

Ten Years of Technical Cooperation Between the DOE and ABACC

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Abstract:

In 1994, the United States Department of Energy (DOE) and the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) signed a technical cooperation agreement where both parties agreed to cooperate on research, development, testing, and evaluation of technology, equipment, and procedures in order to improve nuclear material control, accountancy, verification, and advanced containment and surveillance technologies for international safeguards. Much has been accomplished in the 10 years that have elapsed since this cooperation was initiated. Several projects were undertaken to strengthen safeguards with improved measurement methods, safeguards approaches, and inspection procedures. Positive results were achieved through technical consulting, training, and acquisition of safeguards equipment. Areas of technical cooperation include destructive and non-destructive analysis, remote monitoring, environmental sampling, containment and surveillance, and information management. Courses, seminars, workshops and reciprocal visits were conducted in Argentina, Brazil, and the United States. Technical cooperation has been enhanced through the designation of U.S. *Nonproliferation and Disarmament Funds* to support training and the acquisition of safeguards instrumentation. This paper presents the main projects developed under this technical cooperation that involves many experts from DOE National Laboratories, as well as from Argentine and Brazilian nuclear facilities. The cooperation between the DOE and ABACC has resulted in a significant interaction between the United States, Argentina, and Brazil in nuclear material safeguards and nonproliferation that has enhanced the application of safeguards in South America.

Introduction:

In 1985, Argentina and Brazil began to open their nuclear programs to each other, and the world, to demonstrate that they were pursuing only peaceful uses of nuclear energy. In 1990, their two Presidents signed the "Declaration of Iguazu" which committed them to peaceful nuclear programs and to a joint system of accounting for and control of nuclear materials. In July 1991, a Bilateral Agreement between the two countries was signed guarantying that nuclear energy would be used exclusively for peaceful purposes. This led to the creation of the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC). ABACC is the regional organization that administers the Common System of Accounting and Control of Nuclear Materials (the SCCC). ABACC has headquarters in Rio de Janeiro and an inspectorate of approximately 70 nuclear experts from Argentina and Brazil. In December 1991, the Quadripartite Agreement between Argentina, Brazil, ABACC and the International Atomic Energy Agency (IAEA) for the application of international safeguards was signed. However, the agreement was not enforced until March 1994.

Technical interactions between ABACC, the Argentine and Brazilian nuclear authorities and the US Department of Energy (DOE) led to development of cooperation agreements for effective implementation of international safeguards. DOE and ABACC signed a technical cooperation agreement on April 14, 1994, in San Carlos de Bariloche, Argentina. In May 1999, an amendment was signed extending this agreement for an additional five year period and determining that it shall be automatically reviewed every five years thereafter, unless either party provides notification of its intent to terminate the Agreement.

In 2004, DOE and ABACC celebrated the 10th anniversary of their technical cooperation agreement. The cooperative efforts between DOE and ABACC have served as an efficient and successful tool for enhancing the reliability of ABACC's accounting and control system in South America. The reciprocal exchange of technical and programmatic information has fostered a high degree of mutual respect for ABACC within the international

safeguards community. DOE is proud of its growing cooperation with ABACC, which includes destructive (DA) and nondestructive assay (NDA), environmental sampling (ES), remote monitoring (RM), containment and surveillance (C&S), information management (IM) and training.

A Memorandum of Understanding was agreed to in 1995, for purposes of transferring Department of State (DOS) Non-proliferation and Disarmament Funds (NDF) to ABACC. This funding was essential to assist in procurement of NDA equipment, advanced C&S systems, travel, and per diem for ABACC inspectors attending training courses and workshops. To date, the United States has invested over U\$2Mto enhance ABACC’s technical capabilities.

The implementation of the agreement is supervised by a Permanent Coordinating Group (PCG), which approves each cooperative activity, described in task specific action sheets. The Action Sheets are used for planning and scheduling of cooperative activities. They are living documents that can be revised to meet new technical and programmatic challenges contingent upon agreement by both parties.

