nuclear waste management is presently something of a national dilemma. If this is to be resolved, it would seem important to understand, realistically, the extent to which differences in various expert, institutional, and public perceptions have led to it. This is not simply a question of who is right and who is wrong; rather it is to decide on a method for obtaining a consensus on what is reasonable, and then to enlist broad support in carrying out reasonable steps.

The book's views notwithstanding, this apparently can be done. The Swedish nuclear industry has drawn up a legally mandated plan for disposing of its HLW or spent fuel in a geologic repository. A consensus of Swedish and foreign experts found the plan technically adequate to demonstrate a high level of public safety. The disposal plan was then endorsed by the Swedish government, in reactor licensing actions, and implicitly by the Swedish people in a referendum on the future course of nuclear power. Briefly, it calls for burial of spent fuel in a granite formation, following retrievable storage for about forty years; the storage facility is nearly completed. The Swedes seem to have concluded that storing spent fuel for forty years inherently poses no undue risk to the public. I think this is the opinion of experts from every nation in the world where spent fuel is generated. Very possibly, it has colored the approach of planners and technical managers in this country, to the degree that the ultimate disposition of spent fuel had not been regarded as an urgent safety issue. This is a key perception, and I believe that it has had an impact on schedules.

Surprisingly, "Forevermore" does not discuss the relative risks of spent fuel storage. In the only direct observation on safety, a potential accident is described in which a reracked fuel pool suddenly loses its "cooling power," leading to fuel melting, the release of hydrogen, and to an explosion, which rips open the surrounding buildings and showers the surrounding countryside with radioactive debris. While the authors acknowledge that this is considered a "remote possibility" and has been dismissed by DOE and the utility industry, they point out that cooling system failure lead to the accident at TMI.

Not surprisingly, the source of the scenario is not referenced, and the probability that it could occur is not estimated. In fact, there seem to have been no significant radioactive releases, or any threats of such releases, associated with the storage of spent fuel as currently practiced in the U.S. In Canada, there is a twenty-year positive experience with dry spent fuel storage, using methods which are presently under NRC review for U.S. license. One is tempted to say that the technology for spent fuel storage has been "demonstrated."

The authors, I think, would argue with this interpretation. Citing leakage from HLW tanks at Hanford, trench subsidence and ground water transport at shallow land burial sites, etc., they find that "virtually every medium so far chosen to contain radioactive waste...has failed." This statement illustrates another issue—defining reasonable demonstration and performance criteria. If one can say, that steel, earth, or whatever have "failed" to contain radioactive waste, one can also say that aircraft alloys have failed to support flight and that surgery has failed to help patients. Obviously, such absolute assessments, taken out of context, are misleading. It is unquestionable that some radioactive waste management systems have failed to perform as expected. It is equally true that others have not. What is lacking here is a perspective on the relative number of such "failures," their public health consequences, and whether the record has been improving.

LWR fuel reprocessing, for example, is said to be a failure, foreclosing the option of engineered HLW forms. There is no question that the West Valley operation was a sorry experience. The authors denigrate the French program, which has thus far managed to reprocess 1000 MT of oxide fuel, in a plant not originally designed for this purpose. The book concludes that the existing French plant would take three centuries (!) to reprocess spent LWR fuel produced in the U.S. through 1990. However, the book does not tell us that as experience with LWR fuel has increased, so has the plant factor. In spite of the authors' assertions, I read that the plant achieved its rated capacity in 1984. Based on present experience, then, four such plants (total annual capacity 1600 MT) could reprocess the 1990 U.S. spent fuel inventory in less than 20 years. This is a somewhat different picture from that of one plant struggling along for three centuries. Lest such a capacity appear unrealistic, the French are presently building additional facilities aimed at achieving an annual LWR reprocessing capacity of 1600 MT in about five years.

Turning to the question as to whether the technology for vitrifying high level waste has been "demonstrated," apparently a French study commission report says, among other things, that a decision of principle calling ultimately for the irretrievable burial of alpha wastes would be premature in the current state of our knowledge. The authors simply take this as an expert finding that the HLW glass waste being produced at Marcoule is "unsafe for burial." (Would this apply to spent fuel and other "alpha wastes" also?) This observation is the linchpin of the book's argument that technology for high-level waste vitrification has not been demonstrated: a relatively mild exhortation toward prudence is translated into an absolute indictment of an entire technology. It is remarkable that such a pivotal interpretation was not buttressed by interviews with commission members, particularly when it is at odds with expert opinion in other quarters.

The book then concludes that the Marcoule system would require 1200 years to vitrify 30,000 MT of spent LWR fuel. However these numbers were obtained, the data from the Marcoule plant by no means reflect a technology-limited upper bound on the vitrification process. The French are presently constructing a larger vitrification facility where glass melters evidently have sufficient design capacity to vitrify the 1990 U.S. LWR backlog in about 30 years, assuming only a 5% fission product loading in the glass. In this country, a similar capability for vitrifying Defense HLW should be available in 1989. There are also certain advantages in letting spent fuel or HLW cool for some time before vitrification and/or burial, a point which the book does not acknowledge, but which has been formally incorporated in the Swedish plan.

The authors essay still another extrapolation in their assessment of HLW or spent fuel burial technology. In a carefully instrumented interaction experiment, eleven spent LWR fuel assemblies were emplaced in granite at the Nevada Test Site. Since it took one day to emplace each fuel element in the experimental configuration, the book then calmly suggests that it would take about a century at this pace to bury the 1990 U.S. spent fuel inventory! While acknowledging that federal energy officials insist that repository burial would proceed at a faster clip (in fact more than twenty times faster), the authors assert that no one knows how production-line burial would function. While any data, relevant or otherwise, suggesting a low emplacement rate are citable, the basis for expert opinion to the contrary is not explored. It is simply dismissed as "no one knows."

A perspective on remedial action is given in the book's treatment of plans to compact trenches at the Sheffield shallow land burial site. One study considered initiating shocks in the ground by blasting, while pointing out that radioactive gases may be released in this process and arguing for strict controls to handle the operation. Building on this, the book goes on to say that Sheffield contains thirty-four pounds of plutonium which, "distributed through the atmosphere in an explosion, would cause cancer or death in every American who breathed it." Later the proposal is simply described as a plan to "...blow up low level burial grounds..." This is a bit extreme, to say the least. Plutonium is not a radioactive gas, nor are thirty-four pounds concentrated at any one point in the trench; ordinarily one does not bury critical masses. To loft a significant fraction of the plutonium would imply that a significant fraction of the earth in the trenches themselves is also lofted; this would require many tons of explosive. Finally, even lofting thirty-four pounds of plutonium would not cause cancer or death in every American who breathed it, since the entire release could not simply be breathed in by people throughout the U.S. This seems to be a pervasive misconception.

