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**REPORT ON THE U.S. PROGRAM OF
TECHNICAL ASSISTANCE TO SAFEGUARDS OF THE
INTERNATIONAL ATOMIC ENERGY AGENCY (POTAS)**

MASTER

May 1, 1981

**INTERNATIONAL SAFEGUARDS PROJECT OFFICE
BROOKHAVEN NATIONAL LABORATORY
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FOREWORD

The U.S. Program of Technical Assistance to IAEA Safeguards (POTAS) is in its fifth year of providing assistance to the safeguards activities of the International Atomic Energy Agency (IAEA). The current program is described in the "Fifth Program Plan," May 1, 1981.

This document summarizes the work done under the U.S. Program of Technical Assistance to IAEA Safeguards, providing the U.S. Government, IAEA, and others with a short review of the progress made in the program since its inception. A review of the first year was given in the POTAS annual report, ISPO-17, May 1978.

The size and complexity of the program precludes a detailed discussion of all activities within the format of this report. Therefore, only major accomplishments are highlighted herein. To assist the reader who may need more detailed information, an Index of POTAS tasks and a list of POTAS reports are given in Annex I and II.

Many organizations have contributed to the success of the program. Organizations making noteworthy contributions included the DOE Office of Safeguards and Security, the U.S. Mission to IAEA, the IAEA Division of Development and Technical Support, and the interagency, Technical Support Coordinating Committee, chaired by the Director, DOE/OSS, and with representation from the Department of State, the Arms Control and Disarmament Agency, and the Nuclear Regulatory Commission.

A list of definitions of Abbreviations and Acronyms is given on page 28 of this report.

U.S. Assistance to IAEA Safeguards

The safeguards implemented by IAEA are of major importance to the non-proliferation objectives of the United States of America and of other nations of the world. Assurance of safeguards effectiveness is mandatory if the peaceful use of nuclear power is to continue while these non-proliferation objectives are maintained. Through the U.S. Program of Technical Assistance to Safeguards (POTAS), the U.S. provides technical assistance to enhance the ability of the IAEA to apply safeguards effectively.

The United States provides substantial other assistance to the IAEA safeguards program including: efforts through the Nuclear Suppliers Group to extend the application of IAEA safeguards; participation in the IAEA Standing Advisory Groups on Safeguards Implementation; development and promotion of multinational, regional fuel cycle centers including international regimes for spent fuel or plutonium storage; implementation of the agreement for application of IAEA safeguards to all U.S. nuclear facilities, excluding those of direct national security significance; and, strong assistance to planned growth of the IAEA safeguards program.

In February 1978, the U.S. enacted the Nuclear Non-proliferation Act of 1978, of which Title II encourages the U.S. to contribute funds, technical resources, and other support to assist the IAEA in effectively implementing safeguards.

Scope of U.S. Technical Assistance

The POTAS contributions complement other resources available to the IAEA based on funding from its regular budget. These contributions provide reaction to identified urgent needs to improve effectiveness more quickly than can be achieved through normal IAEA administrative procedures. Special expertise is made available to strengthen IAEA capabilities in areas where such expertise is limited. Where U.S. research has developed and tested advanced technical capabilities for safeguarding, results are made available to IAEA. Under POTAS, members of the IAEA staff are given opportunities to become experienced with actual operating conditions at nuclear facilities, conditions which they will encounter in the discharge of their safeguards duties. POTAS responds to other requests for assistance, but those outlined above have the highest urgency.

Program Implementation

Under the leadership of the President and responding to Congressional initiatives, the Department of State, DOE, ACDA, and NRC each have responsibility for parts of the program of technical assistance to IAEA safeguards. State provides policy guidance, obtains funding through the Agency for International Development, and delegates implementation to DOE. DOE, in turn, has established an International Safeguards Project Office (ISPO) at Brookhaven National Laboratory for the overall technical implementation of the program. In addition, DOE, ACDA, and NRC are each directly contributing programmatic and technical support to the improvement of IAEA safeguards. All assistance to IAEA safeguards is under the cognizance of an Inter-agency Steering Group, comprised of DOE, NRC, and ACDA, and chaired by State.

ISPO has been allowed to use existing DOE Laboratories which are established for implementing priority national programs involving nuclear technology. Participating Laboratories include Los Alamos National Laboratory, Sandia National Laboratory, Argonne National Laboratory, Pacific Northwest Laboratory, Brookhaven National Laboratory, Oak Ridge National Laboratory, Idaho National Engineering Laboratory, Lawrence Livermore National Laboratory, and others. The tasks implemented at these laboratories reflect their particular areas of safeguards specialization. Where needed capabilities are available outside the DOE Laboratories, they have been obtained under contract, or IAEA has been reimbursed for specific procurements and for the services of specific individuals.

Organization of ISPO

The International Safeguards Project Office maintains a highly qualified staff with broad experience in safeguards, particularly in international safeguards. An ISPO liaison office was established in May 1977, at the U.S. Mission to IAEA in Vienna. The liaison post, manned full time by an ISPO staff member, provides daily contact with IAEA for quick response to questions that regularly arise in implementation of the U.S. program. ISPO has had the added responsibility of technical management of TASTEX, the joint Japan-France-U.S.-IAEA program to test advanced safeguards instrumentation at the Tokai reprocessing plant in Japan, and responsibilities for some other initiatives to improve IAEA Safeguards.

Currently, the ISPO Organization is headed by L. Green and includes a Vienna Liaison Officer, six other professionals, and two secretaries.

Laboratory Program Coordinators

Coordination between ISPO and the participating DOE laboratories is maintained through laboratory coordinators who provide monthly reports of technical progress and financial status of the tasks assigned to their laboratory. Coordinators meet quarterly with ISPO and representatives of the Technical Support Coordinating Committee for a review of technical progress.

Program Funding

The following is a review of the major accomplishments which have resulted through assistance provided in the form of (1) equipment and standards, (2) experts, (3) system studies, (4) techniques, procedures, and equipment evaluation, and (5) training. The first two forms of assistance were provided directly to IAEA. The last three represent assistance provided through DOE Laboratories and other contractors.

The table below shows the scope and funding, not including ISPO operating costs, of the program.

Allocation of Funds for POTAS Tasks
March 31, 1981
(x \$1000)

<u>Category of Assistance</u>	<u>No. of Tasks</u>	<u>Funding Allocated (in Thousands of Dollars)</u>
1. Equipment and Standards	69	\$ 7990
2. Experts	52	3900
3. Studies	50	3040
4. Techniques, Procedures and Equipment Evaluation	41	2970
5. Training	29	1770
	<hr/> 241	<hr/> \$ 19670

Current program emphasis is on assistance aimed at placing equipment and techniques into routine use. Although some of the developments of the program are in routine use, many are still being evaluated by the IAEA staff. With the limited resources of IAEA, it is foreseen that equipment developers and others will have to work closely with the IAEA to carry out their implementation plans.

A summary of the program highlights and review of the major accomplishments in each category of assistance follows.

Program Highlights

A significant achievement of POTAS has been the provision of safeguards equipment designed to be reliable, easy to use, and, where required, tamper resistant. Some of the devices provided are already used in the field by inspectors or by IAEA staff at headquarters in Vienna. The following table lists the equipment that has been provided.

<u>Device (Task No.)</u>	<u>No. of Devices Provided to IAEA</u>	<u>Implementation Status*</u>	<u>Application</u>
BSAM (A.55)	5	T & E	NDA-Unirradiated U and Pu
Hand-Held Ge (A.13)	2	T & E	NDA-Unirradiated U and Pu
SAMson (A.11)	4	T & E	NDA-Unirradiated U and Pu
Mini-MCA (A.74)	2	T & E	NDA-Unirradiated U and Pu
HLNCC (A.95)	7	in use	NDA-Pu and MOX
AWCC (A.96)	2	T & E	NDA-HEU
COLLAR (A.75)	3	T & E	NDA-Unirradiated fuel assemblies
Microcomputer (A.63)	1	T & E	NDA-Pu and MOX
SGS (A.7)	1	in use	NDA-Pu scrap and waste
Semiportable Load Cell (A.98)	1	T & E	Mass of UF ₆ cylinders
ION-1 (A.97)	3	T & E	NDA-Irradiated fuel
JAVELIN (E.21)	4	in use	Cerenkov light, irradiated fuel
ITI Underwater Viewer (E.35)	1	T & E	Serial number on irradiated fuel
Semiautomatic Film Scanner (E.27)	1	in use	Reviewing surveillance film
Battery-Operated TV (E.5)	1	T & E	Optical surveillance
Advanced TV (E.25)	2	T & E	Optical surveillance
Reactor Power Monitor (E.24)	1	T & E	Monitoring power reactor operation
Calorimeters (A.9)	3	T & E	NDA-Pu and MOX
Electronic Seals (E.37)	10	T & E	Safeguards seal
Type-X Seals (E.28)	500	T & E	Safeguards seal

*T & E - Test and Evaluation.

Of vital importance to the IAEA, in the light of its limited resources, has been the provision of cost-free experts. Since the start of POTAS, 37 experts have served on the IAEA staff for periods of one to two years. Experts assumed an important role in the transfer of technology to the IAEA staff. Additional assistance was given by experts on short-term assignments from various U.S. laboratories.

Assistance was provided in system studies in areas aimed at improved application of IAEA safeguards. Studies have included: integral exercises designed to examine systematically the activities that are required for application of IAEA safeguards; special short-term studies aimed at assisting the Agency in formulating safeguards approaches for application at various stages of the fuel cycle; and system models for forecasting IAEA inspection effort and assessing the impact of safeguards criteria on the Agency's requirements for manpower and resources.

Of special significance has been the development of "Safeguards Assessment Methodology." This technique, when implemented, will give the IAEA a new tool for assessing the effectiveness of its application of safeguards and will provide a way of selecting new, cost-effective modifications to upgrade safeguards approaches.

Developers of POTAS equipment have been working closely with the IAEA in field testing equipment, formulating procedures, preparing operating and maintenance manuals, and, where needed, training the staff in use of the equipment. An example of this activity was the development of specific procedures and provision of special detector heads to increase the versatility of the High Level Neutron Coincidence Counter to verify different plutonium fuel forms.