ABACC initial needs:

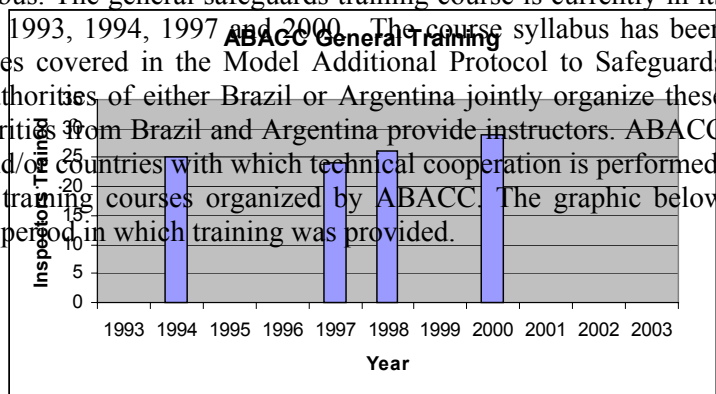
Technical cooperation is one of the most important means used by ABACC to accomplish its safeguards goals. The legal basis for ABACC’s technical cooperation activities is set forth in the Bilateral and Quadripartite Agreements. In the Bilateral Agreement, Brazil and Argentina provide technical capabilities and expertise available in both countries to support ABACC activities. Within the scope of the Quadripartite Agreement, the need for technical developments has increased because ABACC and the IAEA have agreed to perform joint inspections, with common use of equipment and methodologies that must be accepted as effective for safeguards purposes by both organizations.

Although there is an increasing interest to follow up on new technologies in the field of safeguards application, ABACC has prioritized the technical cooperation projects that meet its needs to solve specific safeguards issues in either Brazil or Argentina, taking into consideration the particularities of the nuclear fuel cycle in each country. Technical cooperation between DOE and ABACC has been conducted in the areas described as follows.

Training courses and workshops:

Safeguards training was especially important at the start of ABACC activities back in early 90’s, and remains important today with emphasis shifting to more advanced subjects and issues related to the IAEA’s strengthened safeguards system. ABACC does not have a permanent inspectorate; inspectors perform work for ABACC only for the periods associated with their inspection activity. Both member countries to the Bilateral Agreement provide ABACC with a list of experts that have the technical ability to act as safeguards inspectors. Keeping its inspectorate up to date with safeguards techniques is one of ABACC’s permanent goals. ABACC outlines its own training programs, taking into consideration the different technical backgrounds of its inspectors. The DOE has participated in many of the training courses and workshops conducted by ABACC, assisting with new safeguards techniques and task specific expertise.

The first major project was a three-week safeguards course presented in Buenos Aires in June 1993, prior to the signature of the cooperation agreement between ABACC and the DOE. It was the first training course aimed at bringing all newly appointed inspectors to the same technical level. These comprehensive training courses were initially presented annually with an evolving syllabus. The general safeguards training course is currently in its fourth edition. The course has been conducted in 1993, 1994, 1997 and 2000. The course syllabus has been modified over the years to address new techniques covered in the Model Additional Protocol to Safeguards Agreements. ABACC and the national nuclear authorities of either Brazil or Argentina jointly organize these courses. ABACC and the nuclear regulatory authorities from Brazil and Argentina provide instructors. ABACC also invites lecturers/experts from organizations and/or countries with which technical cooperation is performed. DOE instructors have participated in all general training courses organized by ABACC. The graphic below shows the number of inspector trained for the time period in which training was provided.



In parallel to the general safeguards courses, ABACC organized specific workshops for small numbers of inspectors. These workshops were conducted within the framework of specific cooperative activities, such as destructive and nondestructive assay techniques, containment & surveillance, environmental sampling, remote monitoring and information management.

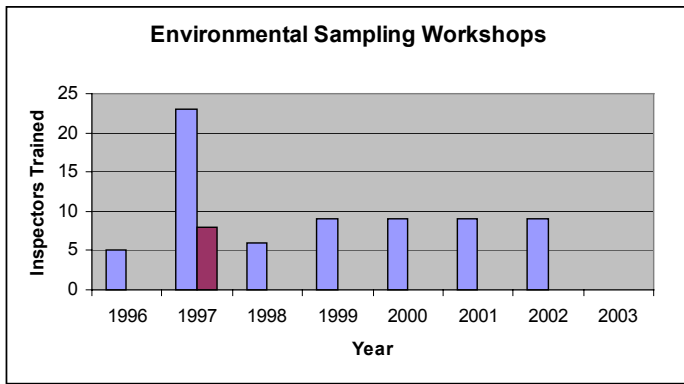
The first physical inventory verification (PIV) workshop that simulated a safeguards PIV inspection at a fuel fabrication plant, was presented in 1995 at *Fabrica de Elementos Combustibles Nucleares* (CONUAR), at the Ezeiza Atomic Center located in Argentina. In June 1997, the second PIV workshop was presented at the *Fábrica de Elementos Combustíveis* (FEC) of the *Indústrias Nucleares do Brasil* (INB) in Resende, Brazil. The workshops were repeated in June 1999 in Argentina and in December 2003 in Brazil. The goal of these workshops was to simulate all the activities of a PIV at either a light-water reactor (LWR) or heavy water reactor (HWR) fuel fabrication facilities. ABACC organized the workshops and experts from DOE, the nuclear national authorities of Brazil and Argentina, and ABACC officials participated as instructors. The graph on the next page shows the year and number of inspectors trained on Physical Inventory Verification.

