30 years of ABACC – A regional safeguards system in the framework of international safeguards and nuclear cooperation for peaceful purposes

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The creation of the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) and the Common System of Accounting and Control of Nuclear Materials (SCCC), a regional safeguards system with unique characteristics in the world, is the result of a process of confidence building and cooperation in the peaceful uses of the nuclear energy between Argentina and Brazil. In July 18, 1991, the Agreement between the Republic of Argentina and Federative Republic of Brazil on the Exclusively Peaceful Use of Nuclear Energy (Bilateral Agreement) was signed. This Agreement that entered into force in December 1991, after its approval by the parliaments of the two countries, constitutes a founding milestone for ABACC. Thirty years after this milestone, it is worthy to review the process that led to its constitution, the main characteristics of the safeguards system that it applies and the insertion of this regional safeguards system in the framework of international safeguards, in which cooperation between ABACC and the International Atomic Energy Agency (IAEA) is of fundamental importance. This paper will describe the milestones in the establishment of ABACC and the SCCC, their main characteristics and the highlights of the implementation of regional safeguards over these three decades. It will also discuss the relevance of the cooperation in safeguards with focus on the current status of the cooperation between ABACC and the IAEA and the benefits of its future enhancement, concluding with some ideas about the challenges and opportunities that ABACC faces and the value of this unique model system established by Argentina and Brazil for the peaceful use of nuclear energy and non-proliferation.

1. INTRODUCTION

ABACC and the SCCC have completed 30 years of existence. All these years were marked by the tireless work of ABACC to fulfil its mission: to verify the commitment of Argentina and Brazil of the exclusively peaceful use of nuclear energy.

ABACC was established by the Agreement Between the Republic of Argentina and the Federative Republic of Brazil on the Exclusively Peaceful Uses of Nuclear Energy that was signed on 18 July 1991 in Guadalajara, Mexico. This Bilateral Agreement signalizes the will of both States to make their nuclear programs transparent and their commitment to use nuclear energy exclusively for peaceful purposes. The political willingness and the commitment of these two countries were realized in various joint declarations on nuclear policy by the Presidents of Brazil and Argentina between 1985 and 1990: Foz de Iguazú, 1985; Brasília, 1986; Viedma, 1987; Iperó, 1988; Ezeiza, 1988; and the Joint Statements of Buenos Aires and Foz de Iguazú, 1990, among others. The Bilateral Agreement entered into force on 12 December of 1991, after ratification by the Congresses of both countries. It should be noted that said ratification implies its promulgation under the force of law as

established under the Agreement, and that this law imposes mandatory common compliance of both countries. The Bilateral Agreement sets up the Common System of Accounting and Control of Nuclear Materials (SCCC) and ABACC's mission to apply the SCCC in both countries, that means ABACC has to verify that all nuclear materials in all nuclear activities in Argentina and Brazil are used only for peaceful purposes.

In addition to the entry into force of the Bilateral Agreement, the two countries had taken the political decision to incorporate this bilateral arrangement into the international safeguards' regime, in order to share broadly with the international community, the peaceful nature of their nuclear programs and the specific mechanism and the path chosen by them to fulfil this goal.

Therefore, on the basis of the Bilateral Agreement, a Quadripartite Safeguards Agreement was signed in December 1991 by the Republic of Argentina, the Federative Republic of Brazil, the ABACC, and the International Atomic Energy Agency (IAEA). The Quadripartite Agreement is a comprehensive safeguards agreement and entered into force in March 1994 after its ratification by the Congresses of both countries.

In May 1994, the two countries brought into force the Treaty of Tlatelolco, which established a nuclear-weapons-free-zone in Latin America and the Caribbean. Argentina and Brazil joined the Non-Proliferation Treaty (NPT) in February 1995 and July 1998, respectively. The Quadripartite Agreement was considered valid by the IAEA for complying with NPT and the Tlatelolco safeguards´ obligations.

