PROGRESS IN THE IMPLEMENTATION OF THE ABACC-CRISTALLINI UF6 SAMPLING METHOD

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ABSTRACT

The ABACC-Cristallini UF_6 sampling method consists of retaining the UF_6 by adsorption in alumina (Al_2O_3) pellets and subsequent hydrolysis of the UF_6 into uranyl fluoride (UO_2F_2) collected in a P-10 tube. The method was conceptually developed by the Argentine chemist Osvaldo Cristallini at his time in ABACC, with the support of Argentine and Brazilian researchers and laboratories. This method is suitable for uranium isotopic determination for safeguards and other purposes and present significant advantages with respect to the conventional method. It allows handling non-reactive, non-volatile, solid UO2F2 sample instead of highly reactive and volatile UF6. The amount of material is minimum which simplifies the requirements for transport. The uranium isotope ratio measurements provided by the conventional and the new UF6 sampling methods were compared in the framework of an international intercomparison exercise. In 2019, the ABACC-Cristallini UF6 sampling method was published by the ASTM International, formerly known as the American Society for Testing and Materials, as ASTM C1880-19: "Standard Practice for Sampling Gaseous Uranium Hexafluoride Using Alumina Pellets". Since then, various cooperative efforts have been taking place to implement the method for safeguards and other purposes by ABACC, the IAEA and other interested parties. It should be noted that cooperation has been critical to demonstrate the technical feasibility of the ABACC-Cristallini UF_6 sampling method and it continues to be this way to progress towards its full and routine implementation for safeguards use by ABACC and the IAEA. Worth noting is the cooperation between ABACC, Argentina, Brazil and the IAEA towards the implementation of the method such as its presentation in international technical meetings related to destructive assays (DA), inter alia, exchanges in the margins of the IAEA DA intercomparison exercises, and its consideration in the discussions of the "International Target Values" (ITV) for 2020. In addition, ABACC is planning to coordinate an international intercomparison exercise with UF_6, including the ABACC-Cristallini sampling method. This paper describes the progress made since 2019 in implementing the ABACC-Cristallini Method for UF_6 sampling at nuclear facilities subject to ABACC and IAEA safeguards with focus in the enrichment facilities of Brazil and the relevance of international cooperation for the development and use of new methods for more efficient and effective safeguards.

1. INTRODUCTION

The Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials –ABACC- performs safeguard inspections and verification of nuclear materials and facilities jointly with the International Atomic Energy Agency –IAEA- at enrichment and conversion nuclear plants in Brazil and Argentina.

In particular, at the centrifuge process enrichment plants in Brazil, routine and unannounced inspections are performed and UF_6 samples are routinely taken from process lines and cylinders to verify the uranium enrichment conformity with design/operator declarations.

A type A package is normally used for UF_6 sampling. Sampling dwells up to one hour, with the tube immersed in liquid nitrogen, and up to 10 grams of UF_6 are collected. The samples taken in Brazil are sent by ABACC to a network laboratory in Argentina for mass spectrometry analysis. This transport requires to fulfill IATA regulations for UF_6 dangerous materials and relevant regulations for the safe transport of radioactive material. In addition to that, many airlines are refusing to transport that kind of material. At laboratory, UF_6 samples are hydrolyzed and a very small quantity (some milligrams) is used for the enrichment determination. The residual quantity of UF_6 retained at laboratory is very large compared to the needs for the enrichment measurement. It is also a costly sampling system, as the type A package is expensive, it has to be cleaned-up before reutilization, and additional costs are added to the transportation of cleaned tubes from Argentina to Brazil.

Due to the disadvantages of the current UF_6 sampling method, technical experts and scientists lead by Osvaldo Cristallini and linked to ABACC network of analytical laboratories have developed a method (named ABACC-Cristallini UF_6 Sampling Method) of sampling UF_6 for enrichment determination. The method was developed in the Physical and Chemical Control Laboratory of the National Atomic Energy Commission of Argentina (CNEA) and the preliminary analyzes were carried out in the Mass Spectrometry Laboratory of the same institution. Both laboratories are part of the ABACC laboratories network. This method uses a P-10 tube (made from PCTFE[1]) type containing approximately 1g of aluminum oxide pellets used to absorb and hydrolyze UF_6 directly during the sampling (Figure 1). The alumina pellets retain up to few hundreds milligrams of U (in a solid compound UO_2F_2) without the need of using liquid nitrogen during sampling procedure. With this new method, the UF_6 archive sample content left at the installation is lower and less reactive than the current method; the laboratory procedures for manipulating the sample are much easier and the residual uranium retained at the laboratory is much lower, and the sampling device is less expensive. As a result, the transportation costs are lower and the radiological aspects involved much simpler to handle. In addition, if a P-10 transparent tube material is used (i.e., PCTFE), an on-line feedback about the alumina UF_6 reaction process is provided [1].