With assistance from Sandia, the IAEA significantly improved the efficiency and reliability of its verification of seals currently used by inspectors. As a result, the number of seals used by inspectors has increased and the time for verification has decreased.

U.S. assistance provided direct financial contributions to the IAEA to permit early acquisition of a larger computer, peripherals, and software for the new system; other equipment, provided as gifts-in-kind; and cost-free experts to assist IAEA in planning, system design, and programming for the upgraded safeguards information system. This information system is currently in operation.

The IAEA has established a Safeguards Training Unit which conducts regular courses for new inspectors and others. U.S. experts played an important part in planning the courses, preparing training materials, and developing procedures for evaluating the effectiveness of the training provided. POTAS also provided audio-visual equipment for use in the new classroom facilities used by the Training Unit.

Special sessions of the training program given at LANL in the use of NDA for safeguards has been made available regularly to the IAEA safeguards staff. About 40 staff members attend each year. The courses are tailored to the specific needs of the IAEA and have become an essential adjunct to inspector training.

Review of Major Accomplishments

1. Equipment and Standards

Hardware in the form of equipment and physical standards supplied to the IAEA is intended for use by inspectors in the field or to support safeguards activities at the IAEA Headquarters or in Regional Offices. Inspection equipment is primarily for verification of nuclear material content and for application of containment and surveillance (C/S) at safeguarded facilities. Equipment for headquarters and regional offices is for automatic data processing, training, and equipment transport. The physical standards provided have been for calibration of instruments and for chemical analysis at the Safeguards Analytical Laboratory in Seibersdorf.

a. Assay of Unirradiated Nuclear Materials. The Brookhaven Survey Assay Meter (BSAM) (Fig. 1) was developed for assay of uranium enrichment and plutonium contents. The unit is simpler to operate than the SAM II now in use by the Agency. The BSAM is more portable and has temperature compensation to provide for more precise measurements. An associated Brookhaven development, the Hand Held Intrinsic Germanium Detector, gives BSAM the capability for high-resolution gamma measurements. The IAEA is testing both units in the field.

The IAEA was given 5 BSAMS and 2 intrinsic germanium detectors for test and evaluation. These units have been used in inspection activities. Based on consultation between vendors and Brookhaven, both the BSAM and the detector are now commercially available.

Using BSAM technology, a hand-held, two-channel assay meter, called SAMson (Fig. 2), weighing 2.2 kg, was developed. This instrument, although not as versatile as the BSAM, is significantly smaller and lighter and it can be used by inspectors to make quick measurements of fresh fuel and other unirradiated nuclear material. Four units were provided to the IAEA for evaluation.

A unique development in portable instrumentation is the Los Alamos Portable Multichannel Analyzer. This design goes beyond the BSAM, providing microprocessor control for data analysis, and display of the gamma spectrum. Three units have been provided to IAEA for evaluation. A commercial vendor has announced its intention to offer a similar unit, based on the Los Alamos design.

A class of NDA instruments which are transportable (large detector heads are usually left at the facility) has been developed by Los Alamos. The basic unit is the High Level Neutron Coincidence Counter (HLNCC) (Fig. 3), provided to the IAEA in the first year of POTAS. The HLNCC is now in routine use by inspectors for verification of bulk quantities of plutonium oxide and metal. Seven units, four built commercially, were given to the IAEA. In addition, Los Alamos is building six detector heads specially designed to assay MOX fuel rods and Pu-coupons at fast critical facilities. The IAEA has recently purchased four more HLNCC's directly from the manufacturer.

Two other transportable instruments which use the same electronic package as the HLNCC are the Active Well Coincidence Counter (AWCC) and Neutron Coincidence Measurement "Collar." The detector head for the AWCC is optimized for assay of bulk quantities of enriched uranium. The detector head for the "Collar" is designed for assay of unirradiated LWR fuel assemblies. Both of these systems are undergoing test and evaluation by the IAEA.

Figure 1. Brookhaven Survey Assay Meter (B-SAM) - The Built-In Calculator Gives a Digital Readout of Results. The Unit is Battery Powered and Conveniently Portable.

Figure 2. Hand-Held Survey Assay Meter (SAMson) -- A Battery-Operated Two-Channel Analyzer and a Sodium-Iodide Detector Contained in a Single Unit Permits Rapid Assay of Nuclear Material.

Figure 3. High-Level Neutron Coincidence Counter (HLNCC) - A Transportable System for Assay of Plutonium Consists of a Detector and an Electronic Package Interfaced with a Programmable Calculator. The Detector Well is Designed to Accommodate Sealed Containers of Plutonium in Oxide or Metal Form.

The Lawrence Livermore National Laboratory built a portable micro-computer designed to be interfaced with the IAEA Silena multichannel analyzer (1000 or 2000 MCA) (Fig. 4). The computer is programmed to determine the isotopic content of Pu and provides the inspector with the capability of in-field analysis to determine plutonium isotopic content. The IAEA now has the unit under test and evaluation.

The Argonne National Laboratory constructed and delivered to the IAEA three types of calorimeters for measuring the plutonium content of various-sized samples. Calorimetric assay provides a new NDA capability to the IAEA, particularly for establishing physical standards. Use of this measurement in combination with gamma-spectrometer analysis of isotopic ratios provides an accurate measurement of the Pu content.

A segmented gamma scanner (SGS) was built by LANL for measuring plutonium scrap or waste contained in drums. A unit was installed at the Comitato-Nazionale per/Energia Nucleare (CNEN-Italy) plutonium fuel fabrication facility in Casaccia, Italy, for test and evaluation. This instrument, given to IAEA, included a spare high-resolution germanium detector.

A second SGS, built commercially by Canberra, was installed in the IAEA's Safeguards Analytical Laboratory (SAL) waste management system. The system is being used to assay Pu in heterogeneous waste.

A transportable weighing system to permit IAEA inspectors to verify the mass of UF_6 cylinders was built by the National Bureau of Standards. The system consists of a calibrated load cell, an electronic digital readout meter, and special hardware for lifting UF_6 cylinders. All components are commercially available. The unit given to the IAEA is scheduled for field testing at a nuclear facility.

b. Assay of Irradiated Nuclear Material. Los Alamos developed a unit called ION-1 to assay spent fuel using both ion chambers and fission detectors. The unit is portable (battery operated) with an integral microprocessor to provide for automatic features such as set up, data analyses, and diagnostic capability. Three ION-1 units with associated detectors have been given to the IAEA for test and evaluation. It is intended to conduct field tests, following procedures that will require little or no movement of fuel assemblies.

Based on extensive tests conducted by Los Alamos, it was demonstrated that the "Javelin" (Fig. 5) night vision device could be used to verify spent fuel. The device permits the inspector to authenticate spent fuel, stored underwater, by viewing the Cerenkov glow emitted. The method is rapid, and the device is lightweight, easy to use, and is an off-the-shelf item. The IAEA has four units (two provided by POTAS) for test and evaluation. Recent field tests have shown this technique to be a highly efficient and useful verification procedure.

A portable underwater viewer, developed by Instrument Technology, Inc. (Fig. 6), is designed for optical verification of identification numbers of spent-fuel assemblies stored underwater. The unit is a high-powered telescope designed to view the assemblies from below the surface of the water. Extension sections permit lengthening the telescope to accommodate special physical conditions in the storage pond area or turbid water.

Figure 4. Lawrence Livermore Portable Micro-Computer - The Unit was Designed to Analyze Plutonium Gamma-Ray Spectra Recorded by the Multichannel Analyzer Used by the IAEA. A Print-Out Gives an Inspector a Direct Reading of Plutonium Isotopic Content.

Figure 5. Cerenkov Viewing (Night Vision) Device - A Commercially Available Unit is Used to Intensify the Light Image of Cerenkov Glow after it is No Longer Visible to the Naked Eye. The Presence of Cerenkov Glow is an Indicator of the Authenticity of Spent Fuel Assemblies.

Figure 6. Underwater Viewer - A Periscope Provides a Means to Read Serial Numbers on Fuel Assemblies Stored Underwater. Two- and Ten-Power Magnification is Provided. Additional Optical Extenders Permit Closer Viewing if Water is Turbid.

A unit was given to the IAEA for test and evaluation. Field tests at storage ponds at two separate reactors showed that it was feasible to use the viewer without extenders when the pond water was clear. In turbid water, extenders were needed to effectively verify the fuel identification numbers.

c. Containment and Surveillance. Sandia developed a semi-automatic scanner (Fig. 7) for review of film from the IAEA surveillance cameras. Inspectors are required to review film to detect any anomaly of events. The unit is designed for rapid scanning and will stop the film when a motion is detected to permit careful review of frames covering the event. The Agency reported that use of the device has significantly reduced the time required for film review.

A battery-operated TV system (Fig. 8) built by Sandia was provided to the Agency. This lightweight system can be carried to nuclear facilities for short-term surveillance activities such as monitoring fuel reloading activities at a reactor or surveillance of areas when inspection activities must be temporarily interrupted. The unit has been used routinely by inspectors.

A major development has been the Advanced TV Surveillance System (Fig. 9). This program was a joint effort between Sandia and Fernseh (a Sandia subcontractor). The basic system consists of 2 redundant video recorders, microprocessor controls, and two video cameras. The design provides for automatic unattended operation. Unique features are pre-programmed operating set up, motion detection capability, redundant recorders, and tamper-resistant enclosures for the recorders and the cameras. The new system should provide significant improvement in reliability and utility over the present system. For special cases, a "slave" recorder is provided to permit a second authority to remove video cassette for joint review during an interim period. The IAEA has three complete units that are ready for field testing.

Two additional Fernseh CCD TV cameras were given to the IAEA for use with the present IAEA TV system. The cameras employ a CCD image device which is superior in performance to the currently used silicon diode type.

Los Alamos developed a reactor power monitor (Fig. 10), for unattended operation. The device provides a means for confirming the operating history of a power reactor. It is compact, battery powered, and microprocessor controlled. The unit measures and records the history of the neutron background outside the reactor shield. These data are then compared with the operator's records of the power history. The IAEA has completed test and evaluation of the unit and considers it to be available for special situations.

d. Automatic Data Processing. POTAS provided direct financial contributions to permit early acquisition of a larger computer, peripherals, and software (Fig. 11), for the new safeguards information system. Funds were used for direct purchases or for initial leasing of equipment.

