Strengthening Regional Safeguards

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Abstract: Nuclear cooperation between Argentina and Brazil has been growing since the early 1980's and as it grew, so did cooperation with the US Department of Energy (DOE). The Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) was formed in December 1991 to operate the Common System of Accounting and Control of Nuclear Materials (SCCC). In April 1994, ABACC and the DOE signed an Agreement of Cooperation in nuclear material safeguards. This cooperation has included training safeguards inspectors, exchanging nuclear material measurement and containment and surveillance technology, characterizing reference materials, and studying enrichment plant safeguards. The goal of the collaboration is to exchange technology, evaluate new technology in Latin American nuclear facilities, and strengthen regional safeguards. This paper describes the history of the cooperation, its recent activities, and future projects. The cooperation is strongly supported by all three governments: the Republics of Argentina and Brazil and the United States.

Introduction:

After a period of tension during the 1970's, the governments of Argentina and Brazil began a period of nuclear rapprochement by signing an agreement on peaceful uses of nuclear energy in May 1980. In 1987, the respective Heads of State initiated an exchange of visits to each other's sensitive nuclear facilities. During the same period, the United States Department of Energy (DOE) began a series of technical exchanges with personnel in the nuclear programs of both Argentina and Brazil. Since 1982, both countries have sent students and instructors to the International Training Course on Implementation of State Systems of Accounting and Control of Nuclear Materials (SSAC) sponsored by the International Atomic Energy Agency (IAEA) and the US Departments of Energy and State. In addition, US instructors participated in the Regional SSAC Courses presented in Brazil in 1988 and in Argentina in 1990. In 1985, DOE and the Nuclear Energy Commission of Brazil (CNEN) began work under an informal letter agreement using a Neutron Coincidence Collar (UNCC) to measure fuel elements produced at the Resende Fuel Fabrication Plant and an ION/FORK system to measure the same fuel after irradiation in the Angra-1 reactor. In 1991, DOE and the Atomic Energy Commission of Argentina (CNEA) began an exchange of visits to uranium enrichment facilities, which led to a technical cooperation on technology to safeguard gaseous diffusion plants that was formalized by an Agreement of Cooperation in San Carlos de Bariloche, Argentina, in April 1994.

ABACC History

The Declaration on Common Nuclear Policy of Foz do Iguazu, 28 November 1990, and the Accord Between the Federative Republic of Brazil and the Argentine Republic For the Exclusively Pacific Use of Nuclear Energy signed in Guadalajara in July 1991 set the legal framework for a Common System of Accounting and Control (SCCC) and created the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) to administer and implement the SCCC. ABACC is headquartered in Rio de Janeiro where it operates with a small permanent staff and an inspectorate of approximately

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70 professionals chosen from the nuclear organizations of each country. The Quadripartite Safeguards Agreement, signed in Vienna on 13 December 1991, by the Presidents of Argentina and Brazil, the Secretary of ABACC, and the Director General of the IAEA follows the Model Safeguards Agreement, INFCIRC/153, and applies to all nuclear materials and facilities in both countries. Thus, ABACC serves a role in Argentina and Brazil that is similar to that of EURATOM for the States of the European Communities.

ABACC/DOE Agreement of April 1994

ABACC and DOE first met officially in Rio de Janeiro in July 1993 to discuss possible areas of cooperation. In April 1994, officials of the two agencies met in San Carlos de Bariloche, Argentina, to sign an Agreement Concerning Research and Development for International Safeguards Applications.[1] Areas of cooperation under this agreement are described in Action Sheets approved by a Permanent Coordinating Group (PCG) with membership from both organizations. The First Annual ABACC Safeguards Inspector Course was presented in Argentina in June 1993 with the participation of four DOE instructors. This course included an abbreviated version of the Enrichment Plant Safeguards Course developed at Oak Ridge for IAEA inspectors. It also included a simulated physical inventory verification (PIV) by the IAEA at the CONUAR fuel fabrication plant in Ezeiza. The second course was presented the following year in Brazil, again with DOE participation and a simulated PIV at the fuel fabrication plant in Resende. What follows is a brief description of the principal activities carried out under the ABACC/DOE cooperation during the past year.