2. COOPERATION FOR THE IMPLEMENTATION OF THE METHOD FOR ROUTINE SAFEGUARDS APPLICATION PURPOSES BY ABACC AND IAEA:

2.1 -Qualification of the "ABACC-Cristallini UF_6 Sampling Method" - ASTM approval.

[1] Polychlorotrifluoroethylene (PCTFE).

Since the conception of this method, ABACC has carried out cooperation activities with Argentina, Brazil, the IAEA, NBL-DoE[2], EU JRC Geel[3], and other key partners with a view to test, validate and implement the method for routine safeguards. Once the results of the international intercomparison exercise demonstrated the equivalence between the isotope ratios provided by both sampling methods, it was decided to present the new method to an international standards organization.

ASTM International, formerly known as American Society for Testing and Materials (West Conshohocken, Pennsylvania, USA) was chosen, because it gathers the most representative experts and professionals involved with the nuclear fuel cycle. ASTM experts don´t develop or evaluate new methods, but just approve standards based on the criteria of consensus. Thus, the unanimous approval of this new method meant that these experts recognized the applicability and advantages of the method, giving a clear signal regarding its reliability to the nuclear safeguards' community.

On June 16th 2016, the work "Assessment of the new UF_6 sampling method using alumina" was first presented at the ASTM C-26 Nuclear Fuel Cycle Workshop, held in Vienna, introducing the subject to the members of the Committee. Numerous pertinent questions were presented and satisfactorily responded.

On June 20th 2017, the results of the international interlaboratory comparison exercise organized under the aegis of ABACC and NBL cooperation were presented to the ASTM C 26 Subcommittee Meeting held in West Conshohocken, Pennsylvania, USA. Participants´ laboratories were from: Laboratorio de Espectrometría de Masas – Gerencia Química – Comisión Nacional de Energía Atómica (CNEA); Buenos Aires, Argentina; Laboratório de Caracterização de Urânio - Centro Tecnológico da Marinha em São Paulo (CTMSP), Brazil; Nuclear Analytical Chemistry and Isotopics Laboratory, Oak Ridge National Laboratory (ORNL), Oak Ridge, USA, Safeguards Analytical Services, Nuclear Material Laboratory (IAEA), Seibersdorf, Austria, Joint Research Centre, Directorate G – Karlsruhe (JRC-Karlsruhe); Germany, Joint Research Centre, Directorate G-Geel (JRC-Geel); Belgium, Laboratoire de Development Analytique Nucleaire, Isotopique et Elementaire (LANIE), France [2]. The validation program was coordinated jointly by ABACC and the NBL Program Office. Several observations were made, a fruitful discussion was set up and the relevant suggestions were promptly incorporated to the text. The committee decided that the standard has to be presented in Sub-committee C 26.02 "Fuel and Fertile Material Specification". The final version of the standard was presented on June 25th 2018 at the ASTM C 26 Subcommittee Meeting held in San Diego, California, USA, under the title "Practice for sampling gaseous uranium hexafluoride". The text was finally approved and published on June 1st 2019 as ASTM C1880-19 "Standard Practice for Sampling Gaseous Uranium Hexafluoride Using Alumina Pellets" [3].

Since the approval of the above-mentioned standard practice, several activities have been carried out with the ultimate goal to allow the implementation of the ABACC-Cristallini method in enrichment commercial facilities and other nuclear facilities worldwide. The results achieved so far as well as some highlights and advantages of this method are presented below.

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[2] New Brunswick National Laboratory.

[3] Joint Research Centre | European Commission.

2.2 Activities carried out since the approval of the ASTM C1880-19

2.2.1. Results and vision of Urenco Deutschland GmbH (UD) in the application of the procedures and the new method in commercial and industrial facilities.

Urenco Deutschland GmbH (UD) has been taken samples with the ABACC-Cristallini method since January 2020 to provide more information about the method from a commercial operating gas centrifuge enrichment facility. The initial discussions with UD to the field trial have been initiated by the IAEA within the German Member State Support Program to IAEA safeguards at the IAEA Symposium in 2018. Since then, several discussions were needed to arrange all relevant steps before starting with the first official sampling in the plant. The discussion has shown that proper initial preparation work at all parties is needed to give the field trial a good start. The preparation started with an on-the-spot visit at Gronau by the IAEA and representatives from the JRC-EU to present the operational environment/installations where the sampling will take place. UD has a specialized mobile sampling rig to take UF_6-samples from UF_6 cylinders in gaseous phase. The idea was to take an additional sample by the ABACC-Cristallini method in parallel to the samples for Safeguards purposes always witnessed by an IAEA or EURATOM inspector during the safeguards inspections in the plant. From the discussions in the plant, the whole "life cycle" of the P10-tube, from selecting the P10 tube to the storage of empty and full P10-tubes in the plant, up to later shipment to the laboratory of the IAEA has been written down in a document. In addition to that, UD prepared the internal documentation (operational checklists) based on the operator experience to safely take a sample by the ABACC-Cristallini method. The first configuration of the set-up, how to mount the sample bottles to the rig, was tested in the vacuum workshop without any UF_6 (see Figure1).