A mini-computer with peripherals was purchased to permit the IAEA to evaluate the use of this equipment for data analysis and information processing. It is intended to install systems of this type in regional or field offices.

Figure 7. Semi-Automatic Film Scanner - Inspectors Use the Scanner to Review Developed Super-8 Surveillance Film. The Projected Image is Converted to Video to Permit Automatic Detection of Unusual Activity in a Projected Scene.

Figure 8. Portable TV Surveillance System - The Battery-Operated System, Designed for Quick Set Up, Permits the Inspector to Monitor Selected Activities for Short Time Periods, between 15 Minutes and 24 Hours.

Figure 9. Advanced TV Surveillance System - The Central Control Console Contains Two Video Recorders to Provide for Redundant Operation. An Auxiliary Recorder, Mounted Above the Central Console, Permits Special Access to a Recorded Tape without the Need for Access to the Main Unit. The Two Cameras, Shown on Top of the Console, Would Be Located in Areas under Surveillance.

Figure 10. Reactor Power Monitor - The Monitor Measures and Records the Neutron Flux Outside the Reactor Shielding. The Measured Neutron Flux is an Independent Verification of the Corresponding Reactor Operating History.

Figure 11. Computer Terminal - The Terminal Permits Direct Access to the IAEA Safeguards Data Base by Inspectors and Other Safeguards Staff.

The provision of a mini-computer to match the units installed under the TASTEX program has given the IAEA a capability for developing and evaluating data analysis techniques for use with installed instrumentation at reprocessing plants.

e. Physical Standards. ORNL and NBS prepared standard reference materials for use by the IAEA analytical laboratory. These materials, primarily uranium and plutonium isotopes, are needed to analyze verification samples.

Although not given directly to the IAEA, special physical standards were made available to inspectors for calibration of NDA instruments. These calibrations are usually performed at a DOE laboratory before the instruments are used in an inspection activity.

2. Experts

Cost-free experts are, in general, assigned to the IAEA for a period of one to two years to supplement the professional staff of the Department of Safeguards. The IAEA is reimbursed for their salaries and other normal costs. A few experts, provided under POTAS, served for shorter periods, generally one to two months. In cases where residence in Vienna was short, the experts were not assigned to the staff but provided assistance under special service contracts with the IAEA.

To date, 37 U.S. experts have served in various capacities, providing assistance to the IAEA in technology transfer, training, system design, and safeguards information processing, analysis, and evaluation. Some of the significant accomplishments of these experts are described below.

a. Technology Transfer. J. Foley, Los Alamos National Laboratory (LANL), developed procedures for installation and use of the present IAEA TV surveillance system. The procedures included an operation manual, video system check-out instructions, and instructions for packing and shipping. Foley also prepared a manual for the High Level Neutron Coincidence Counter (HLNCC), a POTAS development. Based on the HLNCC concept, Foley designed the Active Well Coincidence Counter (AWCC) which was developed under a subsequent task.

R. Sher, Stanford University, assisted in tests and evaluation of both the HLNCC and the Brookhaven Survey Assay Meter (BSAM). Based on IAEA evaluation, seven HLNCC's provided by POTAS are used routinely by IAEA inspectors to verify the plutonium content of bulk materials. Four additional units, built commercially, have recently been purchased by the IAEA. The BSAM has been used by some inspectors for gamma-ray assay of uranium enrichment and plutonium content.

C. Hatcher (LANL), assisted in adapting programs developed for the IAEA's ND6620 computer. These programs were written for the reduction of gamma-ray data from measurements made by inspectors to verify the isotopic composition of irradiated and unirradiated nuclear material.

W. Lindsay, Science Applications, Incorporated (SAI), and D. Lee (LANL) prepared procedures and operation manuals for the HLNCC and for containment and surveillance equipment. Lee also assisted in developing procedures for ion and fission chambers used for verification of spent fuel. Both Lindsay and Lee worked with the Technical Services Section which is responsible for providing equipment and procedures for inspectors.

L. Cowder (LANL) assisted in the evaluation and field testing of two POTAS devices, the high-powered underwater periscope and the portable load cell for weighing UF_6 cylinders. The first unit is for underwater identification of fuel assembly numbers, the second for verifying the mass of UF_6 in shipping containers.

W. Strohm (Mound) assisted the IAEA in evaluating the use of calorimetric techniques and equipment. The IAEA expects to use this technique to develop physical standards for field calibration of other NDA instruments.

C. Sonnier (Sandia) was responsible for coordinating the Division of Development activities on containment and surveillance (C/S) tasks. Interacting with the Division of Operations, Sonnier helped to insure that the requirements of inspectors were fully considered in the task work plans. Sonnier had a significant role in the planning and in the conduct of tests and evaluation of two highly important POTAS developments, the Cerenkov Night Vision Viewing Device and the Advanced TV Surveillance System.

D. McGovern (Sandia), assigned to the Technical Services Section, provided guidance and training to IAEA staff in the maintenance and use of the currently installed TV and camera surveillance systems. He worked closely with the inspectors to identify reasons for failures, and devised maintenance and operating procedures to improve system reliability.

R. Holt (Sandia) assisted in evaluation and testing of the portable battery operated TV surveillance system and the Semi-Automatic Scanner for Super 8mm movie film; both POTAS developments are now used by inspectors. Holt also provided close support to inspectors in training, use, and maintenance of the IAEA's specialized TV and camera surveillance systems. Similar assistance related to maintenance and testing of C/S equipment is being provided by M. Heiser (Sandia).

J. Cline (SAI) assisted the Agency staff in field exercises to develop measurement techniques, instrument calibration, and data interpretation associated with gamma-ray assay of plutonium and uranium materials.

J. Mandler, R. Helmer, E. Killian, R. Morneau, D. Nichols, and R. Heath, all of Idaho National Engineering Laboratory (INEL), in a series of residence periods in Vienna, assisted in implementing programs for analysis of gamma-ray assay data written for the ND6620 computer.

W. Higinbotham, Brookhaven National Laboratory (BNL), after extensive consultation with the IAEA staff in Vienna, provided a forecast of the Agency's needs for safeguards equipment for the years 1981-1985. The report included an estimate on the costs for purchase and maintenance of this equipment.

b. Training Experts. G. Dixon (State University of California) and G. Bates (Sandia) assisted in the planning and conduct of the IAEA's newly developed basic training program for inspectors. Partly on the basis of recommendations of a POTAS study, the IAEA now conducts a 14-module course for all new inspectors. Dixon and Bates were responsible for the formulation of a course syllabus and a number of course manuals. Bates, who had the responsibility for selection and installation of the audiovisual equipment now used in IAEA training courses, recently joined the IAEA as a regular staff member of the Training Unit.

c. System Design. J. Powers (Teknekron) and F. O'Hara (Mound) assisted in developing model safeguards approaches for reactors and bulk processing facilities. Major emphasis in these studies is on short detection times and formulation of model inspection activity lists.

J. Sanborn (BNL/TSO), serving as a short-term expert, designed a computerized data base and forecasting model that facilitates planning and allocation of inspection effort.

F. Persiani, Argonne National Laboratory (ANL), in two short residence periods, worked closely with the IAEA staff to develop a generic approach to safeguarding fast breeder reactors.

d. Safeguards Information Processing and Analysis. POTAS experts made a significant contribution to assist in upgrading the IAEA information system. These efforts have included the development of a new system for computer processing of safeguards data, installation of a data base management system, and formulation of new methods for analysis of safeguards data and inspection reports.

E. Stone, M. Kaplan, A. Caldwell, D. Alspaugh, and B. Alspaugh, all of Oak Ridge National Laboratory (ORNL), provided programming assistance for input editing, data verification, and report generation, all related to safeguards data. Also developed were application programs for processing inspectors data. This work was critical to the implementation of the new safeguards information system that is now in use.

K. Stewart and D. Oden of Pacific Northwest Laboratory (PNL), R. Muller (Teknekron), H. Lewis (GE), and G. Halverson (INEL), assisted the Section for Data Evaluation. These experts assisted in the development of computer-based techniques for data analysis and statistical evaluation of inspection data.

Three experts, S. Thompson of the Department of Energy (DOE), and D. Smith and W. Brach, of the Nuclear Regulatory Commission (NRC), assisted the Safeguards Evaluation Section in the preparation of the annual Safeguards Implementation Report and in the development of safeguards assessment methodology.

J. Ricci, Energy Systems (E Systems), has been assigned to conduct tests to evaluate RECOVER (Remote Continuous Verification), an ACDA-sponsored program. He was responsible for testing operation of the worldwide communication network.

D. Vogt of Teknekron, on a short-term assignment, designed a computer program for use by the Section for Data Evaluation to calculate the production of plutonium in light water reactors. This program was written for the IAEA computer and will be used to check the consistency of operator reports on reactor burn-up.

3. System Studies

Working closely with the IAEA staff, U.S. contractors conducted studies aimed at improved application of IAEA safeguards. The studies covered three areas: (a) Diversion Hazard Analysis, (b) Safeguards Approaches and Application, and (c) Inspection Effort Planning and Forecasting.

a. Diversion Hazard Analysis. These studies identified relevant diversion scenarios and appropriate concealment possibilities associated with light water power reactors (LWR's), fuel reprocessing facilities, fuel fabrication facilities, and a number of interdependent LWR fuel-cycle facilities. Also included were similar studies of the Liquid Metal Cooled Fast Breeder Reactor.

b. Safeguards Approaches and Application. These studies were designed to examine systematically the activities required to apply IAEA safeguards, to test the effectiveness of these activities, and to provide a basis for their improvement.

Facilities in the United States served as models to examine typical material flows, inventories, and operating procedures related to nuclear material control at large-scale facilities. This information provided a basis for developing generic safeguards approaches which were systematically evaluated for effectiveness.