Remote Monitoring Field Trial

One of the exciting activities over the past year is the remote monitoring field trial at the spent-fuel, dry-storage facility of the Embalse Nuclear Power Station in Argentina.[2] This activity is part of DOE's International Remote Monitoring Project (IRMP), which is testing a possible way to assist the IAEA in dealing with their increasing inspection load. The Embalse reactor is a CANDU-6, which began commercial operation in January 1984. As its spent-fuel cooling pond approached capacity, it was necessary to create an alternative storage option. The relatively low burnup of CANDU fuel makes above-ground, dry-storage silos an attractive option. CNEA has constructed 80 silos that can each hold 9 baskets containing 60 fuel bundles; each silo contains approximately 4.5 SQ of plutonium.

ABACC and IAEA inspectors observe the transfer process from storage pond to silo and verify the presence of stored fuel in each silo during the routine inspections that occur every three months. The operator runs two transfer campaigns a year, each lasting 2-3 months. Silos are verified by measuring their gross gamma-ray activity profile with a small CdTe detector lowered into the instrument tubes. In 1994, CNEA approached DOE about technology to reduce the inspection manpower at Embalse. Sandia and Oak Ridge National Laboratories proposed a remote monitoring test which instrumented four silos with ionization chambers and Geiger-Müller tubes that transmitted radiation data every hour to a computer in the Safeguards Inspection Office (see Fig. 1). The welded covers of the instrumented silos are also monitored by fiber optic seals and motion detectors. All information is transferred via modem and telephone to terminals located in Buenos Aires (CNEA, now ENREN), Rio de Janeiro (ABACC), and Albuquerque (SNL). This provides continuous, remote confirmation that fuel in the silos is unchanged; it has operated well for over a year. In May 1996, representatives of ORNL and SNL changed two radiation sensors and all batteries. The performance of this system is described in a separate paper.[3] ABACC and CNEA are developing a graphical user interface for easy data review and analysis to be used with remote monitoring applications.

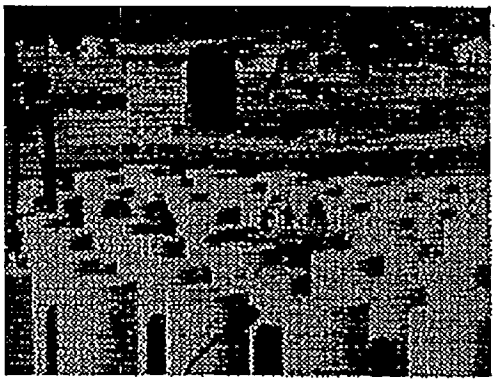

Fig. 1. Installation of remote monitoring sensors on dry-storage silos at Embalse Nuclear Power Station in Argentina.

In 1995, CNEA was reorganized into three agencies and the Nuclear Regulatory Board (ENREN) became DOE's principal partner. Together with ABACC, ENREN approached DOE about enlarging the remote monitoring system to include the entire fuel transfer process. In May 1996, representatives of Sandia and Los Alamos National Laboratories observed the complete process and proposed a monitoring system that would include a series of radiation sensors and video cameras to track fuel from the cooling pond, through the welding hot cell, and out to the silos.

Information from this enlarged system, which may be installed by year's end, will be available at ABACC, ENREN and DOE terminals. ABACC is planning other remote monitoring field tests to evaluate the future application of this technology. If it proves acceptable for routine use by safeguards organizations, it could dramatically reduce the IAEA, ABACC, and ENREN inspection effort at Embalse and at other nuclear facilities.

Inspector Training Workshops

The physical inventory verification (PIV) is the major inspection performed by the IAEA or other safeguards agency to establish a material balance at the facility in question. PIV activities include: receipt of physical inventory listing (PIL), records audit, establishment of book inventory (BI), total item verification, inventory stratification, sampling plan and sample selection, measurement of selected items, sampling for destructive analysis, PIV data analysis, and computation of material unaccounted for (MUF). In the past, simulated PIV exercises have been conducted to train IAEA inspectors at different US fuel cycle facilities, and they are regularly conducted at the PERLA facility operated by the Joint Research Center in Ispra, Italy.[4] The goal of such exercises is to simulate a PIV in as much detail as possible, but without the time pressure of a real inspection.

ABACC and DOE, with the cooperation of ENREN and CNEN, have agreed to conduct a series of PIV workshops at major Argentine and Brazilian facilities. The first of these workshops was presented in March 1995 at the CONUAR (Combustible Nuclear Argentina) fuel fabrication plant located at the Ezeiza Atomic Center outside Buenos Aires. CONUAR fabricates natural uranium fuel for the CANDU reactor in Embalse and the Siemens reactors at Atucha. The PIV exercise was conducted on the Atucha-1 line with an inventory divided into 4 strata: drums of UO_2 powder, boxes of UO_2 pellet trays, fuel rods, and complete fuel elements (an Atucha-1 fuel element is approximately 5 m long). The exercise inventory was 9200 kg of natural uranium.