The book is full of this sort of thing, which serves only to obscure any serious discussion of the issues. This is regrettable, since the mate-

continued on page 32

continued from page 31
rial on institutional issues surrounding the development of waste management policy is interesting reading. Here, the book gives a litany of vacillation, actions of special interests, and technocratic hubris. Some of this offers a useful perspective on the evolution of U.S. radioactive waste management policy. As they move further from the technology itself, the authors seem to be on firmer ground. Again, they argue that the present Nuclear Waste Policy Act practically ensures Federal inaction in the disposal of HLW, and that the system of state compacts for disposal of LLW is largely unworkable.

This may or may not be true. The central question is how American society will handle the regulation and distribution of its risks and its benefits. This, of course depends on how the risks are perceived. Particularly in waste management, benefits are often viewed as regional or national, while risks are seen as local. We need to recognize that risks are relative and that benefits can also be made local. This is a complex matter, but unquestionably it depends to a large extent on what people are told and whom they believe. In particular, alarmist descriptions of anticipated public response must not find a climate where they become self-fulfilling prophecy.

The question remains, "After forty years, why haven't we gotten rid of our spent fuel or HLW?" As the book points out, some of this time was spent in bumbling and false starts. Some was also spent in detailed characterizations on which to base long-term performance designs. This itself takes some time; it is no simple matter to accelerate the tests. The crux of the radioactive waste disposal issue is that planners, regulators and critics alike have chosen to address risks on an almost unprecedented time scale. One could argue that many other things which man produces or does will present hazards "Forevermore," but the real question is, having set one's sights in radioactive waste management so high, how to determine if the mark is hit? A related question is whether American institutions can consistently sustain a regulatory effort over the lifetime of several political administrations.

These questions are by no means unique to radioactive waste management, but radioactive waste management may very well be unique in trying to address them. This has led, I think, both to public overestimates of relative risk, and to underestimates by planners of what is involved in demonstrating the technology. Both have contributed to the situation the authors describe, a series of under-reactions and over-reactions culminating in the National Waste Management Policy Act.

But what level of uncertainty in compliance would the authors accept, concomitant with conservatism in the performance criteria of a geologic repository? Evidently, very little. Indeed, the authors backhandedly acknowledge the safety record of spent fuel storage in their epilogue. There they ask if, in comparison with existing plans for a centrally located geologic repository, it might not be better to store the rods in a permanently retrievable fashion ("Forevermore?") at reactor sites. This, of course, is just an extension of what is presently being done. Other than a scenario which is truly mind-boggling, the authors present no evidence to indicate that present spent fuel management practice involves undue risk. Some readers, then, may not be able to resist the observation that a suitable technology for spent fuel disposal is presently in place.

To proceed further in radioactive waste management requires cooperative input into the decision-making process from a number of groups. Again, as the book indicates, past events and perceptions have produced a climate where one wonders if effective decisions can be reached. The difficulty with "Forevermore" is that its one-sidedness contributes to the perceptions that have lead to this situation.

AN INTEGRATED MONITORING SYSTEM USING INTRUSION DETECTORS

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ABSTRACT

A personnel intrusion detection system, using passive infrared intrusion detectors, is described for monitoring unoccupied or seldom occupied areas of safeguards interest. The data from the detectors are analyzed and stored in a microprocessor-controlled, tamper indicating Data Collection Module. The data may be examined but not altered at any time through the use of a portable Inspector Display Module, which contains a numeric keypad, functional keyboard, and a printer. If the Data Collection Module detects a signal from any passive infrared intrusion detector indicating an alarm condition exists, it triggers a portable television system to record several video frames of the scene of interest for later viewing by the Inspector.

INTRODUCTION

Within the realm of International Safeguards, a traditional means of providing intrusion monitoring of enclosed, unattended areas containing assets of safeguards interest has been to seal the common access point (e.g., room entrance) with International Atomic Energy Agency (IAEA) type "E" seals. The assets of safeguards interest may be nuclear material, sensitive electronic components, computer systems, or other assets, such as instrumentation, which require continuous monitoring. Although, upon inspection, the seal may be verified as being intact, there often is no assurance that an area has not been penetrated through points other than the sealed entrance.

Current technology provides a means of supplementing the conventional methods of intrusion monitoring by providing information as to whether or not an area of safeguards interest has been occupied, and if so, the time and duration of the occupation. This information could aid the IAEA in resolving such an anomaly.

In the 1980-1981 time frame, Sandia National Laboratories (SNL) developed and extensively tested an Integrated Monitoring System (termed IMS-I) to detect the movement of shipping casks containing Light Water Reactor (LWR) fuel (Refs. 1 and 2). The main intelligence of the system was contained in the Data Collection Module (DCM) which collected information from radiation detectors and a crane location detector. The information contained in the DCM could be examined through the use of an Inspector Display Module (IDM) which contained a numeric keypad, functional keyboard, and a printer. As a follow-up to the 1980-1981 activity, development of the IMS has continued, with the objective of providing a system capable of monitoring unattended areas of safeguards interest.

The resulting monitoring system, termed IMS-II, has been extensively tested to verify its performance, reliability, and false alarm rates when operating in an unattended mode. The IMS-II provides intrusion monitoring for unoccupied or seldom-occupied areas through the use of data storage and video recording equipment. The IMS-II equipment (Figure 1) consists of a DCM, an IDM, an Uninterruptable Power Supply (UPS), and passive infrared intrusion detectors which supply intrusion data to the DCM. A Mini-Surveillance Television and Recording (MINISTAR) system provides video coverage for each area. As presently configured, the system can monitor up to four areas with four detectors per area.

SYSTEM OVERVIEW

The system equipment provides intrusion detection for unoccupied areas, using motion detectors and closed circuit television cameras strategically located throughout the areas of interest. When an intrusion alarm is confirmed, the DCM records the intrusion information and triggers the MINISTAR System in the area of interest to record several date/time annotated video frames. The intrusion data are stored with time of day information derived from a clock internal to the DCM, providing an inspector with the time and duration of the intrusion. This information can be correlated with the MINISTAR recordings by examining the annotated video frames and matching the time of

day information contained in the DCM with the annotation on the video. The video recording serves as an independent verification of the occupancy of the monitored area.

The DCM has been equipped with two door position switches and a light sensor which are monitored continuously to determine if the cover is secure. If the internal switches are active, the DCM defines this as a tamper and logs the information in the tamper buffer. This tamper information can be retrieved through the use of the IDM and can be used to verify the validity of the intrusion data contained in the DCM.

The system also has been configured to transmit intrusion and DCM tamper data to an external computer upon request. Like the IDM, information is transmitted upon verification of the request, but data contained in the DCM cannot be altered or destroyed through the external computer.

The IMS-II has been designed to operate as a modular intrusion monitoring system, with its only required input stimulus coming from passive IR detectors. The system will operate with or without the MINISTAR or external computer connected, with no degradation in performance.