Case studies for LWR's and mixed oxide fuel fabrication facilities, developed by POTAS contractors, served as basic documents in applying Safeguards Assessment Methodology. This methodology is being considered for use by the IAEA to evaluate the effectiveness of the design, implementation, and performance of a particular safeguards approach.

c. Inspection Effort Planning and Forecasting. These studies provided the IAEA with techniques for use in forecasting the inspection effort required to apply IAEA safeguards and to assess the cost impact of selected safeguards performance criteria. Methods were developed to: estimate inspection effort for a selected facility; allocate available inspection manpower, worldwide; and assess the impact of adopting particular safeguards criteria such as nuclear material throughputs, goal quantities, and probability of detection.

4. Techniques, Procedures, and Equipment Evaluation

Before equipment can be used by inspectors it must be tested under field conditions. In addition, techniques and procedures for use of this equipment must be developed and tested. Cost-free experts have assisted in this activity, and direct support by equipment developers and others has also been important to the conduct of this work. A number of POTAS tasks, conducted by U.S. contractors, were devoted to this area of assistance.

a. Equipment Field Tests. Assistance was given in field testing NDA instruments, surveillance devices, and other equipment developed under POTAS. These tests were conducted at facilities in Europe, Japan, and the United States. POTAS not only provided expert assistance but supported the travel cost of IAEA staff participating in the test.

In addition to the field test, Los Alamos and Sandia performed reliability tests to identify design faults and, where necessary, made modifications to correct these faults. Reliability tests also serve to identify maintenance practices. These tests were particularly important for TV and film camera surveillance systems where long periods of uninterrupted service are essential.

Because of the number of failures the IAEA was encountering with its film camera surveillance system, Sandia undertook the task of upgrading the reliability of the system. The resulting engineering study recommended modification of the design for the camera enclosure which overcame the humidity problem that was the major cause of camera failures. Where camera enclosures were modified to incorporate the recommended design of a moisture seal, the failure rate has been greatly reduced.

b. Procedures for NDA of Nuclear Materials. Los Alamos developed measurement procedures for the HLNCC to correct neutron multiplication and background effects in large Pu and PuO₂ samples. These procedures were field tested at Mol, Belgium, by a team from IAEA, CEN/SCK Belgium, and Los Alamos. Associated with this procedure, Los Alamos also developed a calculational technique which reduces the number of physical standards needed to calibrate the High Level Neutron Coincidence Counter.

Argonne National Laboratory developed techniques, using autoradiography, to verify U-235 enrichment in fresh LWR fuel assemblies and to verify the plutonium content of fuel for research reactors. These techniques were demonstrated to IAEA, and specially designed film packs were provided to permit further test and evaluation. A manual describing the use of the technique was also provided. *

c. Feasibility Studies. Sandia demonstrated the Integrated Monitoring System (IMS) at the GE Morris Facility. The IMS, a containment and surveillance system, is designed for continuous surveillance of spent-fuel movements in the receiving area at a reprocessing plant or other spent-fuel storage area. Fuel movement is recorded using detectors on the crane for moving fuel assemblies and radiation detectors located at strategic points. Installation of the system in a facility under IAEA inspection has been proposed.

Atlantic Research completed a study to determine the technical feasibility of remote monitoring of the surveillance systems. The technique was demonstrated to the IAEA. The follow-on activity resulting from this task is the ACDA RECOVER Program, which incorporates a multi-national test of remote monitoring of surveillance devices from Vienna.

In an extensive survey, Los Alamos evaluated radiation detectors considered suitable for confirming that fresh or irradiated reactor fuel elements or plutonium bearing materials were not removed from a storage area. A number of suitable detectors were identified.

The operating characteristics of the IAEA Silena multichannel analyzers (MCA) have been substantially improved through modifications formulated by Lawrence Livermore. One Silena was modified and demonstrated to the IAEA. Based on the documentation provided, the IAEA will modify twenty of its existing Silena MCA's.

Studies by Sandia to improve the Type-E seal resulted in the development of a double cap Type-E seal that can be assembled from commercial parts. Sixteen hundred seals of this design are being evaluated by the IAEA. Sandia also developed a Type-X cap seal with stainless steel parts machined to very close tolerances, which should prove to be more reliable and tamper resistant. Five hundred Type-X seals were sent to the IAEA for their evaluation.

A prototype electronically coded fiber optic seal was developed by Sandia. These seals, designed to be highly tamper resistant, may be verified in the field or by having an outside party read the display and transmit the coded message to a remote location. IAEA presently has ten seals and a programmer verifier for test and evaluation.

d. Transportation of Inspection Samples. A major effort is being conducted by Sandia to develop a container which will be certified for international air transport of safeguards samples containing sub-gram quantities of plutonium. The container, called the Lightweight Air Transportable Accident Resistant Container (LAARC/Pat-2), has been successfully tested and is scheduled to be licensed and certified for international use by September 1981. Competent authorities from a number of countries, the IAEA, and U.S. Agencies witnessed the tests. Six containers will be given to the IAEA for transport of samples between inspected facilities and Vienna.

Oak Ridge National Laboratory assisted the IAEA in developing procedures for the application of the resin bead technique to prepare very small plutonium samples. Because of national regulations and international agreements on shipping radioactive material, the use of small samples, containing only very low levels of activity, would greatly simplify the transport of IAEA inspection samples. Field tests incorporating these procedures gave excellent results, demonstrating that it was feasible, with well defined procedures, to prepare very low-level activity samples suitable for IAEA verification.

5. Training

The IAEA is responsible for training two important groups: IAEA inspectors and safeguards specialists from Member States. Under POTAS, U.S. experts assisted in planning and developing courses conducted by the IAEA, and in some cases served as lecturers in these courses. To supplement these courses, DOE laboratories and other facilities gave special courses or provided individual training for IAEA inspectors or other safeguards specialists. In addition, POTAS made direct contributions to support travel of IAEA personnel serving as lecturers, and some others who attended the courses.

a. Inspector Training. Los Alamos has conducted training courses in the use of NDA Safeguards that have been made available regularly to the IAEA safeguards staff (Fig. 12). The basic course is tailored to the specific needs of the IAEA. This course has become an integral part of the IAEA training course and is taken by inspectors who have completed introductory courses in Vienna. About 40 staff members attend each year.

Figure 12. Los Alamos National Laboratory Training Course - New Inspectors are Given Practical Training in the Use of IAEA Instrument. Courses are Conducted by Experts on the LANL Staff.

Individuals on the IAEA staff were given training in such areas as data analysis, NDA methods, and maintenance and testing of safeguards equipment provided under POTAS. In most cases, this training was given by the equipment developers. The operating and maintenance manuals provided with the above equipment have, in many cases, served as basic training material.

U.S. Experts have given seminars at IAEA Headquarters on advanced safeguards concepts to selected IAEA staff. These seminars serve to keep the IAEA informed on advanced ideas and to provide for an exchange of views on the applicability of the concepts to international safeguards.

b. Training for Safeguards Specialists from Member States. An advanced course for personnel responsible for State Systems of Accounting for and Control of Nuclear Material (SSAC) was conducted at the Exxon Nuclear Fuel Fabrication Facility in Richland, Washington. The course was the joint effort of the IAEA, Battelle Pacific Northwest Laboratory, and Exxon. Special assistance was provided to the IAEA in funding for the travel and per diem for some of the participants. Representatives from 15 Member States attended. This course supplements the basic SSAC given by the IAEA in Vienna and in other countries.

ABBREVIATIONS & ACRONYMS

ACDA	- Arms Control and Disarmament Agency
ANL	- Argonne National Laboratory, Illinois
AWCC	- Active Well Coincidence Counter
BNL	- Brookhaven National Laboratory, New York
BSAM	- Brookhaven Survey Assay Meter
CCD	- Charged Couple Device
C/S	- Containment and Surveillance
DOE	- U.S. Department of Energy
Ge	- Germanium
GE	- General Electric Company
GWK	- Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen m.b.h.
HEU	- Highly Enriched Uranium
HLNCC	- High Level Neutron Coincidence Counter
HWR	- Heavy Water Reactor
IAEA	- International Atomic Energy Agency
ION-1	- Ion and Neutron Detector
INEL	- Idaho National Engineering Laboratory
ISPO	- International Safeguards Project Office
LAARC	- Lightweight Air-Transportable Accident-Resistant Container
LANL	- Los Alamos National Laboratory
LEU	- Low Enriched Uranium
LMFBR	- Liquid Metal Fast Breeder Reactor
LWR	- Light Water Reactor
MCA	- Multi-Channel Analyzer
Mound	- Monsanto Research Corporation Mound Facility
MOX	- Mixed Uranium and Plutonium Oxide
NBS	- National Bureau of Standards, Department of Commerce
NDA	- Non-Destructive Assay
NRC	- Nuclear Regulatory Commission
NWAL	- Network of Analytical Laboratories
ORNL	- Oak Ridge National Laboratory
OSS	- DOE Office of Safeguards and Security
POTAS	- U.S. Program of Technical Assistance to IAEA Safeguards
PNL	- Battelle, Pacific Northwest Laboratory, Washington
Pu	- Plutonium
PuO ₂	- Plutonium Dioxide
PWR	- Pressurized Water Reactor

ABBREVIATIONS & ACRONYMS (cont'd)

RECOVER	- Remote Continuous Verification
Sandia	- Sandia National Laboratories
SAI	- Science Applications Incorporated
SAL	- Safeguards Analytical Laboratory, Seibersdorf, Austria
SAM	- Stabilized Assay Meter
SAMson	- Portable Assay Meter
SGS	- Segmented Gamma Scanner
SRM	- Standard Reference Material
SSAC	- States' System of Accounting for and Control of Nuclear Material
T & E	- Test and Evaluation
TSO	- Technical Support Organization
TASTEX	- Tokai Advanced Safeguards Technology Exercise
U	- Uranium
UCND	- Union Carbide Nuclear Division
UF ₆	- Uranium Hexafluoride
UNO ₃	- Uranium Nitrate
UO ₂	- Uranium Dioxide, "Brown Oxide"
U ₃ O ₈	- Uranous Uranyl Oxide, "Black Oxide"
USIP	- U.S. Initiative Program
VIC	- Vienna International Center
VTR	- Video Tape Recorder