Also included in the framework of the technical cooperation between ABACC and the DOE is the participation of ABACC in the IAEA Regional Training Courses. In 1998, ABACC participated in the Regional Training Course on State Systems of Accounting for and Control of Nuclear Materials (SSAC) that was held at three sites, including the Nuclear Energy Research Institute (IPEN), in São Paulo, the Angra 2 Nuclear Power Plant, in Angra dos Reis and ABACC headquarters, in Rio de Janeiro. The Brazilian National Nuclear Energy Commission (CNEN), the IAEA and ABACC organized the course, with support from the DOE. These training courses consisted of lectures on legal tools covering the application of safeguards, the IAEA safeguards approach and objectives, destructive and non-destructive analysis methods, ABACC inspection activities, containment and surveillance, environmental sampling, description of the IEAR-1 reactor (model installation given during the course) and procedures used for physical inventories. The DOE has also invited ABACC officials to participate as instructors in the Training Course on State Systems of Accounting and Control of Nuclear Materials (SSAC) that is held in Santa Fe, New Mexico, USA.

Environmental Sampling:

Environmental Sampling techniques are utilized to characterize bulk trace amounts of uranium and plutonium in swipe samples. This safeguards method is capable of detecting undeclared nuclear activities. The cooperative activity between ABACC and the DOE, signed in 1996, supported conducting seminars in Argentina and Brazil. The cooperative efforts between the DOE and ABACC facilitated technical discussions on sampling plans, sample collection, analytical techniques, data interpretation and conclusions. Workshops were conducted in the U.S. to provide hands-on training on sample collection and analysis. In addition, the DOE provided technical assistance and funding to improve detection capabilities through improved methods application and hardware upgrades for Argentinean and Brazilian laboratories. The cooperative efforts for this activity were initiated in April 1996 when two ABACC officers and one inspector took part in a seminar on environmental monitoring techniques, developed specifically for them by the DOE at the Oak Ridge National Laboratory (ORNL) and Pacific Northwest National Laboratory (PNNL).

In 1997, two workshops on environmental monitoring were conducted: the first in April, at the Brazilian Nuclear Energy Commission (CNEN) headquarters, in Rio de Janeiro, and the second in November, in Buenos Aires. The workshop program included fundamentals of environmental sampling and its application to safeguards, sampling techniques, thermo-ionization mass spectrometry, fluorimetry and alpha spectrometry, particulate measurements, and demonstration of sampling and analysis of results. For both workshops, DOE provided lecturers from the PNNL and ORNL. The nuclear regulatory authorities of Brazil and Argentina (CNEN and ARN) and ABACC also participated in the program. The chart below shows the time and number of inspectors trained on Environmental Sampling methods and analysis.



In 1998, an exercise was launched involving laboratories in Brazil and Argentina, to assess characterization of environmental samples. The IAEA supplied the standard samples for distribution to the laboratories, and the New Brunswick Laboratory (NBL) supplied the ²³³U spikes. Laboratories were instructed on sampling, preparation, and analysis procedures. The following year, meetings were conducted between ABACC and the representatives of those laboratories. Technical experts from ORNL and PNNL attended meetings at ABACC headquarters. The purpose of the meetings was to discuss and

assess comparison of the results obtained from analysis of the bulk standard samples supplied by the IAEA to the declared values for the standards.

A second exercise was conducted in 2000 with the participation of four Brazilian and three Argentine laboratories. The representatives of these laboratories met in November with ABACC officers and specialists from ORNL and PNNL to discuss the results of this second exercise, the progress achieved and problems still being encountered.

A third round of exercises involving bulk type swipe samples was concluded in 2001. In this exercise Brazilian and Argentine laboratories were asked to do chemical preparation and analysis of peach-leaf standards. Three of the six participant laboratories managed to measure concentrations of around 15ng of uranium per gram of material with the necessary accuracy. These results qualified them to carry out this type of analysis. In 2002, two Argentine and four Brazilian laboratories participated in a fourth exercise to measure swipe samples supplied by the IAEA. The results of the analysis were equivalent to those of DOE laboratories. DOE experts visited these laboratories and presented a seminar on the performance of mass spectrometry versus Ion Coupled Plasma (ICPs). Today, three laboratories are able and qualified to measure bulk swipe samples. The results of these exercises are described in a paper entitled *Development of Low-Level Environmental Sampling Capabilities at Brazilian and Argentinean Laboratories by ABACC* that was presented at the 43rd INMM Annual Meeting.