The IMS-II has undergone an Operational Test and Evaluation (OT&E) at General Electric, Morris, Illinois. This system consists of a DCM, a UPS, one MINISTAR, and one intrusion detector in each of two areas. An entry log has been maintained throughout this OT&E, and the log and the intrusions detected by the system have shown excellent correlation.

In addition to the test at the GE Morris facility, two intrusion detection systems have been undergoing accelerated testing at Sandia; to date, no false alarms have been detected.

The two types of intrusion detectors used in this system have undergone extensive tests in the Interior Sensor Laboratory at Sandia and have proven to be very reliable, with extremely low false alarm rates. When used in this system, a software algorithm located in the DCM examines all data from the sensors in order to determine that a sensor is actively alarming and that the data are not a noise burst. The algorithm is expected to lower an already low false alarm rate.

SYSTEM DESCRIPTION

The IMS-II equipment is housed in tamper-protected enclosures which include door-opening sensors installed in the DCM. All the enclosures are designed to accept IAEA Type "E" seals as the first level of tamper protection. The enclosures of critical components are anodized, making it very difficult to bypass seals and switches without leaving physical evidence of tampering.

The microprocessor-based DCM (Figure 2) is the system controller which monitors inputs from the intrusion detectors in each area and the tamper-indicating devices in the DCM. It processes the information, requests video recordings when applicable, stores the intrusion and tamper activity for each zone in a data buffer, and can transmit the intrusion and tamper data to an external device. The DCM maintains date and time through the use of an internal crystal-controlled world-time clock. The information from this clock is used to date and time tag all intrusion and tamper data. The DCM can store and recall up to three months of DCM tamper data and individual area intrusion data. Communications between the DCM and MINISTAR Systems and between the DCM and the intrusion detectors consist of simple switch closures. The data are accepted as authentic since the entire system is under the surveillance of the intrusion detectors and the MINISTAR System. The DCM receives its power from a UPS which can supply a minimum of four hours of back-up power for the DCM and the intrusion detectors. If there is a facility power failure that exceeds the back-up capabilities of the UPS, the DCM will automatically restart when facility power is restored.

The MINISTAR System (Figure 3) accepts a signal from the DCM to record video frames at the onset of an alarm and also records at a given interval to provide continuous video coverage of an area. This interval can be set anywhere from 1 to 29 minutes. The MINISTAR Systems for IMS-II have been set to ten minute intervals. The video frames are annotated with the date and time of the recording. These systems contain their own backup power and will operate for at least four hours when isolated from facility power.

The IDM (Figure 4) is a small, portable device used to initialize the IMS-II and to communicate with the DCM once the system is operational. It receives its power from the DCM through the interconnecting cable. The IDM is a user-friendly device which accepts input commands from a functional keyboard and numeric pad and provides copies of the DCM/IDM interaction on a 20-column printer. The initialization procedure sets the clock/calendar and verifies that the DCM has been properly secured by monitoring the door position switches and light sensor inputs. If there are no active tamper indications for 0.25 second, the DCM is determined to be secured and the intrusion and tamper processors are activated to begin recording information. Once the system is operational, the IDM can be used to obtain a hard copy of the tamper and intrusion data stored in the DCM, to request a camera test to insure the DCM/MINISTAR links are secure, and to reset the date and time in case the clock has drifted or an unattended mode power failure has occurred. The data in the DCM may be examined repeatedly using the IDM, but this device cannot alter or destroy any data. Figure 5 is an example of the required inspector inputs to the IDM and a sample printout of the