ANNEX I

Index of POTAS Tasks

<u>Task No.</u>	<u>Title</u>	<u>Current Active</u>	<u>Completed</u>	<u>Deleted*</u>
A.1	Senior NDA Expert		X	
A.2	NDA/Computer Data Processing Expert		X	
A.3	NDA/Instruction & Procedures Expert		X	
A.4	NDA/Physical Standards Expert		X	
A.5	Gamma Spectroscopy & Neutron Techniques for Unirradiated Nuclear Material		X	
A.6	Neutron Techniques for Unirradiated Fuel Assemblies		X	
A.7	Equipment for Measurement of Plutonium Scrap or Waste in Drums		X	
A.8	Active Well Coincidence Counter		X	
A.9	Plutonium Assay Calorimetry		X	
A.10	In-Field Processing of Inspection Data			X
A.11	Gamma Spectroscopy Technique for Unirradiated Uranium Samples	X		
A.12	CdTe Detector to Operate at Room Temperature			X
A.13	Hand-Held Germanium Detector Probe		X	
A.14	Gamma Absorptiometer Expert		X	
A.15	Track-Etch Technique; Processing & Read-out of Tapes		X	
A.16	Technical Assistance in Application of IAEA Two-Stage Spectrometer		X	
A.17	Acquisition of IAEA NDA Equipment and Appropriate Reference Materials for Training Programs at LASL		X	
A.18	Autoradiographic Verification of Enrichment in Unirradiated Fuel Assemblies		X	
A.19	Vehicle for Instrumented Safeguards Inspection System (Europe)		X	
A.20	Demonstration of an Automated Flow Monitor and Liquid Level Density Measurement System in a Fuel Reprocessing Facility			X
A.21	Development of Safeguards Instrumentation and Safeguards Exercise at Pilot Waste Vitrification Facility, BPNL, Hanford			X
A.22	Access to U.S. Facilities and Calibration Standards		X	
A.23	Spent Fuel Assemblies		X	
A.24	Mass Spectrometer Filaments		X	
A.25	Personal (Pocket) Radiation Monitors		X	
A.26	Portable Neutron Well Coincidence Counter		X	

*These task were withdrawn at the request of the IAEA, usually because the objectives were being met in other programs.

<u>Task No.</u>	<u>Title</u>	<u>Current Active</u>	<u>Completed</u>	<u>Deleted</u>
A.27	Senior NDA Expert		X	
A.28	Senior NDA Expert		X	
A.29	NDA/Computer Data Processing Experts		X	
A.30	NDA/Instruction and Procedures Expert		X	
A.31	Active Neutron Technique for Unirradiated Fuel Assemblies Based on Neutron Generator Containing No Radioactive Material	X		
A.32	Gamma Absorptiometer Expert			X
A.33	Track-Etch Technique; Field Test of Reactor Power Monitor	X		
A.34	Demonstration of the Application of Resin Bead Technology in the Analysis of Irradiated Fuel Solutions		X	
A.35	Autoradiographic Verification of the Plutonium Content of Plutonium-Bearing Fuels		X	
A.36	Vehicle for Instrumented Safeguards Inspection System (Europe)		X	
A.37	Equipment for Vehicle for Instrumented Safeguards Inspection System	X		
A.38	Portable Neutron Well Coincidence Counter		X	
A.39	Determination of the Multiplication in Assay Samples		X	
A.40	UF ₆ Mass Determination		X	
A.41	Thermal Imaging for Plutonium Location and Plutonium Content Verification			X
A.42	Measurement of the Minor Isotopes of Uranium Using the IAEA Two-Stage Mass Spectrometer		X	
A.43	Active Assay of Highly Enriched Uranium in Unirradiated Fuel Assemblies or Containers		X	
A.44	Provision of Spiking Material for Isotope Dilution Mass Spectrometer Analysis		X	
A.45	Plutonium Assay Calorimetry	X		
A.46	Procurement of Two Intrinsic Germanium Coaxial Detectors with Amplifiers		X	
A.47	Prediction of Calorimeter Equilibrium	X		
A.48	In-Storage Pond Spent Fuel Burn-up Verification with Minimum Movement of Irradiated LWR Fuel Assemblies	X		
A.49	Application of Neutron Measurement Technologies for the NDA of Irradiated Fuel Assemblies	X		
A.50	Unique Identification of LWR Fuel Assemblies			X

<u>Task No.</u>	<u>Title</u>	<u>Current Active</u>	<u>Completed</u>	<u>Deleted</u>
A.51	U ²³⁵ Content Determination of HEU with the Active Well Coincidence Counter	X		
A.52	NDA Instrumentation and Supporting Equipment for Agency Vehicle (Europe)		X	
A.53	NDA Applications Technical Assistant		X	
A.54	Highly Portable, In-Place UF ₆ Mass Determination		X	
A.55	Gamma Spectrometry and Neutron Techniques for Unirradiated Nuclear Material - BSAM Modification		X	
A.56	Measurement Procedures and Standard Reference Materials to Optimize Implementation of Resin Bead Techniques	X		
A.57	Expert on Application of Resin Bead Technique			X
A.58	International Air Shipment of Irradiated Plutonium on Resin Beads to Facilitate International Safeguards	X		
A.59	Air Shipment of Plutonium Samples to Facilitate International Safeguards	X		
A.60	Vehicle for Instrumented Safeguards Inspection System (Canada)			X
A.61	Vehicle for Instrumented Safeguards Inspection System (Japan)			X
A.62	Determination of the Pu Content in Mixed Oxide Fuel Assemblies Using the HLNCC	X		
A.63	Microprocessor for In-Field Processing of Agency Multichannel Analyzer (MCA) Gamma Ray Measurements	X		
A.64	Implementation Procedures for Fast Response Calorimeters	X		
A.65	High Precision Pulse Counting Mass Spectrometry Analysis of Nanogram-Size U and Pu Samples		X	
A.66	Detection and Correction of Interference in the Chemical Determination of Fissile Elements	X		
A.67	Supply of U ²³³ and Pu ²⁴⁴ Spike Material with Specific Chemical and Isotopic Purity	X		
A.68	Supply of a Well-Type High Resolution Semiconductor Detector for Gamma Spectrometry		X	
A.69	Analytical Techniques to Reduce Number of Physical Standards	X		
A.70	Development of an Inspector Data Verification and Evaluation System for the Automated Electromanometer	X		

Task No.	Title	Current Active	Completed	Deleted
A.71	Access to U.S. Facilities and Calibration Standards (Continuation of A.22)		X	
A.72	Ion Chamber and Neutron Detector for Spent Fuel Measurements	X		
A.73	Special Neutron Measuring Head for the HLNCC	X		
A.74	Battery-Powered Multi-Channel Analyzer	X		
A.75	Neutron Techniques for Unirradiated Fuel Assemblies	X		
A.76	Implementation of Improved Isotopic Data Analysis Procedures	X		
A.77	Calculational Program for MTR-Type Fuel Assemblies	X		
A.78	Demonstration and Application of Resin Bead Technology in the Analysis of Irradiated Fuel Solutions	X		
A.79	Methods for Adapting K-edge Densitometer and Gamma Spectrometer for IAEA	X		
A.80	Supply of U ²³³ and Pu ²⁴⁴ Spike Material with Specific Chemical and Isotopic Purity	X		
A.81	Selection of a High Accuracy Surface Ionization Mass Spectrometer		X	
A.82	High Precision Pulse Counting Mass Spectrometry Analysis of Nanogram-Size U and Pu Samples	X		
A.83	Study of 1000 Channel Silena Analogue Circuits	X		
A.84	Qualitative Verification Criteria - Material Authenticity	X		
A.85	Field Evaluation and Implementation of U.S. Instruments and Methods	X		
A.86	Technical Assistance in Operation of Two-Stage Mass Spectrometer	X		
A.87	Senior NDA Expert		X	
A.88	Computer Data Processing Expert	X		
A.89	NDA/Instruction and Procedures Expert		X	
A.90	Access to U.S. Facilities and Calibration Standards	X		
A.91	Provide Commercially Available Safeguards Equipment		X	
A.92	Expert in Forecasting of Safeguards Equipment Requirements	X		
A.93	Desktop Computer System for Analysis		X	
A.94	NDA/Instruction & Procedures Expert		X	
A.95	Program for Implementing Use of HLNCC	X		
A.96	Program for Implementing Use of AWCC	X		
A.97	Program for Implementing Use of Gamma and Neutron Chambers for Spent Fuel Measurements	X		

<u>Task No.</u>	<u>Title</u>	<u>Current Active</u>	<u>Completed</u>	<u>Deleted</u>
A.98	Program for Implementing Use of Portable Measurement Equipment to verify UF ₆ Mass Determination	X		
A.99	Special Measuring Heads for Neutron Coincidence Counting of Samples	X		
A.100	Senior NDA Expert	X		
B.1	Planning of Safeguards Training		X	
B.2	Provision of Lecturers for IAEA-Sponsored Training Courses		X	
B.3	IAEA Participation in U.S.-Sponsored Training Courses		X	
B.4	Individualized Instruction		X	
B.5	Funding for Training Participation		X	
B.6	An Advanced SSAC Course Based on the Application of a National System of Accounting and Control with Special Reference to Bulk Fuel Processing Facilities		X	
B.7	A Manual for the Examination of Nuclear Material Records	X		
B.8	Cost-Free Training Expert		X	
B.9	Provision for Lecturers for IAEA-Sponsored Training Courses		X	
B.10	IAEA Participation in U.S.-Sponsored Training Courses		X	
B.11	Individualized Instruction		X	
B.12	Provision for Training Aids for Classroom Work		X	
B.13	Preparation of a Video Training Course on the Use of the High-Level Neutron Coincidence Counter (HLNCC)	X		
B.14	Preparing a Complete Inspectors Basic Training Course		X	
B.15	Training in Nuclear Fuel Plant Processes	X		
B.16	Funding for Training Participation	X		
B.17	Cost-Free Training Expert		X	
B.18	Provision of Lecturers for IAEA-Sponsored Training Courses		X	
B.19	IAEA Participation in U.S.-Sponsored Training Courses	X		
B.20	Individualized Instruction	X		
B.21	Training Manual for Examining Nuclear Material Records	X		
B.22	Prepare Inspector's Basic Training Course		X	
B.23	Management Training Program	X		
B.24	Cost-free Training Expert	X		
B.25	Cost-free Training Expert	X		

