Preserving Technological Secrets and Proliferation Risk

Elías Palacios
Brazilian-Argentine Agency for Accounting and
Control of Nuclear Materials , ABACC
Av. Rio Branco, 123, G 515, Centro, 20040-005,
Rio de Janeiro, RJ, Brasil
palacios@abacc.org.br

Abstract

In July 1991, Brazil and Argentine engaged, by means of the Bilateral Agreement, to use nuclear energy and their respective nuclear programs exclusively for pacific purposes. The said Agreement also created ABACC, in order to monitor the effectiveness of these intents. Since the beginning of its activities, the Agency has been involved in the application of safeguards in ultra-centrifugation enrichment plants, which constitutes an issue of particular relevance for this Agency as well as for the International Atomic Energy Agency (IAEA). The cascades of the centrifuges are concealed behind panels, on request of the operators, so as to protect their technological secrets. Being aware of this necessity, ABACC has implemented alternatives that promote the conciliation of the interests of all the parties involved. A safeguards approach based on the perimeter control has been used in facilities with low installed capacity as well as in the first two cascades of a commercial plant which is being built. This paper discusses the efficiency of this approach as the capacity of the facility is increased and the conclusion is that it is necessary to start a dialogue on the future implementation of more standardized control methods in commercial facilities, and await the compliance of the designs to the new reality.

1. INTRODUCTION

In July 1991, Brazil and Argentine engaged to use nuclear energy and their nuclear programs exclusively for pacific purposes. This was clearly expressed in the Bilateral Agreement, which can be outlined in the following manner:

- Utilize the material and nuclear facilities located in their jurisdiction or submitted to their control exclusively for pacific purposes;

- Prohibit and impede in their respective territories and abstain from pursuing, promoting or authorizing, directly or indirectly, or from participating in any way in:

    a) testing, using, producing, preparing or purchasing, by any means, any nuclear weapon whatsoever and

b) receiving, storing, installing, erecting or possessing in any other way any nuclear weapon.

The Bilateral Agreement also created the Brazil-Argentine Agency for the Accounting and Control of Nuclear Materials, ABACC, in order to check the effectiveness of these intents. Since the beginning of its activities, ABACC had to face all sorts of challenges in order to gain credibility on an international basis, among which must be emphasized: the implementation of a control system applicable on regional scale in only two years; the capacitation and qualification of the staff of inspectors in both countries; enhancing the quality of their inspections to the level of other international organizations; practicing the control of safeguards in facilities using sensitive technology; and preparing to apply measures that will strengthen the international safeguards system. Some of these items are fully implemented by now and demand permanent attention and considerable efforts from ABACC, such as the application of safeguards in ultra-centrifugation enrichment plants.

2. SAFEGUARDS IN ULTRA-CENTRIFUGATION PLANTS OF SMALL CAPACITY

Although ABACC has always been involved in the application of safeguards in research facilities for the development of different enrichment technologies, the ultra-centrifugation plants constitute an issue of particular relevance for this Agency as well as for the International Atomic Energy Agency (IAEA), due to the progress obtained in the past years and of their operational versatility.

According to the extensive safeguards agreements in force, with the exception of the Additional Protocol, the objectives of control aimed at this type of facilities can be condensed in three fundamental points:

- Early detection of any diversion of a significative amount of declared nuclear material.
- Confirmation of the operational declaration of the enrichment plants.
- Detection of any evidence of misemployment of the facility, in particular associated to the non-declared production of high enrichment uranium.

In order to reach these targets, the inspection activities are aimed to verify all the operational declarations as well as to detect any evidence of the non-declared use of the facilities. Among the measures adopted to check the operational declarations are the verification of the enrichment level in the product tanks; the control of the internal and external flow of nuclear material; the verification of the physical inventory; and the confirmation of the actual separative capacity.

A fundamental aspect of the safeguards approach for this type of facilities is that the existence of non-declared nuclear material is not to be excluded . In fact, the chief cause of worry is the misemployment of the facility and the clandestine production of enriched uranium. In order to avoid such situations, it is necessary to implement inspections which are specifically directed to detect evidence of non-declared activities.

3. ALTERNATIVES FOR THE DETECTION OF NON-DECLARED EMPLOYMENT

In order to deal with this scenario in commercial facilities, in the seventies, the IAEA developed together with the countries that mastered the technology of uranium enrichment a safeguard approach called "Hexapartite". It applies to commercial scale ultra-centrifugation plants with installed separative capacity in the order of 1×10^6 separative work units, operating with an enrichment level lower than 5%. This approach is based chiefly on non-announced access to the hall of cascades, with limited frequency and irrestrictive visual access, together with other conventional safeguard measures. Through non-announced access, the inspectors can make sure that the configuration of the cascade matches the declared configuration and that there are no clandestine lines nor non-declared piping in the hall of cascades. The non-announced access to the hall of cascades was the approach that allowed the application of an effective control with reasonable costs for all the parties involved.