It is important to highlight that both countries have maintained their respective national safeguards authorities (State Systems of Accounting and Control – SSCAC). Moreover, in terms of the Bilateral Agreement, the countries should comply with a robust SSAC including strict requirements to be fulfilled by them and the nuclear operators.

Therefore, ABACC is a regional system that verifies the nuclear activities of both countries in order to provide assurances of the exclusively peaceful use of nuclear energy and should not be misinterpreted as a binational safeguards authority. The system formed by ABACC and the safeguards authorities is commonly known as "ABACC's Model".

2. THE COMMON SYSTEM OF ACCOUNTING AND CONTROL OF NUCLEAR MATERIAL (SCCC)

The SCCC was originally developed in 1990 when both countries had safeguards agreements based on the IAEA document INFCIRC/66 Rev. 2. Therefore, the first version of SCCC was compatible with the provisions of this Agency´s safeguards system. Later on, as both countries decided to sign a comprehensive safeguards agreement with the IAEA, a second and definitive version of the SCCC was prepared in order to be compatible with the IAEA document INFCIRC/153.

The SCCC is based on two documents. The first one of permanent character is the Annex of the Bilateral Agreement, as a kind of stone clause which provides the basic guidelines for the SCCC. This includes key elements of the System, such as the starting point of safeguards, termination of safeguards, criteria for determination of suitable level of accounting and control, and safeguards procedures for recording, reporting and measuring nuclear materials. Any modification of this basic guidelines would require to amend the Bilateral Agreement.

The second one is the document named ´*General Procedures of the SCCC*´, that is approved by the policy-making organ of ABACC, the ´Commission´ and contains detailed procedures to ensure the effective implementation of the SCCC. Therefore, this document is of a more dynamic nature being

subject to updates along the time, as required. It is worth noting that this document goes beyond a simple safeguards document, as it encompasses requirements at facility level and at State level with an extent beyond the requirements established by the IAEA´s safeguards. The General Procedures of the SCCC contain provisions related to operator's records and reports, their measurement systems, nuclear materials transfer notifications, and the purpose and scope of the inspections. The level of accounting and control to be applied for a specific facility is reflected in its Application Manual, which is a technical document that specifies in detail the SCCC measures for each particular facility.

3. ABACC's SAFEGUARDS OPERATION

Considering the basic concepts - significant quantities, timely detection, and a reasonable degree of certainty, ABACC applies criteria and procedures established in the SCCC. ABACC is entitled to consider each specific case and defined a particular set of suitable detailed technical criteria and control measures to verify nuclear materials and facilities, taking into account the characteristics of the nuclear activities in each country.

ABACC's safeguards measures include the verification of the continued validity of the information described in the Technical Questionnaires (i.e., design information of the nuclear facilities), independent verification of the inventory and flow of nuclear material, verification of the operator's accountancy and measurement systems, and the use of containment and surveillance measures. The level of control for each facility, including the inspection frequency, is established considering the following variables: characteristics of the facility, category of the nuclear material (taking into account the relevance of the isotopic composition), conversion time, inventory, and production time (linked to the facility throughput). In addition, the quality of the measurement system, the application of containment and surveillance, and the material accessibility are factors that could affect the inspection frequency or the inspection scope. The inspection goal quantities are usually established by considering the type of facility (item or bulk) and the maximum inventory, or the throughput. The intervals of time between inspections are established by considering the nuclear material production time, the conversion time, and the safeguards approach of r each facility.

The first evaluation of the results obtained from an inspection is performed by the inspectors themselves. The inspection report has to contain their comments and conclusions about the verification activities, including judgments about the appropriateness of these activities and the safeguards approach, as well as recommendations about resolved or unresolved discrepancies. The inspectors also have to recommend additional actions when necessary. For ABACC, this is a fundamental stage in the control system and requires the inspector to have technical knowledge and an ability to make judgments. From the beginning, the ABACC has been fully aware of the key role played by well-trained inspectors in the field. Because the inspectors are not part of the permanent staff of the ABACC, their work has to be very detailed and conclusive to ensure the follow-up of activities performed during the inspection.