Twelve ABACC inspectors, 8 Argentine and 4 Brazilian, participated in the 5-day course which was coordinated by two ABACC and two ENREN staff members; ABACC and ENREN provided most of the equipment. DOE provided two instructors and measurement equipment from Los Alamos National Laboratory. The inspectors were divided into four teams to conduct independent inspections that included all the PIV activities listed above. The evaluation questionnaires indicated high participant satisfaction. Cooperation between the many participants, the plant operator, the safeguards agencies, and DOE was excellent and contributed to the course's success. The next PIV workshop is expected to occur in Brazil under the sponsorship of CNEN.

Under this Action Sheet in October 1995, four ABACC inspectors went to Los Alamos for a special workshop on the operation and calibration of a GRAND-FORK detector system to measure spent fuel from the Angra-1 reactor in Brazil.[5] The second week of the workshop covered advanced training on the Neutron Coincidence Collar (UNCC), Active Well Coincidence Counter (AWCC), neutron multiplicity counters, and a miniature, multichannel analyzer (M^3CA).

Third Annual ABACC Safeguards Course

The first two annual ABACC safeguards courses were held in Argentina in 1993 and Brazil in 1994. Because of a heavy inspection load in 1995, ABACC postponed the 1995 course until March 1996. This course was held at the Institute for Energy and Nuclear Research (IPEN) in São Paulo and emphasized nondestructive assay (NDA) techniques for UF_6 and UO_2. The course was attended by nine ABACC inspectors from Argentina and ten from Brazil. Two DOE instructors from Los Alamos and the Portsmouth Gaseous Diffusion Plant participated in the course and demonstrated a new commercial measurement system to test on the materials available at IPEN. The available equipment included NaI and HPGe detectors of different sizes and Davidson and Canberra multichannel analyzer systems (see Figs. 2 and 3). After the measurements at IPEN, participants

Fig. 2. Brent McGinnis(DOE) demonstrates measurement of UF_6 cylinder enrichment to ABACC inspectors from ENREN, CNEN, and IPEN.

went to ABACC headquarters in Rio de Janeiro to discuss their experience with in-field measurements

and their overall experience during two years of ABACC inspections. The course was well received and the instrument performance was even better than expected. The attendee evaluations indicated that the course was very short and that more measurement courses should be organized.

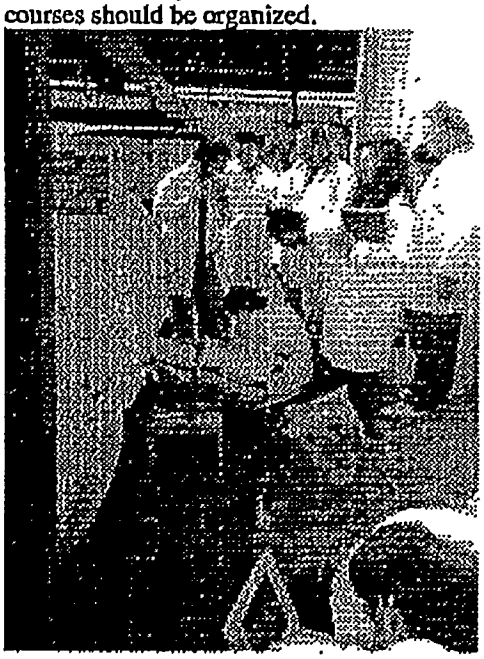

Fig. 3. ABACC inspectors measure a 48Y UF_6 cylinder at IPEN with Canberra U-Pu Inspector with IMCA enrichment software.