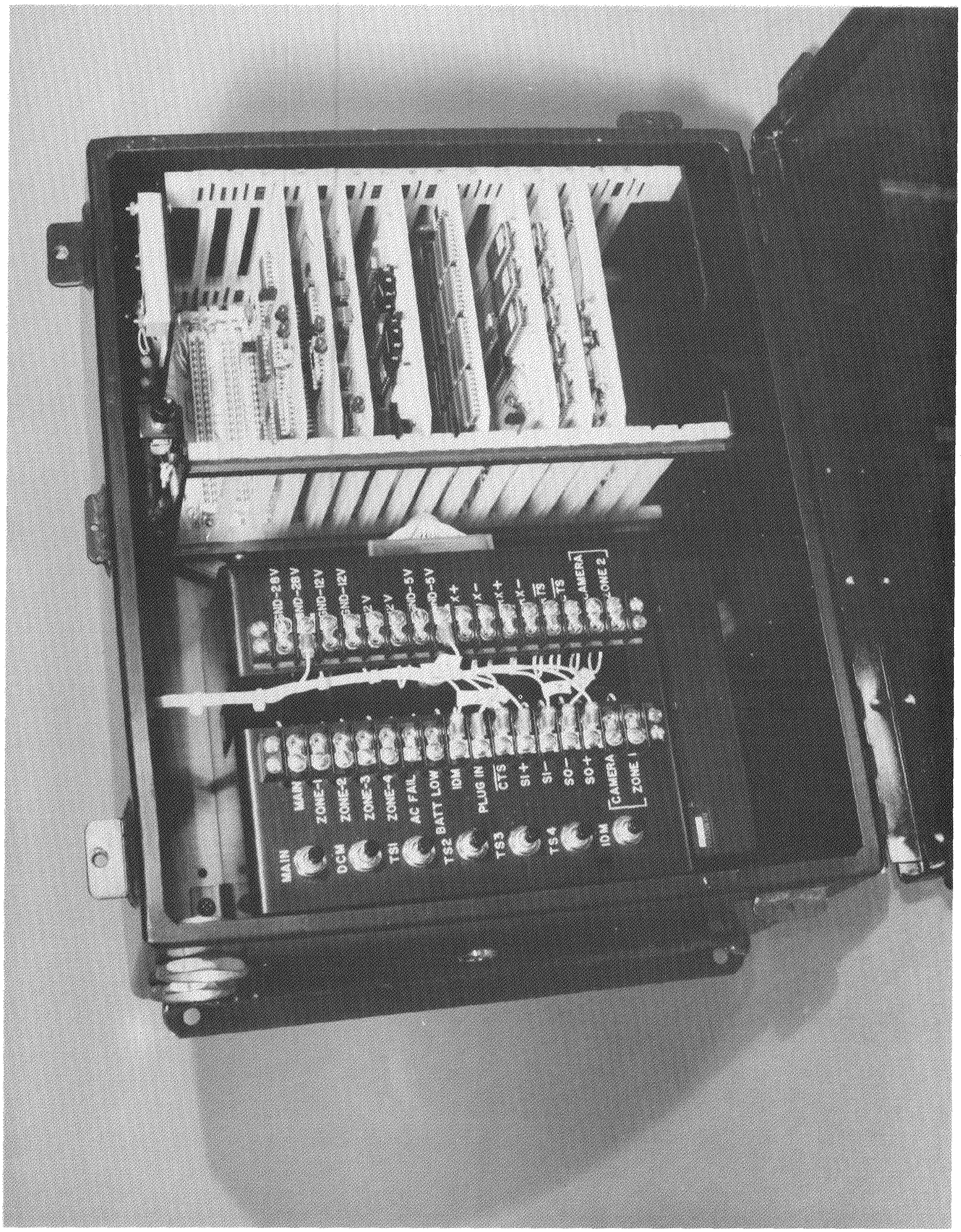

Fig. 2 — Data Collection Module

Fig. 3 — MINISTAR System

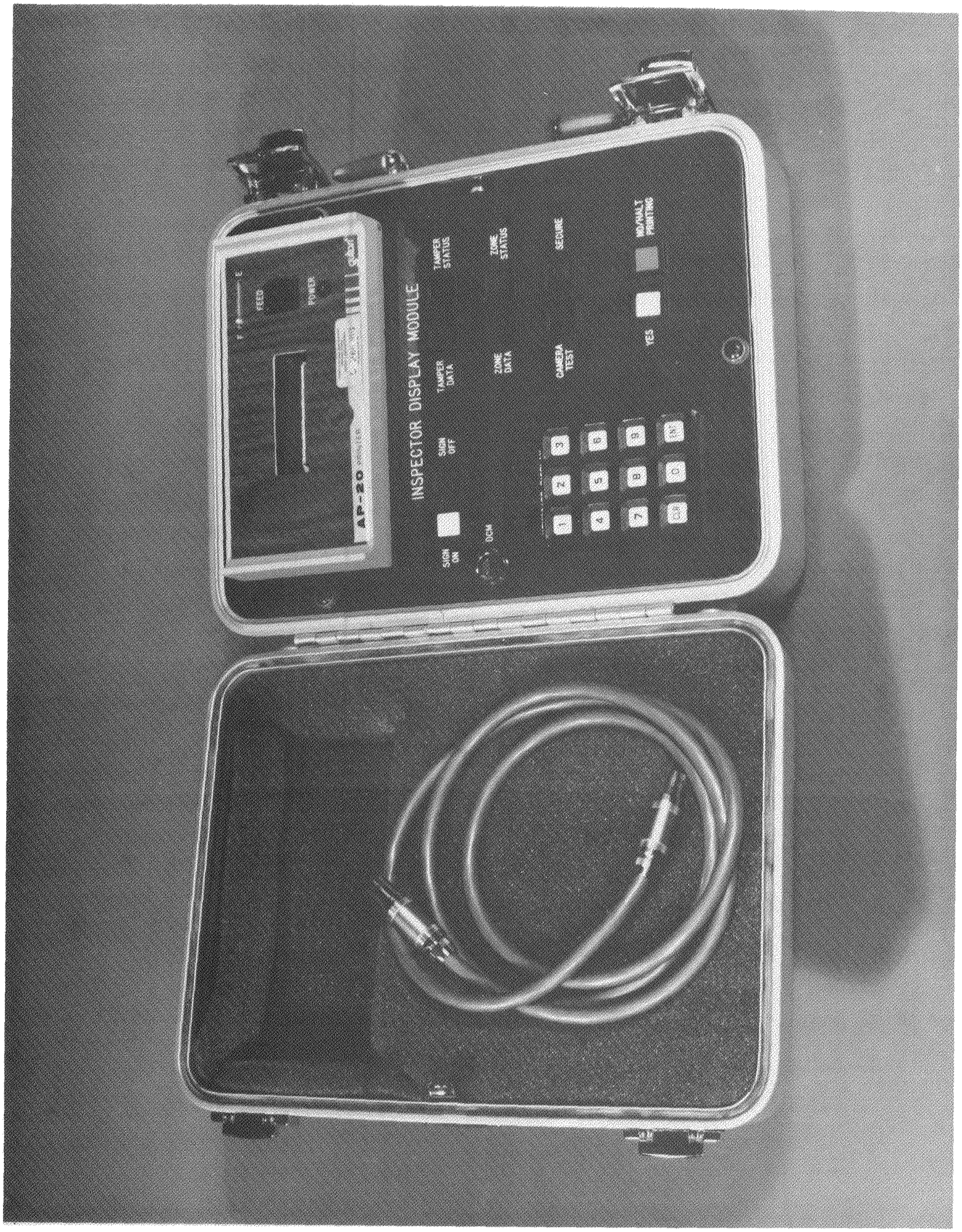

Fig. 4 — Inspector Display Module

Inspector Input	IDM Printout	Comments
SIGN ON YES	********************* INITIATE INSPECTION MODE? ENTER YES OR NO	
	INTEGRATED MONITORING SYSTEM II (1.0)	Following 13 Line Printout is an Information Header for the System
	ZONE 1-OFFICE AREA ZONE 2-MONITOR ROOM	
	RECENT INSPECTION SIGNOFF OCCURRED AT 06-07-83 10:39 AT 01-07-83 10:05	
	SYSTEM INITIALIZED 01-07-83 10:00	
	CURRENT DATE TIME DD-MM-YY HH:MM 08-08-83 08:00	
TAMPER DATA	ENTER FUNCTION	
	LAST SIGN OFF TO CURRENT DATE? 06-07-83 TO 08-08-83	Dates indicated are for time period last sign-off date to current date
YES	PRESS HALT TO STOP PRINTING	
	TAMPER DATA 10-07-83 TO 08-08-83 * FORMAT * *STARTING DATE/TIME* * ENDING DATE/TIME * *DOOR TAMPER COUNT * *LIGHT SENSOR COUNT*	Tamper Buffer Header Showing Format of Data Following
	NO TAMPERS DETECTED	Door Tamper = 0 Light Sensor = 0
	ENTER FUNCTION	
ZONE STATUS 2	ENTER ZONE NUMBER 1 OR 2, 0 FOR ALL	
	08-08-83 08:05 * MONITOR ROOM * * STATUS *	Date and Time of Monitor Room Status Request
	NO ALARM DETECTED	Zone 2 Alarm Count = 0
	ENTER FUNCTION	

