ABACC´s Experience in Implementing Short Notice Random Inspections (SNRI) Regime at Fuel Fabrication Plants in Brazil and Argentina

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Abstract. As a result of discussions initiated in 2006 among the IAEA, ABACC and the respective States Parties, the new inspection scheme was designed to be jointly applied by ABACC and IAEA to the commercial fuel fabrication plants in Brazil and Argentina, to fulfill with the new safeguards evaluation criteria for domestic and international receipts into and shipments from fuel fabrication/conversion facilities with inventories or throughput higher than 2 SQ, in effect since 2007, in compliance with the relevant provisions of the Quadripartite Agreement (INFCIRC/435). Taking into account each plant specific operational and administrative requirements, particular SNRI procedures applicable to each facility were discussed. Several issues were agreed, such as: i) channels of communication between the operator/national authorities and the agencies for E-mailbox operational declarations and notifications to support SNRI; and ii) improvements in the coordination arrangements between the agencies for triggering and carrying out the joint inspections, in order to guarantee that 100% of domestic receipts or shipments are randomly verified by both agencies in a way to avoid duplication of verification efforts and additional burden to the operators and national authorities. Following the field trials completed early in 2008, the new regime started being implemented in the middle of 2008 in both countries. This paper will briefly describe the progress attained since the field trials period of SNRI at the two fuel fabrication plants, the current situation of the coordination of activities within ABACC and among the IAEA, ABACC and the operator/national authorities, and the expected challenges for future.

1. Introduction

The role of ABACC, in connection with the application of Short Notice Random Inspections (SNRI) Regime at fuel fabrication plants in Argentina and Brazil, is primarily founded on the framework of the "Brazilian-Argentine Agreement on the Exclusively Peaceful Utilization of Nuclear Energy" [1], in force since December 1991 (Bilateral Agreement) and the "Common System of Accounting and Control of Nuclear Materials (SCCC)" established by Argentina and Brazil in July 1992.

As a comprehensive safeguards system, the SCCC is applied by ABACC to all nuclear material present in all nuclear facilities of Brazil and Argentina, in order to assure that none of the nuclear materials within their territories or under their jurisdiction is diverted to the manufacture of nuclear weapons or other nuclear explosive devices. Modifications can be introduced into the safeguards basic criteria and procedures adopted by ABACC to incorporate new safeguards concepts and technologies, in order to increase the effectiveness and efficiency of the system applied through cross-national inspections - Argentinean inspectors carry out inspections in Brazil and vice-versa.

Taking into consideration the above-mentioned bilateral agreement and the SCCC, a "Quadripartite Safeguards Agreement among Argentina, Brazil, ABACC and the International Atomic Energy Agency (IAEA)" [3] was signed in December 1991, entering into force on March 1994, after its ratification by the Congresses of both countries. As a full-scope safeguards agreement, similar to INFCIRC/153 model agreements, the basic undertakings of the Quadripartite Agreement rely on the acceptance by the States

Parties the safeguards regime over 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.

In compliance with the provisions of the Quadripartite Safeguards Agreement (INFCIRC/435), a close coordination between the IAEA and ABACC is required in order to, while avoiding unnecessary duplication of efforts, allow each Agency to fulfil its responsibilities and to reach their own independent conclusions.

In line with the above-mentioned legal framework, in 2006 ABACC, Brazil and Argentina agreed to consider in separate a proposal received from the IAEA to take the necessary steps to implement the short notice random inspections (SNRI) regime with mailbox declarations at the fuel fabrication and conversion plants in Brazil and Argentina, in order to strengthen the safeguards measures already applied at those facilities. As the outcome of the negotiations, ABACC, IAEA, and the respective States Parties concerned agreed to establish specific "Joint ABACC-IAEA Short Notice Inspection Procedures" becoming effective for application to the fuel fabrication plants in each country.

In this regard, it is important to point out how much essential has been the coordination among the agencies and the respective States Parties for the successful of the implementation of this new regime.

With characteristics completely different, the two commercial fuel fabrication plants under the ABACC and IAEA safeguards inspections regime are briefly described as follow:

1) In Argentina:

"Fábrica de Elementos Combustibles Nucleares (Fuel Fabrication Plant – FECN)"

- Its production and shipments are related to natural and low-enriched uranium fuels (0.85% U-235 enrichment) for on-load reactors.
- The continuous production schedule is based on periodic campaigns, processing about 140 tons of U-nat and 100 tons of LEU to produce 5000 CANDU type fuel bundles for Embalse NPP and 700 Atucha I and Atucha II NPPs type fuel assemblies in a year.
- UO2 is the feed material in both productions, in which is foreseen the blending of low enriched uranium up to 5% U-235 enrichment with natural uranium at the facility.
- Most domestic shipments are the fresh fuels to the reactors and, occasionally, the scrap material can be sent to the conversion plant for recovery campaigns.
- The major international transfers are occasional imports of LEU powder.