ABACC inspectors' activities may be divided into pre-inspection, inspection, and post-inspection activities. Pre-inspection activities are performed at the ABACC headquarters when the ABACC's operations unit informs the inspectors about the MBAs to be inspected, their operational status, and the possible existence of pending subjects or discrepancies. At that time, they discuss the inspection plan, measurements to be made, and a sampling plan. The accounting unit of the ABACC provides the inspectors with the working papers for records auditing, the inventory as it was checked in a previous inspection, the inventory changes, and the current inventory (when applicable) to be verified

in the present inspection. The inspectors receive all the material necessary for the inspection, such as seals, sampling flasks, and measurement equipment.
Inspection activities include, in general, the auditing of the records and comparison with reports, based on the working papers previously prepared in headquarters; counting and identification of an item; weighing and non-destructive assay, according to the sampling plan; follow-up action; verification of the operator's measurement system; sample-taking; seals examination, application and exchange; and surveillance service and review.
A second level of evaluation is performed in the ABACC's headquarters. It includes the overall evaluation of the inspection report/results. Following these evaluations, the National Safeguards Authority is notified about the conclusions of the verification activities. All discrepancies are followed up immediately, with the urgency being related to the type and quantity of the nuclear material involved and the strategic importance of the facility (or facilities) concerned. Unresolved discrepancies could constitute an anomaly and may trigger a specific sequence of actions. Any anomaly is reported by the Secretariat to ABACC's Commission, its policy making organ, who is responsible to monitor the functioning of the SCCC and to inform the Party concerned of any anomalies which may arise in the implementation of the SCCC and to inform the Parties of the non-compliance by one them of the commitments made under the Bilateral Agreement. The Party in non-compliance shall then be obliged to take the necessary measures to rectify the situation.

4. NUCLEAR FACILITIES

Table I describes the present facilities and other locations in both countries, as of 30 June 2021.

Table I. Facilities and LOFs in Argentina and Brazil

TYPE OF FACILITY	ARGENTINA	BRAZIL	TOTAL
Conversion and Fuel Fabrication	9*	2	11
Uranium Enrichment	2	3	5
Power Reactors	5*	3*	8
Research Reactors / Critical and Sub Critical Units	6*	7*	13
Others (Research & Development Facilities, Storage Units, etc.)	28	10*	38
Total	50	25	75

* One under construction

5. INSPECTIONS

In these 30 years, ABACC has carried out more than 3200 inspections verifying nuclear material inventories and activities declared by Argentina and Brazil. During this period, the inventory of uranium grew 3 times and the plutonium inventory grew 5 times, requiring our focus on increasing efficiency and effectiveness in implementing the SCCC, as the same structure and the same number of officers have been maintained along the time.

Figure 1 presents the number of inspections and design information verification technical visits (DIVs) performed by ABACC since starting its operations.