Fig. 5 — Example Inspection Procedure

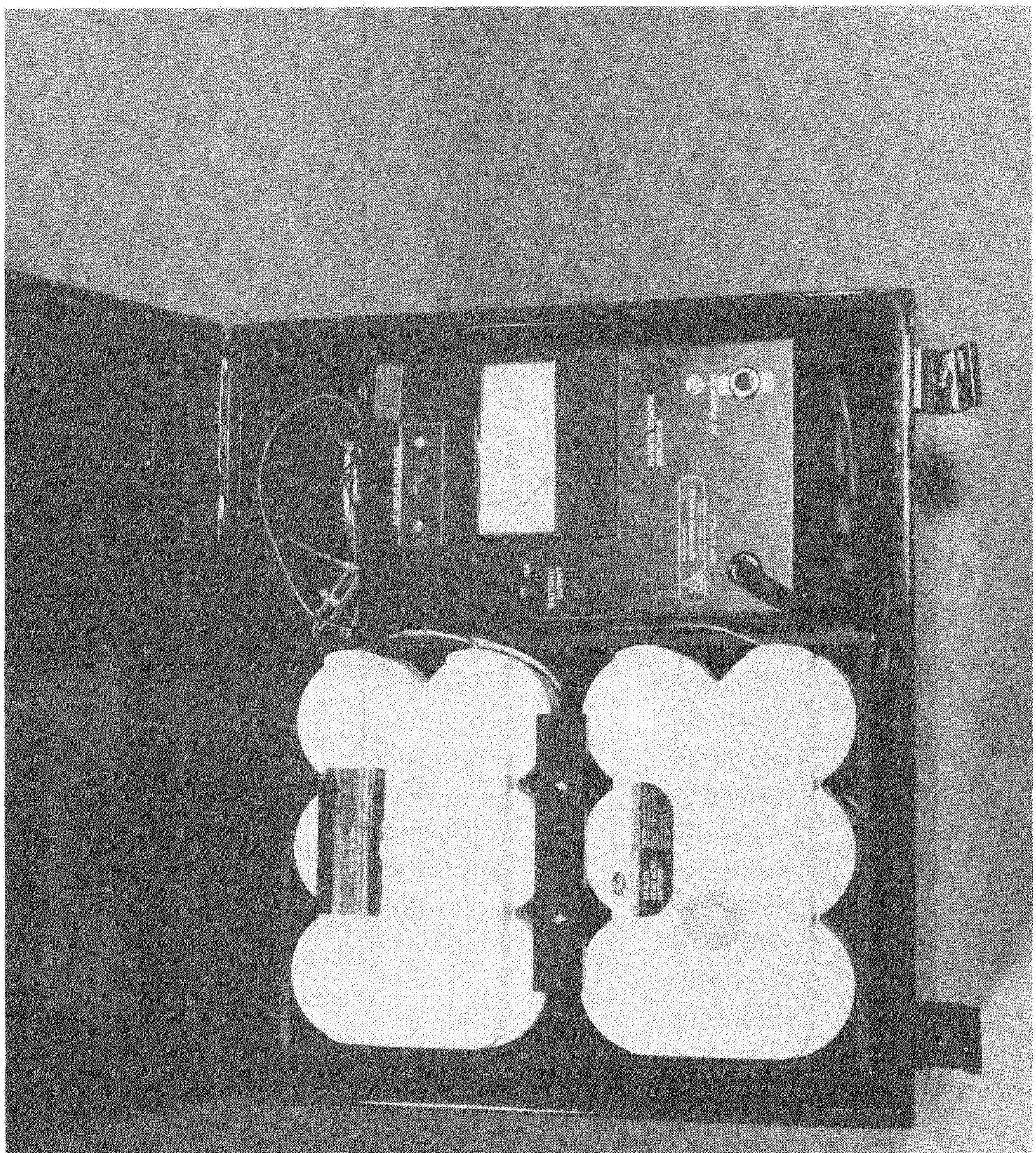

Fig. 6 — Uninterruptable Power Supply

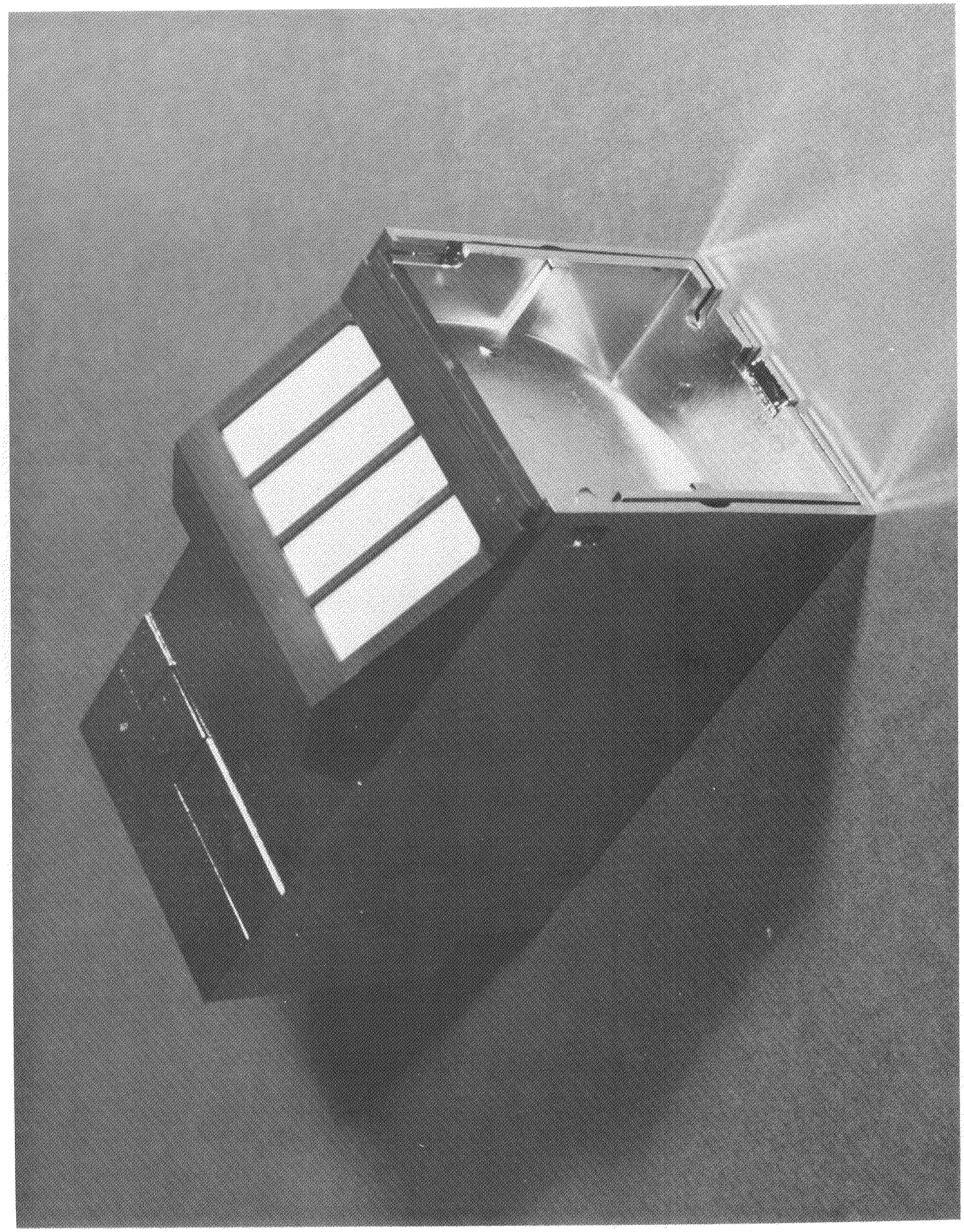

Fig. 7 — ARITECH Curtain Detector

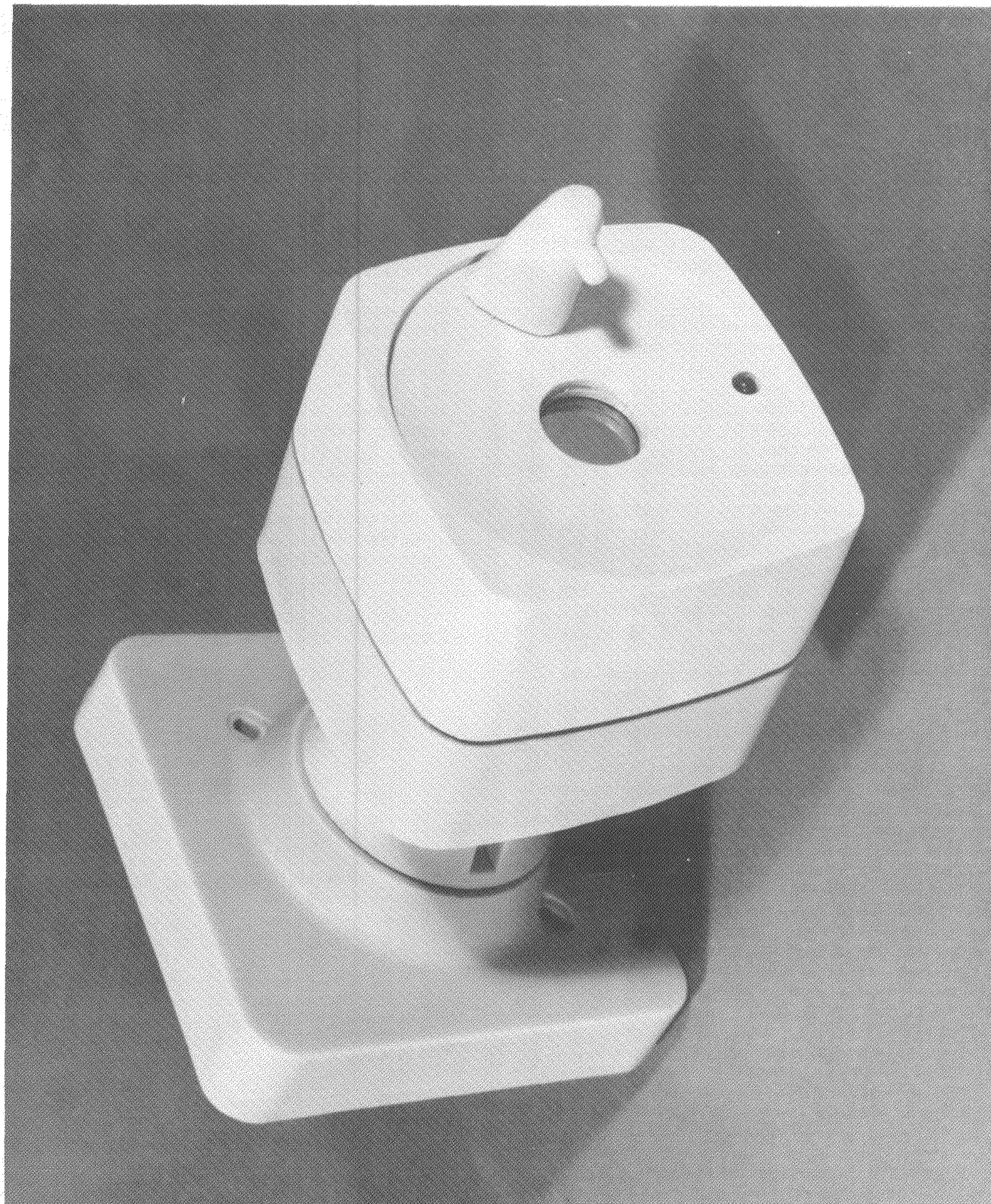

Fig. 8 — BARNES IR Detector

type and format of information that is available to the inspector.

The UPS (Figure 6) associated with the DCM converts facility power to 24-volt dc power. The dc power is used to power the DCM and to trickle charge a 24-volt battery. As shown in the figure, the 24-volt battery is comprised of two 12-volt batteries. The batteries are sealed lead acid batteries, configured as a "six-pack." The power supply also monitors the amount of charge remaining in the batteries and shuts the entire system down when the charge remaining drops to 10% of rated capacity. The system will automatically restart when facility power is reapplied and recharge the batteries to full power.

The intrusion detectors used in this system are passive infrared intrusion detectors. This type of detector measures the infrared energy radiated from every object in its field of view. It looks for changes in the level of this radiation, and if the change is large enough and occurs rapidly enough, an alarm will result. The power for the detectors is derived from the DCM and routed to each detector through a junction box. Two types of infrared intrusion detectors may be used. One is a curtain detector (Figure 7) which detects motion through a plane 20 ft. by 35 ft. The second (Figure 8) provides a beam of approximately 70 degrees for coverage of a large area and is effective up to 50 ft. This type of detector is mounted on a swivel head to make the final adjustments as simple as possible.

The IMS-II system and the external computer communicate over a standard serial data link that will support transmission distances of several hundred feet. The external computer may request DCM tamper and area intrusion status information from the IMS-II at a fixed interval. When the request is received by the IMS-II, the DCM will respond with the current tamper and intrusion status. In the present system, the external computer is requesting information from the DCM once per minute. Even at this low data rate the external computer system is able to construct and maintain a tamper and intrusion data base that is identical to the one maintained by the DCM.