Remote Monitoring:

As the name implies, this technology involves transmission of safeguards data from nuclear facilities to IAEA field offices, and ABACC and IAEA headquarters. The goal is to reduce the cost and improve the efficiency of routine inspections. The IAEA's principal initiative in this arena involves linking several video surveillance systems that have been installed at reactors around the globe.

The first project between ABACC, DOE and ARN consisted of joint field tests using technologies utilized by the DOE remote monitoring project to monitor spent fuel stored at the Embalse Nuclear Power Plant, in Argentina. This activity was very useful to introduce ABACC staff, as well as Brazilian and Argentine inspectors and technicians, to the remote monitoring techniques. Participation in the initial installation and in upgrades provided an invaluable first hand experience related to components, systems and technology used for remote monitoring.

ABACC participated in the installation of the remote monitoring system at Embalse and in the upgrade of the same system performed by DOE, ARN and IAEA in late April 1999. IAEA and Aquila Technologies personnel (under DOE contract) installed a remote station at ABACC headquarters in Rio de Janeiro. A review station was also installed at ABACC headquarters

Two seminars on Remote Monitoring were conducted in cooperation with CNEN, ARN, and DOE; the first in

May, held in Rio de Janeiro, Brazil, and the second in December, held in Buenos Aires, Argentina. Subject matter experts from the Sandia National Laboratory (SNL) conducted a seminar at ABACC headquarters for nineteen participants from Argentina, Brazil and ABACC. Discussions included aspects concerning collection of data and images in nuclear facilities, hardware and software authentication, storage and transmission of information. The second seminar included the same presentation by SNL, as well as presentations of the Argentine Nuclear Regulatory authority's prototype facility at the nuclear material storage of Constituyentes. This meeting also reviewed software that was being developed by the Argentines for ABACC. In exchange, experts from ABACC participated as instructors in the International Remote Monitoring Project workshop presented at SNL in February 1997. ABACC presented information on progress made to date relative to remote monitoring activities.

The activities conducted under this project were presented at several international meetings from 1996 to 1997. These meetings included the International Remote Monitoring Project (IRMP) meetings, held in Vienna, Austria, and in Naples, Florida, USA, respectively in March and August 1996, and in the IRMP Technical Topical Workshop on Software Tools and Development held in Albuquerque, New Mexico, USA, in March 1997.

In 1999, ABACC took part in updating the remote monitoring system at the Embalse Nuclear Power Plant in Argentina. This activity was conducted through cooperative efforts between DOE, ARN, and IAEA. New sensors, cameras, communications servers and software were installed. The system was tested during the spent fuel transfer campaigns to the dry storage canisters. The remote monitoring software was updated at the review station at ABACC headquarters. Data transfers at the test level were performed using a modem, on a temporary basis.

Although the system worked well as a proof of principle demonstration, all parties involved recognized that its functionality would have to be upgraded in order to provide a convenient and reliable data retrieval mechanism. Thus in 1997, the Action Sheet for remote monitoring trials at the canisters of the Embalse Nuclear Power Plant was closed. A new Action Sheet was initiated in December 2001 entitled "Developing, Testing and Implementation of Unattended & Remote Monitoring Technologies". The objective of the new Action Sheet was to design and upgrade the technical capacity of both countries in this area, in order to provide technical advisory services to ABACC for the specification, analysis, development and maintenance of these systems.

Information Management:

Cooperation in Information Management seeks to provide ABACC with an overview of the methodology, applicability, limitations, and information sources for tools developed by DOE to store, display, and analyze safeguards information. The program also provides consultation on authentication and encryption technology, client-server architectures, and database interfaces. A meeting was held in Rio de Janeiro in December 1996 with DOE experts from PNNL to begin this cooperation. During the visit, PNNL presented a seminar on database management, encryption, and network security. Five ABACC officers traveled to Washington, DC, in October 1997 for a demonstration exercise on data processing and consistency analysis.