Figure 1- UF_6 sampling rig

Figure 2 – P10 tube with Al_2O_3 pellets after the reaction with UF_6

After the configuration of the set-up has been defined a vacuum and pressure equalization test (still without UF_6) has been conducted to guarantee that the set-up is leak tight and no Al_2O_3-pellets from the P10-tube are sucked up into the pipework during evacuation of the pipework.

The next step of the preparation was to mount the sampling rig to the mobile vacuum rig in the plant and to take the first UF_6-test-sample (low enriched uranium) based on the procedures established in the operational checklist. The test was successful with a prompt color change (see Figure 2) of the Al_2O_3 pellets.

The sample of the Al_2O_3 pellets has been analyzed and compared with the sample taken in the standard UF_6-steel bottle. A deviation of less than 0.001 weight percent in uranium 235 between the two samples has been measured which is satisfactory for operational purposes. The amount of adsorbed material is in the average of about 0.3 g.

In addition to the operational interests, the nuclear regulator for UD has been informed as well about the field trial in advance and the need to evaluate and test new methods for international Safeguards in an operating nuclear facility.

After the successful testing of the method in the plant in Gronau, the field trial is still ongoing so that additional samples can be collected to enable investigation of the effects of using the ABACC-Cristallini method versus the traditional method. At the moment only UF_6-cylinders with low-enriched uranium are sampled. Since also natural and depleted UF_6-cylinders are sampled in gas centrifuge enrichment plants during safeguards inspection, these material categories should be considered in future as well (outlook). Further, it is planned to win Urenco Netherlands to attend at the field trial as well to get more data and information from a commercial gas centrifuge enrichment plant.

From the operational view point, the ABACC-Cristallini method is a good alternative compared to the current method with steel bottles, and the Safeguards Manager at UD can imagine to have this method as the future standard method to take Destructive Analysis samples from UF_6-cylinders during the Safeguards inspections as far as all aspects has been evaluated in advance.

2.2.2 Activities carried out and in research, development and commercial/industrial facilities in Brazil.

The validation of ABACC-Cristallini method with the goal of adopting it in uranium enrichment facilities in Brazil, was performed in three stages:

In the first stage, an intercomparison of isotopic analyzes of samples obtained by the traditional method and by the ABACC-Cristallini method was carried out. The results indicated consistency for application of the method for ABACC/IAEA safeguards purposes, and as mentioned in item 2.1, an ASTM standard was developed and published.

In the second stage, COSAP/CNEN[4], through the IAEA Safeguards Support Program, coordinated a set of sampling tests of the ABACC-Cristallini method which was carried out at the CTMSP´s enrichment laboratory (Laboratório de Enriquecimento Isotópico -LEI, located at the Centro Industrial de ARAMAR - CINA). For these sampling, a special designed metal ampoule developed by the IAEA was used. This special ampoule allowed simultaneous sampling by traditional and the ABACC-Cristallini methods. The experience of CTMSP technicians allowed to carry out this phase of the project successfully. In this facility, the most important method parameters (for instance, mass of aluminum oxide, P-10 pumping time, initial P-10 tube pressure, UF_6 sampling time, P-10 pressurizing time) were identified in an enrichment cascade to assure the practice permitted collecting

[4] Safeguards and Physical Protection Coordination of the Brazilian National Commission of Nuclear Energy.

the mass of uranium needed to execute the isotopic determinations. Also, the isotopic results of UF_6 samples collected using the traditional and new method provided comparable values.