2) In Brazil:

"Fábrica de Combustível Nuclear (FCN)-Reconversão e Pastilhas/Componentes e Montagem (Nuclear Fuel Fabrication Plant)"

- Its production and shipments are related to low-enriched uranium fuels for PWR reactors, Angra I and Angra II NPPs.
- The production is scheduled by demand, normally working by 2 campaigns per year, with a maximum design capacity of approximately 170 tons of LEU.
- The plant comprises two parts: one for processing of UF6 (mostly imported, up to 5% U-235 enrichment) for producing about 120 ton UO2 powder and sintered pellets per year, and another for producing the fuel elements for the reactors.
- Major domestic shipments are fresh fuels to the reactors while major domestic receipts are in general limited to damaged fuel elements.
- The major international transfers are imports of LEU as UF6 and U-Gd fuel rods.

2. From the Conventional to the Short Notice Random Inspections

In both facilities, conventional comprehensive safeguards schemes [3,4] had been applied until the end of 2006 whereby a number of scheduled interim and one PIV inspections a year were conducted in each plant covering a percentage of transfers. In compliance with the respective approaches, the agencies and National Authorities had taken into consideration the possibilities of a diversion into the MUF or an abrupt or protracted diversion during a material balance period concealed for instance by substitution by dummies of

nuclear material of a lower value (e.g. natural uranium).

The main activities performed during the PIV and interim inspections were normally the following:

- PIV Inspection (once a year);
- Observation (Material Involved in Domestic Transfers);
- Book Auditing;
- Nuclear Material Verification; and
- Design Information Verification (DIV) (once a year, usually during the PIV).

In addition, ABACC and IAEA occasionally performed ad-hoc inspections for the verification of international transfers. ABACC usually verified all international transfers based on advance notification and the material received would be verified.

At least once a year, normally during the PIV, the operator's measurement system (scales) and pellets sampled from the fuel rod loading station were verified by the IAEA and ABACC.

In Argentinean facilities, during the simultaneous PIV the nuclear material of the same type suitable for borrowing from other facilities (more than 1 SQ) was verified by performing a simultaneous PIV at the conversion facilities and short notice inspections in the fresh fuel storage at any of the corresponding NPPs. This verification was carried out during the simultaneous PIV day, when the nuclear material of the same type at the FFP was checked for any change from the PIV list and verified if new material had been received.

Based on the Brazilian and Argentinean Facility Attachments, respectively in force since November 1997 and September 2000, for the plants producing continuously the inspection efforts corresponded to one PIV per Material Balance Period (MBP) and normally 3 or 4 interim inspections per year, scheduled on announced basis. The strata of finished products (fuel elements) and domestic receipts not yet verified were clearly identified and distinguished by the operator.

The dates for the inspections were selected by IAEA and ABACC based on the operational program of the facility, provided in advance at the beginning of the year, as well as the advance information regarding PIT and expected receipts and shipment.

During the PIV and interim inspections, at least 20% of the material involved in domestic transfers was randomly verified (receipts into and finished product shipped out from the facility). In addition, to the possible extend, ABACC routinely verified international transfers carried out during scheduled interim inspections. In practice, this would imply the verification of at least 20% of the fuel elements produced at the facility.

Taking into consideration that performing the interim inspection scheduled on short notice random basis would result in better effectiveness, due the unexpected inspections, and the complete verification coverage of domestic and international transfers (flow), in 2006 negotiations started between the agencies and the national authorities in order to enhance the conventional safeguards measures already implemented.

According to the IAEA proposal, the interim inspections would be scheduled on short notice random basis and the PIV would continue being scheduled based on the operational program. In addition, to support SNRI, the receptions, shipments and production of nuclear materials would be declared through encrypted E-mails messages (mailbox) provided to the agencies.

Under the new approach designed for each facility, the inspection activities performed by the IAEA/ABACC safeguards inspectors should be able to:

- Provide 100% verification coverage for nuclear material transfers into and out of the facility during the material balance period;
- Make concealment of diversion by false reporting of receipts or shipments more susceptible of detection;
- Confirm that the plant operation is consistent with the SNRI declaration;

• Verify the operators measurement system and nuclear material at the strategic points; and
• Confirm and reconcile the movements of nuclear material between facilities.