Following the initial assessment of ABACC information infrastructure in December 1996, ABACC implemented DOE recommendations on network security and started the standardization of its database architecture for future integration and unification. A seminar on Secure Data Transmission was held in Buenos Aires in July 1998 with the participation of sixteen inspectors, specialists and professionals from Argentina and Brazil. The program included cryptography systems, authentication methods, commercial software and point-to-point communication security. Negotiations started in mid 1998 with Brazil and Argentina to implement the capability to transmit reports via the Internet. The software was selected and the testing phase began in September 1999.

The initial project was closed in 2000 and in August this same year, a new activity entitled Safeguards Data Management was signed. This project foresees cooperation on implementation of ABACC's network security measures, unification and integration of different databases and the development of software for online

accountability.

In December 2001, three experts from the PNNL visited ABACC headquarters to continue discussions on network structure and security. They also conducted a seminar on information security. The topics presented at the seminar and discussed at the meeting included encryption tools, current network protection processes, platforms, protecting information in notebooks, network infrastructure, and personal access tools, in addition to network monitoring. These discussions included Argentine and Brazilian experts. A report from PNNL on the ABACC network structure project was received by the DOE, and will be forwarded to ABACC after the analysis has been completed. The next steps under this activity include follow-up discussions at PNNL on implementing PNNL's recommendations for ABACC's network, and a seminar to be presented by PNNL experts in Buenos Aires.

Nondestructive Assay Development (NDA):

A course on "Non-Destructive Analyses of Nuclear Material" was conducted at IPEN in São Paulo, Brazil, in March 1996. Nine Argentine inspectors and ten Brazilian inspectors attended the course. Two ABACC Officers and two NDA experts from the DOE acted as instructors. The workshop concentrated on uranium enrichment measurement applications.

In March 1997 studies were performed to develop a method to detect shielded and unshielded UF₆ cylinders located behind the centrifuge cascade panels at the Isotopic Enrichment Laboratory (LEI) in Brazil. This study included a measurement campaign conducted jointly with the IAEA and the DOE. The objective of the study was to develop and test methods to obtain supporting data for measurements that were obtained during the experiments in November 1996. In June, specialists from ABACC, the IAEA and Brazil met to assess the results of these studies. In October, supplementary measurements and tests were carried out with the slab neutron detector acquired recently by ABACC for the possible implementation of the method in question. The results show that this method is technically feasible for detecting UF₆ cylinders that are either bare or lightly shielded. A method was also developed to detect shielding materials that may be used to moderate neutrons emitted by UF₆. This technique involves using a transmission source and neutron slab detector. Detection of a shielded or unshielded UF₆ cylinder depends only on the detection target set: a mass of UF₆ under specific enrichment and the probability of detection. Qualitative gamma-ray measurements were also conducted during these tests to complement the passive and neutron transmission measurement techniques. The qualitative gamma scanning technique has a high probability for detecting unshielded UF₆ cylinders.

In February, a Technical Support Officer and one ABACC consultant took part in a non-destructive analysis (NDA) inter-comparison exercise held in Geel (Belgium) for uranium samples using various enrichment measurement techniques. The exercise was organized by the *Commissariat à l'Énergie Atomique* (CEA) and the *Département des Applications et de la Métrologie des Rayonnements Ionisants* - DAMRI. Various laboratories attended the exercise from all over the world. The global results were presented at the European Safeguards Research and Development Association (ESARDA) Congress in May 1997. These results are important for establishing realistic reference values that are representative for the errors expected in determining enrichment by gamma spectrometry during a safeguards inspection.

The ABACC Secretariat Advisory Group for Non-Destructive Analysis (NDA) met twice during 1997, in January and April. At these meetings, the Group assessed studies on the measurement of nuclear material at the Pilcaniyeu enrichment plant in Argentina, and LEI in Brazil. The Group discussed NDA measurements of nuclear material hold up at the Pilcaniyeu facility and measurement methods developed to detect nuclear materials behind the panels at LEI. Based on the result of these meetings, the Group prepared reports that were submitted to the Ad-Hoc Group of the ABACC Commission for sensitive facilities.

A new activity was undertaken related to the analysis, development and testing of systems and instruments for non-destructive analysis (NDA) required for specific safeguard approaches. This activity falls under the technical cooperation program between ABACC and DOE. This activity also makes provisions for the

evaluation, testing, and integration of new NDA methods and hardware that could be used to improve the efficiency and effectiveness of ABACC inspections.

The DOE has provided funding and training to ABACC for integration of newly developed hardware and software used to perform NDA measurements in support of safeguards. One example is the integration the EG&G ORTEC Nomad multi-channel analyzer into ABACC inspections. This analyzer was developed to replace the Davidson portable multi-channel analyzer. The ORTEC Nomad provides the inspector with more capability for software integration and portability, thereby improving the efficiency of the inspection.