CONCLUSIONS

The IMS-II is an intrusion monitoring system which will provide continuous monitoring of an unoccupied or seldom-occupied area containing assets of safeguards interest. The system will maintain continuous day-to-day records of occupancy. Even though there is no physical evidence of intrusion, the information contained in the system can aid the IAEA inspector in determining whether penetration has occurred through other than sealed access points.

In addition to supplementing the traditional means of providing intrusion detection of an area, IMS-II is a cost-effective and efficient means of providing intrusion information for relatively large areas.

The DCM and IDM used in this system were specifically designed to be general purpose instruments which would be applicable to a wide variety of monitoring systems. Virtually any type of detector could be interfaced to the DCM to provide unattended monitoring of any safeguards-related activity.

REFERENCES

Ref. 1, "A Data Collection Module and Inspector Interface for Surveillance Devices" by T. A. Sellers and W. C. Fienning, Sandia National Laboratories. Presented at the 3rd ESARDA Symposium of Safeguards and Nuclear Material Management.

Ref. 2, "Integrated Monitoring System (IMS) Development and Demonstration Activities", ISPO Working Draft Report No. 221, by W. C. Fienning and R. P. McKnight.

APPLICATIONS OF MICROCOMPUTERS FOR IN-FIELD NDA ANALYSIS BY THE IAEA

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ABSTRACT

Personal Computers (PC's) attached to non-destructive analysis instrumentation are being used by the International Atomic Energy Agency to complement microprocessors built into the equipment. The use of PC's allows user prompting and in-field data analysis which are custom tailored to the specific tasks at hand. Examples of the use of the PC both with custom-designed IAEA NDA equipment and with general-purpose commercial equipment are given and discussed.