Environmental Monitoring

Under the IAEA's "93+2" program, environmental monitoring is being evaluated by the Agency and its Member States for its ability to detect undeclared nuclear facilities, activities, and materials. The most recent Board of Governors examined proposals for implementing Part 2 measures of Program 93+2 and established a committee to draft the necessary protocol; environmental monitoring is included in Part 1 measures, however, under Part 2, it is proposed with increased physical access. ABACC and DOE are preparing a cooperative study on implementing environmental monitoring technology. A workshop was presented in April to a group that included three ABACC inspectors at the Oak Ridge (ORNL) and Pacific Northwest National Laboratories (PNNL). It included an overview of environmental monitoring and proliferation indicators; information on sampling and sample preparation; a demonstration of swipe and vegetation sampling; information on analytical methods, data interpretation, and data analysis; an overview of Oak Ridge and Hanford operations; and information on IAEA field trials and the DOE Network of Analytical Laboratories (NWAL). Participants toured gaseous diffusion and centrifuge enrichment facilities in Oak Ridge to look at potential locations for collecting environmental samples, saw demonstrations of sampling, and saw laboratories where samples are received and analyzed for concentration of uranium and plutonium (element and isotope), radio-iodine, and fission and activation products (see Fig. 4). The workshop was well-received and successful in describing the technical and administrative requirements necessary to implement an environmental monitoring program.

Fig. 4. ABBAC inspectors observe swipe sample collection during environmental monitoring workshop.

Advanced Containment and Surveillance

ABACC has been studying surveillance systems for installation and evaluation at facilities in Argentina and Brazil, especially enrichment facilities, and has visited the IAEA, EURATOM, and organizations in the USA. ABACC personnel visited Sandia National Laboratories, Los Alamos National Laboratory, and the Aquila Technologies Group for information on optical surveillance systems which could fit the safeguards approaches currently under study. These visits included discussions and demonstrations on digital video systems, fiber-optic electronic seals, and equipment tagging units; they led ABACC to procure two Gemini Surveillance Systems, one Gemini Review Station, and VACOSS fiber optic seals.

On May 2-3, 1996, at ABACC Headquarters in Rio de Janeiro, two scientists from SNL presented the initial workshop on Advanced Containment and Surveillance Technology to more than 20 participants from ABACC, CNEA, and CNEN. The emphasis of this workshop was on the new remote monitoring and video surveillance techniques, including front-end triggering of video image collection. A significant

reduction in the amount of data collected and reviewed, and an increase in monitoring and inspection personnel efficiency, are possible using these methods. The presentations included discussions of the types of sensors appropriate for monitoring and image triggering, and the technology of digital video collection and recording. The latter facilitates remote access to the video data. A similar course is expected to be presented in Argentina this fall.

Characterization of Secondary Standards

The measurement of uranium concentration and enrichment requires equipment properly calibrated with reliable standards. In this area, ABACC has two activities supported by DOE under Action Sheet 2: a network of Argentine and Brazilian laboratories, qualified through a Laboratory Intercomparison Program, and the characterization of nuclear materials to be used by ABACC as secondary standards for both nondestructive and destructive assay.

The natural U_3O_8 supplied to Intercomparison Program participants was characterized by New Brunswick Laboratory (NBL). Also, low enriched samples of U_3O_8, jointly prepared by Argentina and Brazil, were isotopically characterized by NBL as secondary standards for calibrating mass spectrometers.

In August 1994, two of ABACC's technical staff visited NBL to study the methods, techniques, and procedures to assay uranium and plutonium. The trip included visits to Los Alamos and Sandia to discuss the state nondestructive assay and containment and surveillance. In November 1994, two members of NBL visited several of the ABACC network laboratories in Argentina and Brazil which proved a valuable technical exchange. Afterwards, discussions were held at ABACC headquarters in Rio de Janeiro on the Laboratory Intercomparison Program and a future isotopic intercomparison program.

Conclusions

ABACC and DOE believe that the cooperation has been successful and beneficial to both organizations. A Permanent Coordinating Group (PCG) meets each year to review the activities underway or completed and discuss new areas of cooperation. The recent workshops on environmental and remote monitoring are examples of new tasks. The PCG will next meet in the US in September and is expected to approve future workshops, continued joint training activities (including a surveillance training course later in 1996 and ABACC participation in the 1997 SSAC course in the US), expansion of the remote monitoring field test at Embalse, and implementation of a remote monitoring field test in Brazil. It should also approve joint environmental monitoring studies at Argentine, Brazilian, and US facilities and an accelerated exchange of uranium chemical analysis technology.

The ABACC/DOE cooperation is, of course, coordinated with similar cooperative programs that DOE has established with ENREN and CNEN. US nuclear policy wishes to support ABACC and the other safeguards organizations in Latin America as they bring the nuclear materials and facilities in this important region under national and international safeguards. The cooperation also provides the US with opportunities to test and develop advanced safeguards technologies.

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