A workshop on Non-Destructive Analysis (NDA) was held in June 1997 at Portsmouth, Ohio, USA. Two ABACC officers and four inspectors attended the workshop. The training involved the measurement of uranium enrichment in UF₆ cylinders using a wide range of techniques, types of cylinders and range of enrichments. Passive neutron measurements were also performed at the Portsmouth Gaseous Diffusion Enrichment Plant (PORTS).

Between 1997 and 1999, three workshops were conducted under this project. The first NDA workshop was conducted at PORTS in June 1997, to study the measurement of UF₆ cylinders and in-cascade holdup. A neutron NDA training course was conducted at the IPEN, in São Paulo, in September 1998. The course included six Argentinean and eight Brazilian inspectors/operators, two ABACC and two DOE instructors. The course included experiments associated with passive neutron measurements and active measurements utilizing a neutron transmission source. The experiments were performed using an experimental mock-up unit that could be used to vary the cylinder configurations within the cascade hall of an enrichment facility.

An additional workshop on NDA was held in August and September 1998 at the Nuclear and Energy Research Institute (IPEN/CNEN). Two ABACC officers, a specialist from the Los Alamos National Laboratory (LANL) and another from PORTS gave presentations. Six Argentine inspectors and eight Brazilian inspectors took part in the workshop. The course was conducted using ABACC equipment, which consisted of a mock-up. The mock-up contained a polyethylene-shielded UF₆ cylinder that was hidden. The objective of the course was to train ABACC inspectors on NDA methods developed for detecting the hidden cylinder. The inspectors were trained on the use of qualitative gamma measurement procedures, passive neutron measurement procedures (referred to as emission) and active neutron measurement procedures (referred to as transmission), developed for the LEI facility. This workshop was highly productive and it was decided to repeat it during 1999. This training session included the cooperation of IPEN, which made its facilities available to ABACC, as well as the Brazilian Navy Technological Center (CTM-SP), which helped prepare the mock-up.

In March 1999, the first workshop for ABACC and IAEA inspectors on unannounced inspections (UI) was held at the IPEN in São Paulo, with the participation of five inspectors from ABACC and five from the IAEA. Experts from DOE, ABACC and CNEN served as instructors. The workshop included lectures on the procedures agreed to for unannounced inspections and methodology for detection of hidden cylinders. The inspectors performed passive and active neutron and passive gamma measurements using an experimental mock-up. In September 1999, a second workshop for ABACC and IAEA inspectors on unannounced inspections was conducted in Buenos Aires, Argentina, with the participation of five inspectors from ABACC and five from the IAEA. Gamma and neutron NDA and surveillance procedures were performed. Instructors gave lectures on the safeguards procedures identified above. Instructors from ABACC, DOE, ARN, CNEN and IAEA participated in this workshop. The workshop was designed to provide the inspectors with hands-on training for safeguards applications.

During 1999, ABACC sponsored two additional training workshops on unannounced inspections. These activities followed the guidelines issued by the Enrichment Group that analyzes the implementation of safeguards approaches at Enrichment Plants. The Enrichment Group consists of representatives of the IAEA, CNEN, CTM-SP and ABACC. The workshops were held at IPEN and the Ezeiza Atomic Research Center, respectively. Each of these workshops trained five inspectors from ABACC and five from the IAEA. The inspectors were provided with hands-on training in neutron emission and transmission measurements, qualitative gamma measurement procedures, and the use of surveillance, with emphasis on unannounced

inspections. The instructors consisted of employees of ABACC, IAEA, ARN, CNEN, CTMSP and DOE. The institutions where the training sessions were held helped with the organization and infrastructure. Equipment belonging to ABACC and CNEN was used during the course held in Brazil. Equipment belonging to ABACC and ARN was used for the course held in Buenos Aires.

The Cooperative Agreement between the DOE and ABACC has also enhanced ABACC's ability to facilitate exchange of technical ideas. An ABACC Technical Support Officer attended a seminar on neutron measurements at the LANL from July 10 - 14, 2000. This program consisted of presenting and discussing the accounting principles for singles and coincident neutrons, as well as experiments using the neutron collar for various fuel rod configurations for Pressure Water Reactors (PWR). Various calibration curves were obtained with the neutron collar, resulting in a better understanding of the software. A configuration was tested that simulated an Atucha I type fuel element. This procedure was then tested by IAEA and ABACC with the Atucha I elements and is today jointly used by ABACC and IAEA during the inspections.