<u>Task No.</u>	<u>Title</u>	<u>Current Active</u>	<u>Completed</u>	<u>Deleted</u>
C.1	Integral Exercises - Uranium Enrichment Facility			X
C.2	Integral Exercises - LWR Power Plant		X	
C.3	Integral Exercises - LEU Fabrication Facility		X	
C.4	Integral Exercises - Reprocessing Facility		X	
C.5	Estimation of Inspection Effort for Chosen Inspection Procedures		X	
C.6	Material Flow and Inventory Data Processing in Typical Nuclear Facilities		X	
C.7	Safeguarding Fast Breeder Reactors		X	
C.8	Consultant to Consider Safeguards Aspects Related to Heavy Water		X	
C.9	Explanatory Notes and Examples for Design Information Questionnaire		X	
C.10	Dynamic Material Control		X	
C.11	Evaluation of Effectiveness of Those SSAC's Where the State Performs an Independent Verification in Applying Safeguards			X
C.12	Material Operation Control Monitoring		X	
C.13	Guidelines for Facility Design and Operating Features to Facilitate Accounting and Physical Protection for Reactors			X
C.14	Study of Technical Problems of Implementation of Safeguards at Uranium Enrichment Facilities		X	
C.15	Containment and Surveillance Measures for Reprocessing and Enrichment Facilities			X
C.16	Diversification Analysis for Nuclear Fuel Cycle		X	
C.17	Safeguards System for Critical Facilities		X	
C.18	Safeguards Data Base and Forecasting Model		X	
C.19	Model for Analysis of the Impact of the Safeguards Criteria (Categorization of Nuclear Material, Significant and Goal Quantities)	X		
C.20	World-Wide Allocation of Inspection Effort	X		
C.21	Safeguard Approach for a Mixed Oxide Fuel Fabrication Facility			X
C.22	Evaluation and Quantification of Safeguards Effectiveness	X		
C.23	Possible Use of Performance Assessment Methodology for International Safeguards		X	

Task No.	Title	Current Active	Completed	Deleted
C.24	Diversion Hazards for LWR's		X	
C.25	Design of Nuclear Facilities to Make International Safeguards Easier and More Effective		X	
C.26	Safeguards for Reprocessing Facilities			X
C.27	Application of Advanced Material Control Concepts to the Safeguarding of Reprocessing Facilities			X
C.28	Models for Safeguarding Generic Types of Facilities		X	
C.29	Safeguards Database and Forecasting Model (Continuation of Task C.18)		X	
C.30	Development of Short Detection Time Inspection Procedures for Reprocessing MOX and HEU Facilities		X	
C.31	Development of Guidelines for Practical Implementation of the Elements of SSAC	X		
C.32	Diversion Analysis for LEU Conversion/Fabrication Plants		X	
C.33	Integrated Safeguards Test Ensemble			X
C.34	Diversion Analysis Consultant (LWR)		X	
C.35	Calculation of Parameters for Inspection Planning and Evaluation	X		
C.36	Independent Verification at Reprocessing Facilities with Installed Instrumentation as Tested in the TASTEX Program	X		
C.37	Simulation of Cumulative Detection Capabilities over Multiple Material Balance Periods	X		
C.38	Diversion Hazards Possible with Multiple and Interdependent LWR Fuel Cycle Facilities	X		
C.39	Long-Term Forecast of Nuclear Activities		X	
C.40	Assistance on Development of the Safeguards for Uranium Enrichment Facilities	X		
C.41	Diversion Analysis Consultant (MOX)		X	
C.42	Special Cases of "Diversion Hazard for LWR's"			X
C.43	Diversion Analysis and Safeguards Measure for Liquid Metal Cooled Fast Breeder Reactors (LMFBR)	X		
C.44	Diversion Analysis for Nuclear Fuel Cycle		X	
C.45	Seminar on System Studies Related Topics	X		
C.46	Computerization of PWR Anomaly Assessment Modules	X		
D.1a	Assist in Acquiring New Computer		X	
D.1b	Assist in Acquiring New Computer at an Earlier Date		X	

Task No.	Title	Current Active	Completed	Deleted
D.2a	Computer Terminals		X	
D.2b	Computer Terminals			X
D.3	Remote Data Terminal with Dial-Up Capability		X	
D.4	Study and Possible Conversion of Statistical Software Packages		X	
D.5	Concept for Implementation of, and Instruction in Safeguards Information System		X	
D.6	Design and Coordination of Safeguards Forms		X	
D.7	Cost-Free Experts - Senior Analysts/Programmers (2)		X	
D.8	Cost-Free Experts - Analysts/Programmers (2)		X	
D.9	Evaluation of Effort Required for Development of New Advanced Safeguards Information System		X	
D.10	Evaluation of Technical Requirements for Operation of the New Advanced Safeguards Information System		X	
D.11	Provide the IAEA with Two Word Processors		X	
D.12	Reducing Copying Machine		X	
D.13	Computer Terminals		X	
D.14	Direct Transmission of Safeguards Data		X	
D.15	Cost-Free Expert - Senior Analyst/Programmer		X	
D.16	Cost-Free Experts - Analysts/Programmers (2)		X	
D.17	Calculational Procedure for Production of SNM in Reactors		X	
D.18	Upgrade System for Data Security			X
D.19	Cost-Free Expert - Junior Analyst/Programmer		X	
D.20	Encryption Devices for Safeguards Data			X
D.21	Safeguards Information Treatment (SGIT) Exchange Seminar in the U.S.A.		X	
D.22	Mini-Computer for Inspection Data Evaluation	X		
D.23	Computer Software Acquisition			X
D.24	Computer Graphics Hardware Acquisition			X
D.25	Cost-Free Experts - Analysts/Programmers (2)		X	
D.26	Software Support for the Field Computer System		X	
D.27	Leasing of Reducing Copy Machine		X	
D.28	Cost-Free Expert - RECOVER		X	
D.29	Cost-Free Experts - Analysts/Programmers (3)		X	

<u>Task No.</u>	<u>Title</u>	<u>Current Active</u>	<u>Completed</u>	<u>Deleted</u>
D.30	Expert for Designing and Documenting Procedures for Handling of Inspection Data		X	
D.31	Expert for Developing Methods of Evaluation and Processing of Inspection Data		X	
D.32	Exchange of Experience with NRC Safeguards Inspectors		X	
D.33	Assistance in Application of POTAS Developments		X	
D.34	Special Travel by IAEA Safeguards Personnel to U.S.A.	X		
D.35	Establish ICT Procedures for Use by Inspectors at Reprocessing Facilities Under IAEA Safeguards		X	
D.36	Records Examination and Check Lists	X		
D.37	Expert for Development of Methods for Evaluation of Inspection Data		X	
D.38	Expert for Developing Methods of Evaluation and Processing of Inspection Data	X		
D.39	Senior Expert in Evaluation of Safeguards	X		
D.40	Cost-free Expert Analyst/Programmer	X		
E.1	Irradiated Fuel Bundle Counters			X
E.2	Modification of Irradiated Fuel Bundle Counter		X	
E.3	Semi-Automatic TV Tape Scanner		X	
E.4	IAEA TV System Transmission Security		X	
E.5	Design of a Battery Powered Portable TV Surveillance System		X	
E.6	Provision of Environment-Resistant TV Surveillance Systems		X	
E.7	Study of Before-the-Lens Tamper Detection for Camera and TV Surveillance Systems		X	
E.8	Study and Possible Development of On-Line Interrogation of Surveillance and Sealing Systems		X	
E.9	Super 8-mm Surveillance Cameras			X
E.10	Study of Feasibility of Slow Scan TV Surveillance System		X	
E.11	Development of Electronic Fiber Optic Seal System		X	
E.12	Improved Fiber Optic Seals		X	
E.13	Temporary Seals for Identification of Containers (Pressure Sensitive Tape)		X	
E.14	Sealing System for UF ₆ Cylinders		X	
E.15	Sealing System for Storage Arrays of Spent HWR Fuel			X
E.16	System for Sealing LWR Fuel Assemblies		X	

<u>Task No.</u>	<u>Title</u>	<u>Current Active</u>	<u>Completed</u>	<u>Deleted</u>
E.17	Intrusion/Motion Detection for Surveillance/Containment		X	
E.18	Tamper-Resistant Tamper-Indicating Containers		X	
E.19	Methods of Tamper Detection/Indication		X	
E.20	Status Monitoring (Alternative to Optical Surveillance)		X	
E.21	Irradiated Fuel Monitor		X	
E.22	Solar Cell Gamma Detector		X	
E.23	Portal Monitors		X	
E.24	Reactor Power Monitor		X	
E.25	Development of a Reliable Advanced TV Surveillance System	X		
E.26	Expert to Perform Reliability Analysis and Recommend Maintenance Procedures for In-Field Video Surveillance System		X	
E.27	Design of a Semi-Automatic Scanner for Super 8-mm Movie Film		X	
E.28	Metallic Seals	X		
E.29	Seals for Unirradiated LWR Fuel Assemblies		X	
E.30	Expert in Containment and Surveillance		X	
E.31	Professional Experienced in Containment and Surveillance Techniques		X	
E.32	Mechanical Tamper-Indicating Reuseable Seal System			X
E.33	Functional Evaluation of Film Cameras Suitable for Surveillance		X	
E.34	Hardware and Procedure to Prevent Before-the-Lens Tampering	X		
E.35	Underwater Identification of Fuel Assembly Numbers		X	
E.36	Optimum Design of Containers to Accommodate Seals	X		
E.37	Production of Electronic, Fiber Optic Seal Systems	X		
E.38	Development of an Improved Surface-Type Seal			X
E.39	TV Surveillance for Conditions of Low Light Level			X
E.40	Supply Portable Battery-Powered TV Systems	X		
E.41	Radiation Detectors as Yes/No Monitors for Safeguards		X	
E.42	Evaluation of Ultrasonically Identified Seals		X	
E.43	Identify Recording and Verification of Type-E Seals		X	