The in-field analysis of inspection measurement data allows abnormalities or discrepancies to be investigated and measurements to be repeated while the sample is still available. Limited in-field analysis of measurement data has been used by IAEA inspectors for some time, utilizing built-in microprocessors in some of the equipment to partially analyze the data. NDA instruments presently used by the IAEA inspector which include dedicated microprocessors are:

1) SILENA Multi-Channel Analyzers (MCA's).[2]
2) Lawrence Livermore National Laboratory (LLNL) Plutonium Isotopic Microprocessor.[2]
3) Mini-MCA Davidson 2056-4K.[3]
4) High Level Neutron Coincidence Counter (HLNCC).[4]
5) ION-1 Portable Spent Fuel Gamma-Ray/Neutron Electronics.[5]
6) Load-Cell Based Weighing System.[6]

The partial reduction of data by these instruments is often followed by hand entry of the data into a programmable calculator for further analysis. More complex analyses, including automated search for backgrounds and fitting of gamma-ray peaks has in the past been performed on larger computers at Agency headquarters in Vienna.

The advent of small portable, programmable microcomputers, which can be connected directly to the measuring equipment via the RS-232 interface, has allowed considerably more sophisticated data-reduction and analysis programs to be written for the inspectors' in-field use. Even more important, the in-field computer allows prompting of the inspector in the set-up and use of the instrumentation, with the possibility to check on-line important parameters such as resolution, energy calibration, peak to background ratios, and singles-to-total ratio, which can give an indication of instrument misadjustment or malfunction.

By checking these parameters in the field, and informing the inspector of problems at the time, the conditions can often be corrected, rather than attempting to correct the data after the fact.

The Agency is utilizing several programmable microcomputers connected to instruments for in-field NDA measurements. These are the Hewlett-Packard Corporation HP-97, HP-85, and the EPSON Corporation HX-20.

The HP-97 should probably be classified as a programmable calculator, but it is included because it was the IAEA's first generation of programmable computer tied to an NDA instrument, the High Level Neutron Coincidence Counter in this case. Table 1 compares the specification of this first instrument computer to the models currently being used. The much larger memory and on-line storage, larger and more versatile display, and software configurable instrument interfaces make the new computers a vast improvement over the HP-97.

While a number of small utility programs to plot spectra, calibrate MCA's, calculate energy resolution, perform fitting, and solve simultaneous equations have been written and used, the major in-field programs used by the Agency to date, together with the instrument from which they accept data and the computer on which they are used are:

A) Uranium Enrichment - (Silena - MCA's with the HP-85).

This program is based upon measurement of the activity of the 186 keV peak of U-235. The gamma-ray spectrum is transferred to the computer via the RS-232 interface. The counts in the full-energy peak are determined with a Gunninck stepped background subtraction. The U-235 area is normalized to the area in the 122 keV peak of a fixed Co-57 source to correct for pulse-pileup and counting time. The normalized 186 keV counts for an unknown are ratioed to the normalized 186 keV counts of a standard. As in the case of other enrichment measurements (SAM-II) constant geometry is required. An example of the main menu showing some of the options together with typical output is given in Figure 1. A version with gamma-ray attenuation corrections for UF6-cylinder measurements is also available.

B) Plutonium Isotopic Determination - (Silena MCA's with the HP-85 or the HX-20).

This program is based upon the same basic algorithm implemented in the Nuclear Data Corporation 6620 computer used at Agency HQ for plutonium isotopic analysis and also used in the Lawrence Livermore National Laboratory (LLNL) Plutonium Isotopic Microprocessor.[7]
Peak areas are determined for several peaks originating from different plutonium isotopes in the spectrum transferred from the MCA. The ratios of several peaks originating from the same isotope are used to determine an intrinsic relative efficiency calibration. An iterative method is used to correct for cross contamination in the peaks from other isotopes. The relative efficiency curve determined, together with the half lives, branching ratios and peak areas are used to determine the isotopic ratios. An isotopic correlation due to Gunnink[8] is used to estimate the Pu-242 which allows an estimate of the percentage isotopic composition. The input dialogue and the resulting output for the program are shown in Figure 2.

C) Plutonium Mass Determination - (HLNCC and derivative detectors with the HP-85).

These programs read the count time, total counts, total coincidences, and the accidental coincidences from the electronics unit of the HLNCC. Multiple repeated measurements are made, and this data is checked for consistency by the accidentals/totals ratio and the deviation of the totals and coincidence rates of individual runs from the average value. Totals and coincidence rates are corrected for background and normalized. The effective Pu-240 is calculated from calibration parameters stored in the program, and printed together with an error estimated from counting statistics, normalization error, and systematic error in the calibration procedure. Actual plutonium mass is calculated from the isotopic composition.

D) Spent Fuel Verification - (ION-1 with the HX-20).

These programs read gamma-ray and neutron measurement values from the ION-1. The data are printed and plotted as a function of position on the fuel assembly, giving the profile of the neutron and gamma-ray producing isotopes along the assembly. After corrections, a log-log plot of gamma-intensity versus neutron activity is made, together with a least-squares fit to a straight line relationship between the gammas and the neutrons. The use of the slope of this straight line as a parameter characteristic of the fuel will be described in more detail in another paper in this issue.

The philosophy in writing the programs described has been to make them as completely self-explanatory as possible in their operation.This is in recognition of the fact that the instruments are to be used by non-expert users under stressful conditions in field facilities. This is done mainly with a question and answer dialogue, although some menus that list a set of options are used. The computer is used as a checklist to ensure that the instrumentation is properly set up, and as many parameters as possible are automatically checked by the computer, with warning messages if any parameters are out of range. Repeated runs of similar samples are simplified in so far as possible, since this is a common case for the inspector. Programs have been developed in an interactive cooperation with inspectors who provide the initial requirements and suggest corrections and improvements in the programs after using them in actual field conditions. The benefit of having a programmable computer is that the programs can be easily modified to take advantage of such suggestions from the actual users of the program. The ability to have a quick response to user suggestions and requests is the principal advantage of the programmable microcomputers over the essentially non-modifiable software in the fixed microprocessors of the instruments.

In conclusion, the general-purpose microcomputer for NDA data acquisition supervision and data reduction represents a significant step towards the elusive goal of taking consistently reliable NDA data under field conditions. It allows programs to be quickly adapted to particular requirements of a given facility. The use of the microcomputer which is just starting to be significant in measurements has been well received by the inspectors who make the measurements and welcome any improvement in the overall ease and reliability of the measurements.