In May 2001, two workshops were conducted to train ABACC inspectors on NDA using the mini-multichannel analyzer (MMCA) coupled to NaI(Tl), CdZnTe and HpGe detectors. Containment and Surveillance training was also performed. The first workshop lasted five days and was held at ABACC headquarters in Rio de Janeiro. The second workshop was also five days and was held in Buenos Aires. The technical speakers came from ABACC, CNEN, DOE and the IAEA.

During the last week of October 2001, a course was conducted for ABACC and IAEA inspectors. The course was held in São Paulo and at ARAMAR (Iperó/SP). The course focused on unannounced inspections for the ARAMAR facility. A mock-up simulating a portion of the cascade hall with a UF₆ cylinder placed behind shielding was set up in a warehouse made available by IPEN with the support of that Institute. ABACC was supported by the participation of CNEN, ARN, DOE, CTMSP, IPEN, and the IAEA, in addition to its own technical staff. This course allowed the inspectors to be divided into groups of two, with all activities planned for the unannounced inspection procedures being carried out. On this occasion, the working papers were tested for the common use with the IAEA. The working papers were revised based on comments from the course attendants. A total of 10 inspectors, five from ABACC and five from the IAEA, conducted hands-on exercises relative to safeguards application for the ARAMAR facility. The additional workshops are necessary due to the complexity of the safeguards methods used for this facility and the reassignment of IAEA and ABACC inspectors to this task.

The Fourth Training Course for ABACC and IAEA inspectors on Unannounced Inspections was conducted in São Paulo, at IPEN and in ARAMAR, from 13 to 17 May, with the participation of lecturers from CNEN, ARN, IAEA and ABACC. Six inspectors from ABACC and five from the IAEA were trained. The mock-up used in previous courses was assembled again to simulate ultra-centrifuge cascades. The course program included activities that are conducted during unannounced inspections, such as, containment and surveillance verification, NDA, perimeter verification and environmental sampling. Unfortunately, due to scheduling conflicts DOE was not represented in this activity.

A workshop on non-destructive assay methods for ABACC inspectors and staff was conducted at PORTS from August 25 to 29, 2003. The objective of this workshop was to inform ABACC personnel of the application and integration of quality assurance and quality control measures used to meet regulatory requirements for the Portsmouth Analytical Laboratory. The workshop was performed in a cooperative manner that emphasized integration of quality assurance and quality control into nondestructive assay measurement applications. Several issues were discussed that will be added to the appropriate Action Sheet.

A fifth UI training course was conducted in São Paulo, Brazil, from September 15-19, 2003. The instructors for the course represented several organizations; ABACC, IAEA, DOE, CNEN, and CTM-SP. Four inspectors from the IAEA and six ABACC inspectors attended the course. Lectures were given on various course topics specific to the performance of unannounced inspections at the Brazilian enrichment facility. The course was designed to provide the inspectors with several days of hands-on practical experience using actual field inspection equipment. Other participants included three from the Brazilian commercial operator and one from Argentina.

Destructive Assay Development:

ABACC and DOE's New Brunswick Laboratory (NBL) coordinate cooperation in destructive analysis. ABACC has built a network of analytical laboratories in Argentina and Brazil that can accept and accurately analyze nuclear material samples. These analyses are performed on a cross national basis, that is, samples taken in Brazil are analyzed by an Argentine laboratory and vice versa. The network includes 14 laboratories, all of which participate in the various exercises and inter-comparison programs to improve analytical skills and procedures.

Three round robin studies have been organized by ABACC with NBL participation. During the first exercise, defined in 1993, NBL characterized nuclear material that was used as a secondary standard. In the second exercise, defined in 1997, NBL provided the reference value for the uranium content of the samples. In June 1997, a specialist from NBL participated in a meeting of the ABACC inter-comparison group to discuss the implementation of a permanent system for evaluating quality control in the laboratories, the isotopic inter-comparison program, and the basis for ABACC laboratory participation in the Safeguards Measurement Evaluation Program (SME). In the SME program, NBL prepares and distributes nuclear material samples to participating laboratories. The laboratories analyze the samples and submit their assay results to NBL for evaluation. The major purpose for the program is to encourage consistency within a laboratory network to improve bias and precision. At present five Argentine and five Brazilian laboratories are participating in the SME program. Reciprocal visits have occurred between ABACC laboratories and NBL and will continue in the future. In 1997, the activity conducted between DOE and ABACC for laboratory inter-comparison was replaced by a new version covering a broader range of objectives, including a quality control program for the laboratories in the ABACC analytic network. In 1999, a paper entitled *Participation of ABACC Laboratories in Measurement Inter-comparison Programs*, was presented at the INMM annual meeting. The paper showed that most of the results of the SME exercise complied with the levels of accuracy required.