Task No.	Title	Current Active	Completed	Deleted
E.44	Improved Reliable Film Camera System	X		
E.45	Integrated Monitoring System for Light Water Reactor Spent Fuel Storage Area	X		
E.46	Cassette-Type Video Tape Recorder Evaluation	X		
E.47	Portable Super 8-mm Film Developer Kits		X	
E.48	Loop Used With a Type-E or Other Seal Closures		X	
E.49	Semi-Automatic Scanners for Super 8-mm Movie Film			X
E.50	Improved Cerenkov Measurement System	X		
E.51	Containment and Surveillance Equipment Reliability Techniques	X		
E.52	Expert in Containment and Surveillance		X	
E.53	Professional Experienced in Containment and Surveillance Techniques		X	
E.54	Program for the Implementation of the Task E.25 Advanced TV Surveillance System	X		
E.55	Evaluation of RECOVER Monitoring System	X		
F.1	Quality Control IAEA-NWAL Through the SALE Program			X
F.2	Exchange of Experience with NRC Safeguards Inspectors		X	
F.3	Statistical Analysis of Analytical Data		X	
F.4	Sample Plan Calculation and Application		X	
F.5	Detection of Irregularities in Overall Fuel Cycle Transaction Reports		X	
F.6	Expert for Development of Methods of Evaluation of Inspection Data		X	
F.7	Cooperative Study with NRC at GE-Wilmington		X	
F.8	Review of Part F of Safeguards Technical Manual		X	
F.9	Development and Application of Isotopic Safeguards Techniques		X	
F.10	Senior Expert in Safeguards Implementation		X	
F.11	Expert for Designing and Documenting Procedures for Handling of Inspection Data		X	
F.12	Expert for Developing Methods of Evaluation and Processing of Inspection Data		X	
F.13	Application of Isotopic Safeguards Techniques at a Reprocessing Facility			X
F.14	Senior Expert in Safeguards Implementation		X	
F.15	Senior Expert in Evaluation of Safeguards		X	

<u>Task No.</u>	<u>Title</u>	<u>Current Active</u>	<u>Completed</u>	<u>Deleted</u>
F.16	Volume III of Part F of Safeguards Technical Manual		X	
F.17	Senior Expert in Evaluation of Safeguards		X	
F.18	Technology Transfer of Developed Methodology for Applying the Kalman Filter		X	
F.19	Expert for Development of Methods of Evaluation for Safeguards Data		X	
F.20	Exchange of Experience with NRC Safeguards Inspectors		X	

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ISPO #2	Track-Etch Technique - Processing and Readout of Tapes - Consultation & Training, September 1978, NEDG- 12682, GE-VNC	D.B. Lovett	A.15
ISPO #3	Integral Exercises - Reprocessing Facility (Barnwell DIQ), March 1978, BNL-TSO	A.M. Bieber, Jr. S.C. Suda	C.4
ISPO #4	Results of Tests to Determine Response of Solar Cell Gamma Detector "C" to High Dose Rate Gamma Radiation, June 1977, Sandia Laboratories, Letter Report	J.F. Ney	E.22
ISPO #5	Cooperative Study with NRC at GE Wilmington, October 1978	A.M. Bieber, Jr. C.M. Vaughn	F.7
ISPO #6	Study of Before-The-Lens Tamper Detection for Film and Television Camera Surveillance Systems, June 1978, Sandia Laboratories, SAND 78- 1221 (limited distribution)	C.S. Johnson	E.7
ISPO #7	Independent Verification of a Material Balance at LEU Fabrication Plant, November 1977, PNL-2418, NTIS UC-15	R.J. Sorenson T.I. McSweeney M.G. Hartman R.J. Brouns K.B. Stewart D.P. Granquist	C.3
ISPO #8	Heavy Water Accountability, September 1978, BNL 24941, Informal Report, Limited Distribution	C. Auerbach J.R. Lemley W.P. Bebbington	C.8 A.25
ISPO #9	Non-Destructive Assay Methods for Irradiated Nuclear Fuels, January 1978, LA-6923 NTIS UC-15	S.T. Hsue T.W. Crane W.L. Talbert J.C. Lee	A.23

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ISPO #11	Report on a Study of the Staffing Required to Complete the Development of the New IAEA Safeguards Information System, June 1978, BNL-TSO	R.J. Fontana E.M. Kidd	D.9
ISPO #12	Autoradiography as a Safeguards Inspection Technique for Unirradiated LWR Fuel Assemblies, May 1978, ANL-78-27 NTIS UC-15	S.S. Brumbach R.B. Perry	A.18
ISPO #13	Small-Sample Calorimeter System Design and Operation, April 1981, ANL-NDA-7	C.T. Roche R.B. Perry G.A. Youngdahl R.N. Lewis E.A. Jung J.R. Haumann	A.9
ISPO #14	Operating Manual - Bulk Calorimeter (In preparation)	R.B. Perry	A.9
ISPO #15	ANL Four-Meter Calorimeter Design and Operation Manual, February 1980, ANL-NDA-3	R.B. Perry R.N. Lewis G.A. Youngdahl E.A. Jung C.T. Roche	A.9
ISPO #16	A Portable Calorimeter System for Non-destructive Assay of Mixed-Oxide Fuels, April 1978, ANL-78-33 NTIS UC-15	C.T. Roche R.B. Perry R.N. Lewis E.A. Jung J.R. Haumann	A.9
ISPO #17	Annual Report on the U.S. Program of Technical Assistance to Safeguards of the International Atomic Energy Agency (POTAS), January-December 1977, March 1978, BNL-50869 UC-15	ISPO	
ISPO #18	Planning of Safeguards Training, May 1978, AGNS, NMS-11	P. Ebel	B.1

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ISPO #20	Diversion Analysis of Light Water Reactor Fuel Cycle, May 1978, Draft, SAI-77-693-LJ	J. Glancy G. Borgonovi	C.16
ISPO #21	Explanatory Notes for an Enrichment Facility Design Information Questionnaire, September 1979, SAI-77-981-LJ	J. Glancy J. Swartz R. Larivere R. Graham	C.9
ISPO #22	Diversion Analysis of Uranium Enrichment Facility, August 1979, SAI-78-694-LJ	J. Glancy R. Graham M. Hecht T. McDaniel	C.16
ISPO #23	Diversion Analysis of a LWR Reprocessing Facility, August 1979, SAI-77-956-LJ	J. Glancy A. El-Bassioni W. Hagan G. Borgonovi	C.16
ISPO #24	Volume I - Explanatory Notes for Design Information Questionnaires May 1979; Volume 2 - Model Responses for an Enrichment Facility Design Information Questionnaire May 1979; Volume 3 - Model Responses for a Conversion/Fuel Fabrication Facility Design Information Questionnaire, May 1979; Volume 4 - Model Responses for a Reprocessing Facility Design Information Questionnaire May 1979; Volume 5 - Model Responses for a Research Reactor Design Information Questionnaire, May 1979; Volume 6 - Model Responses for Power Reactor Design Information Questionnaire, May 1979; Volume 7 - Model Responses for a Critical (sub-critical) Facilities Design Information Questionnaire, September 1979; Volume 8 - Model Responses for Information in Respect of Nuclear Material Outside Facilities, September 1979; SAI-01579-733LJ	J. Glancy W. Hagan J. Swartz	C.9

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ISPO #26	Isotopic Safeguards Statistics, June 1978, PNL-SA-6595 NTIS UC-15	C.L. Timmerman K.B. Stewart	F.9
ISPO #27	Developing Isotopic Functions, June 1978, PNL-SA-6594 NTIS UC-15	B.A. Napier C.L. Timmerman	F.9
ISPO #28	Diversion Analysis of a Light Water Reactor Facility, August 1979, SAI-78-704-LJ	J. Glancy W. Hagan T. McDaniel	C.16
ISPO #29	Diversion Analysis of a Mixed Oxide Fuel Fabrication Facility, August 1979, SAI-78-705-LJ	J. Glancy G. Borgonovi T. McDaniel	C.16
ISPO #30	Explanatory Notes for Conversion and/or Fuel Fabrication Plants - Design Information Questionnaire, September 1979, SAI-78-793-LJ	J. Glancy J. Swartz	C.9
ISPO #31	Explanatory Notes for Research and Power Reactors Design Information Questionnaire, September 1979, SAI-78-894-LJ	J. Glancy J. Swartz J. Mahn	C.9
ISPO #32	Direct Transmission of Safeguards Data, March 1979, Teknekron	W. Hewitt	D.14
ISPO #33	Electronic Fiber Optic Seals (Self Monitoring Seal Operations Manual), July 1978, SAND-78-1370, NTIS UC-15	J.W. Campbell	E.11
ISPO #34	Isotopic Safeguards Data Bank (ISTLIB) and Control Program (MISTY), September 1978, PNL-2726	C. Timmerman	F.9
ISPO #35	Estimation of Inspection Effort, June 1979, PNL-2558 UC-15	M.F. Mullen M.A. Wincek	C.5
ISPO #36	Integral Exercises - LEU Fabrication Facility, October 1978	A.M. Bieber, Jr.	C.3
ISPO #37	Selected Isotopic Functions: A Description and Demonstration of Their Uses, October 1978, PNL-2761	C.L. Timmerman G.P. Selby B.A. Napier	F.9

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ISPO #38	Sealing System for UF ₆ Cylinders, September 1978	S. Fiarman	E.14
ISPO #39	Summary Report of TASTEX Task J: Resin Bead Mass Spectrometry for Safe- guards, October 1978, ORNL/TM-6612	J.A. Carter D.H. Smith R.L. Walker	T-J
ISPO #40	SAFE - Statistical Analysis Facilitation Environment, September 1978, Calcologic Corporation	I.H. Fuchs J.E. Korenthal	D.4
ISPO #41	Sealing System for LWR Assemblies, October 1978	S. Fiarman	E.16
ISPO #42	NDA/Computer Data Processing, October 1978, TREE-1313 UC-15	J.W. Mandler R.G. Helmer E.W. Killian R.A. Morneau	A.2
ISPO #43	Preliminary Portable Spent Fuel Gamma- Ray and Neutron Detector Electronics, User and Technical Manual, May 1979	J.K. Halbig	A.72
ISPO #44	Nondestructive Measurement of Spent Fuel Assemblies at the Tokai Reprocessing and Storage Facility, December 1979, LA-8076-MS UC-83	J.R. Phillips G.E. Bosler J.K. Halbig D.M. Lee	T-B
ISPO #45	Investigation of the Feasibility of Applying an Integrated Containment and Surveillance System in the Spent Fuel Receiving Areas of the PNC, Tokai Nuclear Fuel Reprocessing Facility, November 1978, SAND-78-1740 (Limited Distribution) Addendum, March 1981	J.P. Holmes C.P. Cameron R.P. McKnight	T-A
ISPO #46	The PGT IG510 Gamma-Ray Detector: Assess- ment and Instructions, February 1979	A. Fainberg	A.13
ISPO #47	Passive Neutron Assay of Irradiated Nuclear Fuels, February 1979, LA-7645-MS UC-15	S.T. Hsue J. Stewart K. Kaieda J.K. Halbig J.R. Phillips D.M. Lee C.R. Hatcher	A.23