The new regime would cover all types of nuclear materials at the plant and would maintain the provision of periodic operational declarations concerning the production forecasts and nuclear material receipts and shipments as foreseen in the previous regime.

To comply with the requirements of the SNRI scheme, IAEA and ABACC started jointly to design the SNRI approaches for both facilities and discussed with ARN and CNEN, respectively, to define plant specific requirements for the implementation of the new inspections regime in 2008 [5,6], starting in 2007 with a short field trials period for necessary adjustments in the procedures.

3. SNRI Implementation

3.1 Joint inspections scheme

The SNRIs are planned in advance taking into account the respective operational program and SNRI declarations provided by the facility operator. So, in each facility, over the year a number of joint SNRI per material balance period has been carried out during the normal working hours, to verify the nuclear material transfers into and out of the facility, triggered and coordinated by the IAEA or ABACC. Contingent to achieve 5% detection probability, at least, one SNRI triggered and coordinated by the IAEA is performed during any given material balance period.

3.2 Support documentation provided by facility operator/national authority

Once a year, the anticipated operational programmes covering the next calendar year, are provided to the Agency through ABACC, as specified in the respective Facility Attachment. Nevertheless, in case of relevant modifications, the update of the operational programmes should be provided as soon as possible.

For information on transfers into, out of and between the States Parties, advance notifications are also provided indicating specific dates for international transfers.

Routinely, the facility operator provides a declaration of all nuclear material received by the facility or prepared for shipment, through a secure mailbox system using the so-called "Public Key Infrastructure (PKI)". In the case of Argentinean facility, such declaration is provided by the operator directly to ARN and to the agencies at the same time. In the case of Brazilian facility, it is provided through CNEN. In both cases, in order to assure the timeliness, completeness and accuracy of the information provided/received, dedicated PCs with restrictive and secure access control have been used.

In order to support the SNRIs specific information are provided by the facility operator/national authority, as follow:

i) International Receipts: As soon as the itemized list (List of Inventory Items – LII) from the Shipper is available, but not later than the receipt date. A detailed LII for the receipt, indicating: item identification, gross, net and tare weights, uranium concentration and weight, as well as isotope composition and weight, should be provided;
ii) Domestic Receipts: As soon as the nuclear material is available at the facility for verification. A detailed LII for the receipt, indicating: item identification, gross, net and tare weights, uranium concentration and weight, as well as the isotope composition and weight;
iii) Completed Fuel Assemblies: On a daily basis, the information on all completed fuel assemblies. The declaration should include item identification, uranium and isotope weights.
iv) International Shipments: To reach the organizations, not later than two weeks before the nuclear material is prepared for shipment. A detailed LII indicating, for each bulk item: item identification, gross, net and tare weights, uranium concentration and weight, as well as the isotope composition and weight; and for each fuel element: item identification, uranium concentration, as well as the uranium and isotope weights.
v) Domestic Shipments of nuclear material other than fuel assemblies: As soon as the nuclear material is ready for shipment and available for verification. A detailed LII indicating: item identification,

gross, net and tare weights, uranium concentration and weight as well as isotope composition and weight.

All declarations since the last inspection must be kept available at the facility, as well as archives of the original declarations and all correspondences, including the notification messages and automatic replies, are kept for further reference.

3.3 Notification

In case the inspection is triggered by the IAEA, before the start of the SNRI a formal notification fax is sent to ABACC of its intention to carry out a SNRI, and vice versa.

Arrangements with the State Authority concerned are foreseen based on special circumstances as informed in advance by the operator and for which the SNRI regime becomes more restrictive than the usual.

Following the agreed communication procedures, 24 hours (including a working day) before the start of the SNRI, ABACC and IAEA send a formal notification fax to the State Authority concerned informing their intentions to carry out a SNRI. For the Brazilian facility, it can be reduced, becoming more restrictive the announcement than the usual.

3.4 List of Inventory Items and Retention Period

Upon inspectors arrival at the facility, the operator provides a detailed hard copy (electronic format, if possible) of the list of inventory items (LII) of all nuclear material received and not yet processed (including the receipt date). In addition, an itemized list of all nuclear material ready to be shipped that are available for verification since the previous inspection is provided to the inspectors, including all packed and not-yet-packed finished fuel assemblies, for verification of the nuclear material involved in domestic and international transfers and to cover the internal borrowing possibilities.