In 2001, the third round robin organized by ABACC with cooperation of NBL was started. This time, uranium pellets produced in Brazil and Argentina to be used as secondary standards, were forwarded to NBL for characterization. The ABACC network laboratories participating in the inter-comparison exercise then measured these pellets. The results of the exercise were received in 2002, and the analysis of variance (ANOVA) and other statistical techniques were applied by NBL to the results. These results were discussed at a meeting held at ABACC headquarters with NBL and the participating laboratories in May 2003. The group made recommendations concerning future sample exchanges, training, and quality control. The results of these exercises are described in a paper entitled *ABACC LABORATORIES QUALITY ASSURANCE THROUGH SECONDARY STANDARDS EXCHANGE PROGRAM* that was presented at the 43rd INMM Annual Meeting.

Containment and Surveillance:

Containment and surveillance (C&S) is an important safeguards measure. This is as true for ABACC as it is for the IAEA. The cooperative efforts between ABACC and the DOE have enhanced ABACC's ability to apply this safeguards technology to inspections performed in South America.

A technical meeting was held at SNL in 1995 to discuss specific needs and acceptance criteria for C&S equipment and technology used at enrichment plants and spent fuel storage facilities. Digital optical surveillance equipment, fiber optic electronic seals, and equipment tagging units were demonstrated at the Aquila Technologies Group plant in Albuquerque, New Mexico, USA. In mid 1996 laboratory tests started with two Gemini optical surveillance systems and one review station purchased with NDF funds. In July 1997, one of the systems was installed for a field test in the feed and withdrawal station of a Brazilian enrichment facility. The system was operated for a test period of two months, ending with a joint review and a preliminary evaluation by ABACC and the IAEA. Several issues were identified and the manufacturer was requested to resolve these issues prior to installation of the systems in a permanent mode.

The first containment and surveillance course organized under the ABACC/DOE and ABACC/IAEA cooperation projects was held in July 1996 at the ABACC headquarters. It was attended by twelve inspectors and six members of the ABACC C&S Advisory Group. The speakers at this course included contributions from two specialists from SNL, as well as a technician from the IAEA training section and an ABACC Technical Support Officer. The program included the following topics: autonomous monitoring systems; remote monitoring systems being developed, and equipment used by ABACC such as the VACOSS and COBRA seals, EMOSS and Gemini surveillance systems, and review stations.

In December 1999, a C&S workshop was held in Rio de Janeiro and in Buenos Aires. The workshop was conducted jointly by the IAEA and the DOE and was attended by ten inspectors from Brazil and Argentina. The program included lectures on remote monitoring and practical training in handling and operating containment seals (VACOSS and COBRA). Training was also provided on surveillance systems and equipment (Cosmos, MIVS, MUX, Bundle Counter and Alis) and review stations (MORE and Alis).

A new action sheet titled “Unattended and Remote Monitoring Technologies” was agreed upon and initiated in December 2001. This Action Sheet was developed to train inspectors in C&S and assist technical research and development groups in the analysis, specification, development, deployment and maintenance of C&S and remote monitoring systems (RMS). During 2002, the testing period of the Atucha 1 Nuclear Power Plant surveillance system was concluded satisfactorily and the system is now under joint use with the IAEA.

Two workshops for inspectors training in C&S was held in June 2003 and October 2003 in Rio de Janeiro and Buenos Aires including the training on SDIS, DMOS, DSOS, VIFM and GARS systems, VACOSS and COBRA seals, and HM-5. DOE supported this course through SNL participants. A total of 40 ABACC inspectors were trained in these two workshops.

Conclusions:

Since our initial cooperative activity in June 1993, the interaction between ABACC and DOE has flourished and grown. Our cooperation involves many people from DOE national laboratories and from the many nuclear facilities in Argentina and Brazil. The Action Sheets that have been developed under the framework of the Cooperative Agreement between ABACC and DOE continue to meet the objective for improving nuclear material control, accountancy, and verification in Argentina and Brazil. We should note that the separate agreements between DOE and ARN and DOE and CNEN work together to form a productive interaction between the United States, Argentina, and Brazil to enhance nuclear material safeguards and nonproliferation. This interaction benefits all parties. DOE and its National Laboratories are proud to be a part of this cooperative program with ABACC.