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ISPO #49	Autoradiography as a Safeguards Inspection Technique for Plutonium Fuels, May 1979, ANL-NDA-2	S.M. Brumbach R.B. Perry	A.35
ISPO #50	Brookhaven Survey Assay Meter (BSAM) Instruction Manual, January 1979	S. Fiarman M. Zucker	A.5
ISPO #51	Irradiated Fuel Monitors: Preliminary Feasibility Study, May 1979, LA-7699 UC-15	E.J. Dowdy J.T. Caldwell	E.21
ISPO #52	Portable Active Neutron Interrogation System for Light-Water Reactor Fuel Assemblies, October 1978, LA-7528-M, UC-78	J.D. Brandenberger H.O. Menlove E. Medina	A.6
ISPO #53	The High-Level Neutron Coincidence Counter (HLNCC): Users Manual, June 1979, LA-7779-M	M.S. Krick H.O. Menlove	A.26
ISPO #54	Semi-Portable Load-Cell-Based System for Weighing UF ₆ Cylinders, September 1980	D. Mitchell P. Pontius	A.40
ISPO #55	Evaluation of Procedures for Handling Neutron Multiplication Effects With the High Level Neutron Coincidence Counter (HLNCC) - January 1979	M.S. Krick	A.39
ISPO #56	ISPO Task D.6 Final Status Report, November 1978	R. Muller	D.6
ISPO #57	Applications Guide for Plutonium Autoradiography, May 1979, ANL-NDA-5	S.M. Brumbach	A.35
ISPO #58	"INSPECT" - A Package of Computer Programs for Planning Safeguards Inspection, April 1979, PNL-2559 UC-15	M.A. Wincek M.F. Mullen	C.5

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ISPO #60	Quantitative Plutonium and Uranium Analyses, Verification Measurement for Gamma-Ray Spectrometer and High Level Neutron Coincidence Counter Calibrations, August 1979	J.E. Cline P.G. Voilleque	A.4
ISPO #61	Irradiated Fuel Monitoring by Cerenkov Glow Intensity Measurements, September 1979, LA-7838-MS UC-15	E.J. Dowdy N. Nicholson J.T. Caldwell	E.21
ISPO #62	A New Instrument for the Confirmation of Declared Power Histories of Central Station Nuclear Power Plants	E.J. Dowdy A.A. Robba R.D. Hastings S.W. France	E.24
ISPO #63	The Measurement of Leached Hulls, April 1979, LA-7784-MS	T.D. Reilly	T-C
ISPO #64	Progress Report Through January 9, 1979 on Contract #450284-S. Diversion Hazard Analysis on Light Water Reactors, January 1979	L. Geller	C.24
ISPO #65	Assistance to the Department of Safe- guards and Inspection, August 1977	J.A. Merrill	F.5
ISPO #66	Description and Operation Manual for the Active Well Coincidence Counter, May 1979, LA-7823-M	H.O. Menlove	A.8
ISPO #67	Operations Manual for the TASTEX Gamma Spectrometer System, March 1979, M-106	R. Gunnink A.L. Prindle J.B. Niday A.L. VanLehn D.W. O'Brien	T-H
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ISPO #70	Secure Transmission and Analysis of TV Surveillance Imagery, May 1979	Fairchild	E.4 E.3
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ISPO #72	Status Monitoring (Alternate to Optical Surveillance) January 1980	A. Binder	E.20
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ISPO #76	Use of Sealed Tube Neutron Generators for Verification of LWR Fuel Assemblies, September 1979, LA-7996-MS UC-78	D.M. Lee	A.31
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ISPO #78	Javelin Model 222 Night Vision Device Spent Fuel Viewing Procedures Manual, October 1979, Q-2-79-7888	N. Nicholson	E.21
ISPO #79	Experimental Comparison of the Active Well Coincidence Counter with the Random Driver, June 1979; LA-7882-MS UC-15	H.O. Menlove N. Ensslin T.E. Sampson	A.8 A.43

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ISPO #81	An Overview of the Software for Telemation/Sandia Unattended Video Surveillance System, December 1979, SAND-99-1668	P.D. Merillat	E.25
ISPO #82	The ORTEC 9603-S Intrinsic Germanium Gamma-Ray Detector - Assessment and Operating Notes, December 1979	A. Fainberg	A.13
ISPO #83	Metallic Seals, March 1980, SAND-79-2462	D. Poli	E.28
ISPO #84	A Study of Narrow Bandwidth Transmission Techniques for Video Images, June 1980, SAND-79-1780	C. Johnson	E.10
ISPO #85	Mol Exercise: Measurement of High-Mass PuO ₂ Samples with the HLNCC, December 1979	M.S. Krick G.E. Bosler M. DeCarolis C. Beets F. Franssen	A.38
ISPO #86	Seals for Unirradiated LWR Fuel Assemblies, March 1980, SAND-80-0187	A. Binder	E.29
ISPO #87	Demonstration of the Loadcell Technique for the Measurement of Solution Weight in the Accountability Vessel, August 1980	F.O. Cartan	T-D
ISPO #88	Isotopic Safeguards Techniques and Evaluation of the Current Situation, January 1980	A. Fainberg	2.03.3
ISPO #89	Neutron Multiplication Corrections for Passive Thermal Neutron Well Counters, July 1980, LA-8460-MS UC-15	M. Krick	A-39

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ISPO #91	Motion, Intrusion and Tamper Detection for Surveillance and Containment, March 1980, SAND-79-0792	C.L. Henderson A.M. Fine	E.17 E.18
ISPO #92	U.S./IAEA Seminar on Safeguards Information Treatment, May 1980	A.M. Bieber, Jr.	D.21
ISPO #93	Analysis of Tokai-mura Reprocessing Data, March 1980, PNL-3323	C.L. Timmerman	T-K
ISPO #94	Review of Light-Water Power Reactor Fuel Assembly Characteristics and Storage for Minimum Movement Verifi- cation Measurements, March 1980	L.O. Lindquist	A.48
ISPO #95	Automated Electromanometer System, April 1981	S. Suda M. Hayashi B. Keisch Y. Fukuari T. Onuma	T-E
ISPO #96	Identity Recording and Verification of Type E Seals, May 1980, SAND-80-0816	D. Poli	E.43
ISPO #97	Channel Coincidence Counter: Version I, June 1980, LA-8404-MS UC-15	M.S. Krick H.O. Menlove	A.73
ISPO #98	Safeguarding Large UF ₆ Cylinders, April 1980	S. Fiarman	E.14
ISPO #99	Resin Bead Uranium and Plutonium Analysis of WAK Input Solution - A Statistical Summary of Experiment #1, June 1980, ORNL/TM-7362	C.K. Bayne J.A. Carter D.H. Smith R.L. Walker	A.34
ISPO #100	Review of Selected Dynamic Material Control Functions for International Safeguards, September 1980, LA-8384-MS UC-15	L. Lowry	C.10

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ISPO #102	Radiation Detectors as Surveillance Monitors for IAEA Safeguards, October 1980, LA-8584-MS UC-15	P.E. Fehlau E.J. Dowdy	E.41
ISPO #103	Tracer Method for Input Measurements, June 1980	W.J. Maeck	T-M
ISPO #104	Calculational Procedure for Production of Special Nuclear Material (SNM) in Reactors, June 1980	D. Vogt	D.17
ISPO #105	TASTEX Task J: Resin Bead Mass Spectrometry for Safeguards	D.H. Smith L. Walker J.A. Carter	T-J
ISPO #106	ANL One Meter Calorimeter Design and Operational Manual, August 1980	R.B. Perry R. Lewis G. Youngdahl E.A. Jung C.T. Roche	A.45
ISPO #107	Independent Verification of Reprocessing Facilities with Installed Instrumentation as Tested in the TASTEX Program, January 1981	H. Katz	C.36
ISPO #109	Functional Evaluation of Film Cameras Suitable for Surveillance, August 1980, SAND-80-1762	C.L. Henderson R.L. Martinez C.E. Robertson	E.33
ISPO #110	Irradiated Fuel Inspection in a Storage Pond with No Fuel Movement and an Uncollimated Detector, July 1980, LA-8463-MS UC-15	P. Rinard	T-H
ISPO #111	Report on TASTEX-H Exercises, Measurement of Plutonium Isotopic Abundances by Gamma-Ray Spectroscopy, August 1980	R. Gunnink Y. Asakura	T-H

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ISPO #113	Development and Evaluation of the K-Edge Instrument at Tokai-mura, June 1980, LA-UR-80-1881	P. Russo S. Hsue J. Sprinkle Y. Asakura T. Fukuda I. Kondo	T-G
ISPO #114	Gravimetric (Pu/U) Method for Input Measurements, June 1980	W.J. Maeck F.W. Spraktes	T-L
ISPO #115	NDA/Computer Data Processing, October 1980 UC-15	R.A. Morneau J.W. Mandler R.G. Helmer E.W. Killian D.H. Nichols	A.29
ISPO #116	Advanced Training Course on State Systems of Accounting for and Control of Nuclear Materials Vol. I and Vol. II, August 1979, PNL-3525 UC-15	R. Sorenson R. Schneider	B.6
ISPO #117	Interim Report on Analytical Techniques to Reduce the Number of Physical Standards, August 1980, LA-8509-MS	G.E. Bosler	A.69
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