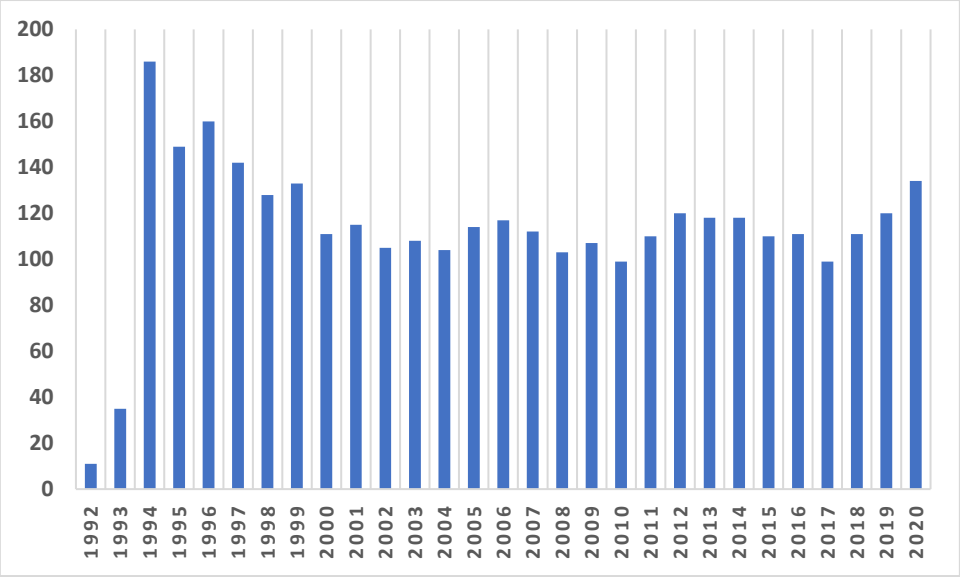

Figure 1: Number of inspections and DIVs per year

The figure in 1994 reflects the verification of initial nuclear material report to comply with the Quadripartite Agreement. It should be noted that in average about 100 inspections and DIVs a year are performed in the ABACC´s system. In 2020, ABACC performed 114 inspections in nuclear installations in both countries, despite the restriction in both countries and in all over the world due to the pandemic Covid-19. The inspections effort required a total of 889 inspector-days, made up of in-field activities and pre- and post-inspection activities.

During the inspections in 2020 and in addition to the 650 non-destructive measurements and 177 weighing, a total of 34 samples of nuclear material were collected in Argentina and Brazil for further determination of the element uranium and the U-235 isotope in the ABACC network laboratories. Furthermore, 38 environmental swipe samples were taken for uranium particles analysis. To control the nuclear material at the two countries' installations, a total of 805 seals have been applied and 34 ABACC surveillance cameras were in used.

6. COORDINATION OF ACTIVITIES BETWEEN THE ABACC AND THE IAEA

As above-mentioned, the Bilateral Agreement was supplemented by the Quadripartite Safeguards Agreement (INFCIRC/435), signed by the two governments, the ABACC, and the IAEA on 13 December 1991 in Vienna, Austria. Under this agreement, the IAEA also takes responsibility for applying comprehensive safeguards in Argentina and Brazil. The Quadripartite Agreement entry into force on 4 March 1994.

The Agreement's basic undertaking is the acceptance by the State Parties of safeguards, in accordance with the terms of the Agreement, on all nuclear materials in all nuclear activities within their

territories, under their jurisdiction or carried out under their control anywhere, for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other explosive devices. The ABACC undertakes, in applying its safeguards to nuclear material in all nuclear activities within the territories of the States' Parties, to cooperate with the Agency, in accordance with the terms of the Agreement, with a view to ascertaining that such nuclear material is not diverted to nuclear weapons or other devices. The Quadripartite Agreement further states that the IAEA shall apply its safeguards in such a manner as to enable it to verify the findings of the SCCC. The IAEA verification shall include, inter alia, independent measurements and observations conducted in accordance with the procedures specified in the Agreement. The IAEA, in its verification, shall take due account of the technical effectiveness of the SCCC. Moreover, the Agreement states that ABACC and the IAEA shall avoid unnecessary duplication of safeguards activities.

The General Part of the Subsidiary Arrangements to the Quadripartite Agreement entered into force on the same date of the Agreement (4 March 1994). Some particularities can also be found in this document, such as the provision for the ABACC to periodically send information on the scope of its inspections, inspection reports, etc. to the Agency. There is an entire protocol dealing with arrangements between the ABACC and the Agency for cooperation in the application of safeguards under the Agreement. In implementing these arrangements, both Agencies shall be guided by the following principles: the need to reach their own independent conclusions and to coordinate, to the extent possible, their activities for the optimum implementations of the Agreement and, in particular, to avoid unnecessary duplication of the ABACC's safeguards. Also, when performing their activities, the ABACC and the IAEA shall work jointly, whenever feasible, according to compatible safeguards criteria of the two organizations.