Distinct retention (residence) periods have been agreed for each plant, taking into account its own specific operational requirements.

For the Brazilian facility, the normal retention period for receipts and shipments is 5 working days. For completed fuel assemblies it is also 5 working days after SNRI declaration of completion (before or after quality assurance control) of the fuel element.

For the Argentinean facility, the retention period for receipts and shipments is 6 working days. For completed fuel assemblies the retention period is also 6 working days after SRNI declaration of completion of the fuel element, including the quality assurance control period. Assemblies to be returned to the process must be available for verification for the full retention period before it is returned to the process. For shipment of scrap, the retention period is 6 working days after SNRI declaration of the intended shipment.

3.5 Main activities

Prior to access to the facility, the following preparation activities are performed at IAEA and ABACC-HQ:

i) Confirm that the Notification has been prepared and arrangements are made for sending it to the National Authority 24 hours in advance;
ii) Collect a general schedule of nuclear material transfers for the current month, together with related advance declarations on matters of Force Majeure (any event beyond the control of the facility operator that limits the inspection activities foreseen to be carried out on any particular day); and
iii) Obtain the latest SNRI declarations.

Upon completion of the preparation activities as above-mentioned, the inspectors are ready to access to the facility. Once the notification of a SNRI has been given to the State, the inspection must take place, regardless to what extent the subject force majeure may limit inspection activities. Upon arrival and receipt the LII from the operator, the following verification activities are performed:

i) Examination of records and reports - the joint auditing software (SJAR) is applied to carry out the joint book auditing activities and the SNRI declarations given through the mailbox system and Advance Notifications are compared for consistency with the LII;
ii) Domestic Receipts and Shipments – the fixed size sample plan is applied for verification of nuclear material in the LII and not yet verified during a previous inspection;
iii) DA Sampling at Other Strategic Points;
iv) Verification of seals applied to the material;
v) Borrowing within the MBA - nuclear material verified during previous inspection still available at the facility should be included in the sampling population; and
vi) International Transfers – UF6 cylinders, fuel assemblies, fuel rods, powders and pellets are verified, if present at the facility during any inspection.

3.6 Field trials

With the objective to adjust all the SNRI practical implementation details involving the operator, national authority and inspectors, the field trials SNRI period started in 2007, prior to the implementation of the new inspections regime at the Brazilian and Argentinean FFPs, carrying out two joint ABACC-IAEA field trials in each facility, within a normal operating schedule.

4. Lessons learned and improvements for future

In both facilities, the new regime is being implemented since 2008. The progress achieved with the transmission of information and the advantages of joint use of equipments and common procedures by the agencies have been so successful that, until now, no need for improvements is being foreseen, at least in a short-term period. Perhaps in future, special procedures may be necessary to be developed in order to resolve special needs or unusual operative problems.

Indubitably, the cooperation and coordination between ABACC, the IAEA, the State Authorities and Operators has led to an optimization of the safeguards activities under the SNRI regime and contributing to strengthen the safeguards control at the two commercial fuel fabrication plants in Brazil and Argentina.

References

[1] “Agreement between the Republic of Argentina and the Federative Republic of Brazil for the Exclusively Peaceful Use of Nuclear Energy”. INFCIRC/395. IAEA, Vienna, November 1991.
[2] “Agreement between the Republic of Argentina, the Federative Republic of Brazil, The Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials and the International Atomic Energy Agency for the Application of Safeguards. INFCIRC/435. IAEA. Vienna, March 1994.
[3] IAEA/ABACC: “Guidelines for IAEA/ABACC Joint Inspection Activities at the Nuclear Fuel Fabrication Plant in Argentina”, Intern. Paper, Vienna/R.J. Jan 2005.
[4] IAEA/ABACC: “Guidelines for IAEA/ABACC Joint Inspection Activities at the Nuclear Fuel Fabrication Plant in Brazil”, Intern. Paper, Vienna/R.J. Oct 2004.
[5] IAEA Procedure: “IAEA and ABACC SNRI Scheme for the Fábrica de Combustíveis Nucleares (Nuclear Fuel Fabrication Plant – FCN) in Brazil”, Intern. Paper, Vienna. May 2008.
[6] IAEA Procedure: “IAEA and ABACC SNRI Scheme for the Fábrica de Elementos Combustibles Nucleares (Fuel Fabrication Plant – FECN) in Argentina”, Intern. Paper, Vienna. Nov 2007.