TABLE I

MICROCOMPUTER SPECIFICATIONS:

A) HP-97

1) MEMORY: 224 PROGRAM STEPS
2) PROGRAMMING LANGUAGE : HP KEYSTROKE
3) PROGRAM STORAGE: MAGNETIC STRIPS
4) DISPLAY: 11 CHARACTER X 1 LINE LED
5) PRINTER: THERMAL, NUMERIC (NO ALPHABETIC CHARACTERS)
6) INTERFACE: NONE (CUSTOM HARDWARE)

B) HP-85

1) MEMORY: 32 KBYTES
2) PROGRAMMING LANGUAGE: HP BASIC
3) PROGRAM STORAGE: CASSETTE (FLOPPY DISK)
4) DISPLAY: 32 CHARACTER X 16 LINE CRT, HIGH RES. GRAPH
5) PRINTER, THERMAL, ALPHANUMERIC AND GRAPHIC
6) INTERFACE: RS-232C (HP-IB)

C) HP-85B

1) MEMORY: 32 KBYTES PROGRAM
32 to 512 KBYTES DATA, ELECTRONIC DISK
2) REMAINING SPECIFICATIONS SAME AS HP-85

D) EPSON HX-20

1) MEMORY: 32 KBYTES*
2) PROGRAMMING LANGUAGE: MBASIC
3) PROGRAM STORAGE: MICROCASSETTE
4) DISPLAY: 20 CHARACTER X 4 LINE LCD, HIGH RES. GRAPH
5) PRINTER: MICRO-IMPACT, ALPHANUMERIC AND GRAPHIC
6) INTERFACE: RS232C (SERIAL)

*Some models modified to 144 KBYTES.

TABLE II

EQUIPMENT INTERFACED TO MICROCOMPUTERS;

A) SILENA MCA's

1) 1k (BS27)
2) 4K (NIM)
3) 8K (CICERO)

B) MINI-MCA's

1) CANBERRA 10
2) DAVIDSON

C) HLNCC

D) ION-1

FIGURE 1

EN4 MENU AND SAMPLE RESULTS

```
PUSH K1, K2, K3, K4, K5, K6, K7, OR K8
FOR DESIRED FUNCTION BELOW.
K1 =  CALIBRATION WITH NEW STANDARD
K2 =  MEASURE UNKNOWN SAMPLE
K3 =  ENTER ANY DESIRED COMMENTS
K4 =  MEASUREMENTS FINISHED, STOP
K5 =  REANALYZE THE 'UDATA' FILE
K6 =  PRINT RESULTS
K7 =  PRINT SPECTRUM
K8 =  PLOT SPECTRUM
      ('PAUSE' TO STOP BEEPING)
      ('CONT' AFTER 'PAUSE')

-------------------------------------

REANZ   PRINT   SP. PRNT   SP. PLOT
CAL     UNK     COMMENT    STOP

**************************************

SAMPLE 1
ID =
TIME = 1:24
SPECT NO 16    T = 369 sec.
ENRICHMENT = (94.456 +/- 1.3130%

**************************************

SAMPLE 2
ID =
TIME = 1:32
SPECT NO 18    T = 300 sec.
ENRICHMENT = (17.317 +/- 1.171)%

***************************************

SAMPLE 3
ID =
TIME = 1:32
SPECT NO 21    T = 100 sec.
ENRICHMENT = (17.153 +/- 1.392)%

***************************************

SAMPLE 4
ID =
TIME = 3:1
SPECT NO 21    T = 100 sec.
ENRICHMENT = (17.215 +/- 1.388)%

****************************************
```

R E F E R E N C E S

1) Silena s.p.a., Via Negroli 10/A, 20133 Milano, Italy

2) W. D. Ruhter and D. C. Camp, "A Portable Computer to Reduce Gamma-Ray Spectra for Plutonium Isotopic Ratios", Lawrence Livermore National Laboratory reports UCRL-53145 (ISPO-134) (1981) and UCRL-53506, volume 1 (ISPO-209) (1984).

3) D.S. Davidson Company, North Haven, Ct. USA.

4) M. S. Krick and H. O. Menlove, "The High Level Neutron Coincidence Counter (HLNCC) : User's Manual", Los Alamos Scientific Laboratory Report, LA-7779-M (1979).

5) "Instructions for the use of the ION-1 and the Fork Detector", International Atomic Energy Agency, IMI #42, November 1984.

6) R. Mitchell "Operation Manual for Semi-Portable Load-Cell Based System for Weighing UF6 Cylinders", Draft ISPO Report, September 1980.

7) R. Gunnink, J. B. Niday, and P. D. Siemens, "A System for Plutonium Analysis by Gamma-Ray Spectroscopy, Part I: Techniques for Analysis of Solution", Lawrence Livermore National Laboratory report, UCRL-51577 (1974).

8) R. Gunninck, "Use of Isotopic Correlation Techniques to Determine ^{242}Pu Abundance", Nuclear Materials Management 9/83 (1980).

FIGURE 2

PUISOD SCREEN DIALOGUE AND PRINTED RESULTS

Screen Dialogue

PUISOD

Connect the HP-85 to the Silena with the SERIAL INTERFACE cable

If your Silena is 4k or 8k add a special short cable. (Between the HP-85 cable and the Silena) ENDLINE when hooked up.
?

Enter date YYMMDD
?
840302

Enter time HHMM
?
1053

ENTER SAMPLE TITLE
(ENDLINE for old title.)
?

THIS IS AN EXAMPLE

ENTER 148 KEV PEAK CHANNEL
(ENDLINE for old value, neg for peak area entry)
?
570
ENTER 208 KEV PEAK CHANNEL
?
800

Get desired spectrum in Silena.

Push STOP, DATA OUT on SILENA
(Do not use 'PAPER ADVANCE' until after completion of transfer)

Printed Output

PUISOD

DATE: 84-03-02
TIME: 10:53

THIS IS AN EXAMPLE

SPEC # 26 LT = 1000 SEC.

148 KeV:channel 570
208 KeV:channel 800
GAIN = .25928 KEV/CH
OFFSET =.691564712 KEV
FWHM (208 KeV) = .98326

125.29 KeV: 216023+/-.57%
129.3 KeV: 228059+/-.57%
148.6 KeV: 532758+/-.36%
152.7 KeV: 46220+/-1.88%
160.28 KeV: 45190+/-2.18%
164.58 KeV: 154716+/-.74%
203.5 KeV: 33737+/-2.74%
208 KeV: 1992039+/-.14%

Time since separation= 12.1
+/- 0.4 Years

Am241/Pu239= .0275+/-1.27%
Pu241/Pu239= .0357+/-2.914%
Pu238/Pu241= .0992+/-2.15%
Pu240/Pu241= 6.1249+/-2.417%
Pu239/Pu241= 28.1214+/-1.19%

Mass Pu238= .277
Mass Pu239= 78.67
Mass Pu240= 17.134
Mass Pu241= 2.797
Mass Pu242= 1.12
Mass Am241= 2.163

PU-240 EQUIVALENT =19.582%

****
DATE: 84-03-02
TIME: 10:55