Several levels of coordination between the ABACC and the IAEA are considered in the Quadripartite Agreement and its General Part of the Subsidiary Arrangements. A significant improvement in the cooperation was achieved with the approval of the document *Guidelines for Coordination of Routine and Ad Hoc Inspection Activities between the Agency and ABACC*. The guidelines described in this document provide guidance on the coordination of activities of the two agencies. They are reviewed and amended, as appropriate, in the light of changing circumstances and developments of, inter alia, new safeguards` measures on the part of the IAEA, the ABACC's capabilities, technical effectiveness and functional independence, the need to appropriately apportion the financial burden of shared activities, and changes in the general situation.

Based on these Guidelines, around forty sets of common procedures for joint use of safeguards equipment have already been established. Both agencies agree in advance to the safeguards´ equipment acquisition planning. Significant cooperation was also achieved on the preparation of joint inspection guideline procedures and approaches for specific relevant facilities. Joint safeguards approaches and procedures are established by the two agencies in order to apply a common set of verification measures. The development of relevant safeguards measures and approaches for enrichment facilities at the beginning of the implementation of safeguards are worth noting. Under these approaches, ABACC/IAEA have established arrangements for unannounced inspections and for swipe sampling, among other arrangements. Joint inspection guidelines documents have been agreed for light water and on load power reactors and procedures for short notice random inspections at two fuel fabrication plants. At present, two procedures to implement safeguards at spent fuel dry storages, including the transfers of those spent fuels are under discussion or already agreed and under routine implementation. It is worth noting that this approach has been proved to be an efficient and effective way to coordinate ABACC and the IAEA´s respective safeguards criteria and responsibilities.

7. CONCLUSIONS

The description of the efforts made by Brazil and Argentina to set up a Common System for Accounting and Control of Nuclear Materials, the creation of ABACC as an independent organization from the States to administer it, and the level of implementation achieved, show the possibility of successfully establishing regional systems for the application of safeguards.

This paper presents in technical detail the characteristics and contribution of a regional safeguards system unique in the world that was created with the objective of verifying the exclusively peaceful use of nuclear energy in two countries with significant activities from the safeguards standpoint. Moreover, the ABACC model represents a significant contribution to the peaceful uses of nuclear energy and to nuclear nonproliferation within a Nuclear Weapons Free Zone.

Cooperation and coordination with the IAEA safeguards along these years and their future direction are also worth mentioning. The signature of the Quadripartite Agreement and the progress achieved with the IAEA in its implementation thereof emphasizes the feasibility of these systems playing a major role and contributing to the efficiency, effectiveness, and success of the international safeguards system. This work also highlights the existence of a technical robust regional model system that has been embedded into a comprehensive safeguards agreement with the IAEA, which contains clear and well-defined principles governing the cooperation and coordination of activities between ABACC and the IAEA.

The requirement for each agency to reach independent conclusions does not prevent the cooperation and the sharing of common approaches, procedures and technology for joint use. On the contrary, the Quadripartite Agreement allows to enhance the cooperation between the two agencies further.

Cooperation with institutions which work in the area of nuclear safeguards is of fundamental importance for the exchange of information on safeguards concepts and techniques and to ensure ABACC state of the art technologies and methods. Since the very beginning, technical cooperation and the participation in fora like ESARDA and the INMM have been permanent policies of ABACC.

The success of the ABACC model in verifying the peaceful use of nuclear energy in two countries with significant nuclear programs over these 30 years represents a unique opportunity to explore ways and means to enhance cooperation with the IAEA in implementing international safeguards.

The steady expansion of the nuclear programs of the two countries under the verification of ABACC, presents new opportunities and challenges to ABACC in leading the process of developing new approaches and procedures and to incorporate new technologies to continue fulfilling its mission in the years to come, both effectively and efficiently. Undoubtedly, the cooperation between Argentina, Brazil, ABACC and the IAEA will continue to be the basis for the success of this regional-international scheme.