Another alternative which was discussed on that opportunity was a safeguards approach based on the perimeter control. This type of approach is used to verify that no non-declared material enters or leaves the hall of cascades and it utilizes surveillance and contention measures in a delimited space, the perimeter. Although this alternative carefully protected any sensitive information through the restriction of the visual access to the cascades, it lost its effectiveness because of the limitations of the existing surveillance and contention systems as well as of some of the destructive and non-destructive measuring techniques, not to mention the high costs of implementation that made them impracticable.

On the other hand, the operators have resisted against the unrestrictive visual access for they understand that neither the sensitive information nor their commercial interests are being sufficiently protected. In fact, the access of inspectors to materials and components, process control elements, mechanical developments, etc. allows the indiscriminate disclosure of the technology and the identification of the supplying companies, all of which can hinder the future improvement of the facilities and raise difficulties to the commercial development of their production.

In the last thirty years, a significant progress was achieved in the technological development of the surveillance systems, not only in terms of the capacity to store information but also regarding its operational reliability. Nevertheless, the potential showed by some measuring techniques in the detection of evidences of misemployment, such as the sampling by means of surface sweeping of some strategic points of the facilities, allowed to develop new alternative approaches based on perimeter control which take into account the need to extensively protect any sensitive information.

However, it is necessary to point out that any approach based on perimeter control implies the combination of elements of contention and surveillance and destructive and non-destructive measurements, which in terms of costs, intrusiveness and inspection efforts shall always be less efficient when compared to the approach using unrestrictive visual access on a non-announced basis.

With respect to what was said above, it is possible to conclude that although the restrictions imposed on visual access protect suitably the technological developments, they introduce

limitations in the control systems that can only be compensated by the application of alternative measures which imply higher costs and whose effectiveness is limited, in most cases, due to the size of the facilities.

The following punctual questions remain: What is the limit for the application of perimeter control? For how long can this approach be applied in a certain facility? When does the risk of proliferation cease to be sufficiently low? To supply an answer to these questions and establish an adequate criteria for all the parties involved represents a new challenge for ABACC.

4. PRESENT SITUATION IN THE REGIONAL SYSTEM CONTROLLED BY ABACC

Since the Bilateral Agreement came into force, ABACC has applied safeguards control to ultra-centrifugation enrichment plants in a context that, although it has evolved according to the technological development, it has not changed expressively with regard to the risks of proliferation. This context can be condensed in the following boundary conditions:

- Facilities with low installed separative capacity, in a scale compatible with laboratorial development or demonstration plants (on a pilot-scale).
- The presence of panels restricting the visual access to the centrifuges.
- The possibility of non-announced access to the facilities (hall of cascades as well as supply and withdrawing stations) with a maximum delay of two hours.
- The possibility to implement contention and surveillance measures.
- The possibility to carry out non-destructive measurements through the panels.
- The visual access to the main piping configuration of each cascade.

In this context, ABACC developed safeguards approaches (control systems) which take into consideration the specific features of the facilities in each stage of development and respect the restrictions of the visual access to the centrifuges, based on the following premises:

- The routine application of surface sampling at strategic points of an isotope enrichment plant deals adequately with the scenario of the production of enriched uranium with a content of isotope U235 above 5%, no matter what technology is being utilized.
- The combination of non-destructive active or passive measurements through the panels, by means of the interaction of gamma and neutronic radiation, proved effective in order to detect the eventual presence of barrels containing nuclear material concealed by the panels.
- The reliability and the storage capacity of the now existing surveillance systems make them appropriate to establish an effective surveillance at the access doors of the hall of cascades and of the supply and withdrawing stations.
- The total installed separative capacity is low and can be verified at least once a year.
- The time required for the non-declared production of a significant amount of high enrichment uranium is considerably longer than the time of response to the routine application of surface sampling at strategic points.

PERSPECTIVES FOR THE NEXT YEARS

The difficulty to control the misemployment of ultra-centrifugation enrichment plants together with the restrictions imposed on the access in order to protect technological developments clearly represent an opposition of interests regarding the application of safeguards control. The ponderation of one or the other varies as a function of the installed capacity, the risk of diversion of declared nuclear material and the possibility to detect any misemployment which implies the utilization or production of non-declared material.

The beginning of the construction of an enrichment plant with commercial capacity implies a substantial increase of the installed capacity and, consequently, an important reduction of the time required for the production of a significant amount of high enrichment uranium. In these conditions, some of the premises presently accepted will be considerably altered and it is urgent to find an answer to the questions formulated above.

Is obvious that the increase of capacity demands the optimization of the time of response of destructive measurements by means of surface sampling in order to keep an adequate level of dissuasion regarding the most important scenario, which is the capacity to produce obtain high enrichment. On the other hand, the increase in size together with the mentioned increase in capacity reduce the efficiency of some non-destructive measures and rise significantly the costs associated to the contention and surveillance systems.

ABACC appreciates the need to preserve technological secrets and has permanently shown disposition to explore new alternatives which shall conciliate the interests of all the parties involved. However, notwithstanding this disposition and considering the present situation, it is necessary to start a dialogue on the implementation of more standardized control methods, and await the compliance of the designs to the new reality.