In the third and last stage, the validation and demonstration tests, whose goal were to prove that the method could be executed in commercial/industrial facilities, were performed at industrial enrichment plant (Indústrias Nucleares do Brasil-INB-Resende). This stage was carried out between 2019 and 2021 and it was composed of three steps:

- In the first step, due to the lack of an international standard for the use of PCTFE ampoules in industrial units, just metallic P-10 tubes were allowed in the enrichment cascades. The reaction between alumina oxide pellets and UF6 could not obviously be seen. Because of this, the sampling times adopted were in the range of 20-30 minutes;
- In the second step, P-10 tubes manufactured from PCTFE were allowed in order to define the sampling time. In this way, the operator could visually follow the reaction within the P-10 tube and a sampling time of just few minutes was enough to collect about 300 mg of uranium. After these tests, a sampling time of 5 minutes was defined for this facility; and
- In the third and final step, the demonstration tests were followed by IAEA inspectors, CNEN and ABACC officials. The intent was to show that the UF6 sampling according to the new method is simple, safe and reliable. Again, just metallic P-10 tubes were allowed, which was not a problem, because it was already known that a sampling time of just 5 minutes is enough for that facility. Samples from the feed, enriched and depleted UF6 streams, containing about 300 mg of uranium were collected and delivered to IAEA, ABACC and CTMSP laboratories for further isotopic determinations. In order to maintain the comparison between both methods, the traditional method sampling was also performed for IAEA and CTMSP. The IAEA and ABACC will shared the results of the latter.

  It is important to mention that to allow the demonstration tests, adaptations in the Operator's procedures were also necessary in order to keep compliance with the national regulatory requirements.

After more than two years of sampling tests, the validity of the method was demonstrated in an industrial plant and presented for the agencies. The material collected during the demonstration was made available for the agencies to analyze the samples in their own laboratories.

The validation and the demonstration tests executed in the Brazilian facilities were of utmost importance to prove the applicability of the new method in real safeguards because samples were collected from enrichment cascades. Until now, all the tests had been executed sampling UF_6 from storage ampoules or cylinders.

The ABACC-Cristallini method presented the following advantages over the traditional method: reduction of the sampling time from 30’ to 5‘; reduction of the amount of material collected from 10 g to 1 mg; does not require the use of liquid nitrogen; and easier removal of alumina pellets containing UF_6 from the installation. It is faster, cheaper and safer method. It reduces the safeguards effort during interim and unannounced inspections.

2.2.3 Activities coordinated by the IAEA

Since 2017, a support program task was created to request support from Member States with enrichment capabilities for field testing of the ABACC-Cristallini method at the industrial scale.

Following support program regular meetings, and exchanges with State Authorities including on-site visits, the task was finally accepted by different countries and test campaigns were launched in 2019. Direct contacts with Operators and having the new ASTM standard sampling practice available was key to facilitate discussions, review test procedures and agree on a workplan.

Routine sampling equipment was used by the Operators adapting to facility-specific constraints (using IAEA or facility P-10 PCTFE tube type, preparing alumina pellets at the IAEA Nuclear Material Laboratory (NML) or at a facility, using specifically designed or existing sampling working papers to record test parameters and results). The sampling scheme was designed to avoid potential biases or other issues related to heterogeneity of the bulk material (cylinder was systematically homogenized before sampling) or related to possible preferential route when using liquid nitrogen to trap uranium with the traditional (classical) sampling method (sampling was systematically done sequentially, starting sampling with ABACC-Cristallini method and then with classical method).

The first campaign was completed within 16 months (October 2019 – January 2021). A second campaign started in January 2021 in a different enrichment plant, where recorded data indicates that temperature and pressure variations observed before and after sampling are consistent with the previous laboratory testing of the ABACC-Cristallini method. During both campaigns, UF_6 samples have been collected in pairs, during IAEA inspections so that performance of new method could be compared with the classical method. As of June 2021, a total of 29 sample pairs have been collected from UF_6 cylinders with different enrichment levels (natural, LEU, depleted) and analyzed at NML. The resulting data was used to evaluate the performance of the ABACC-Cristallini method as compared to the classical UF_6 sampling method.

NML has gained useful experience in processing ABACC-Cristallini samples: original uranium recovery procedure described in the new ASTM standard has been improved to (1) time needed for treatment was reduced, (2) risk of sample contamination was reduced and (3) optimal conditions were defined to limit measurement variation between pellets.

The first two goals of the task (i.e., to demonstrate practicalities and robustness of the ABACC-Cristallini method) were successfully achieved through checking that:

- there was no safety or operational issues during ABACC-Cristallini sample collection,
- sampling time observed was compatible with facility constraints, in some cases shorter than the current sampling method (between 15 min to less than 5 min),
- there was always enough uranium trapped in pellets (about 0.3 g U or more)
- calculated U/Al2O3 ratio indicates good U mass control (ration below 0.62 achieved in most cases),
- there were no shipment delays associated with UN 2910 Excepted Package,
- there was no major bias due to contamination from impurities present in sampling lines (and in particular no significant impact of volatile fluorides).

The average relative difference on the U-235 isotope abundance measured between samples collected using the ABACC-Cristallini method and the classical method is larger than that observed during the inter-laboratory comparison organized by ABACC in 2017: for LEU materials, the U-235 isotope weight percent abundance results in ABACC-Cristallini samples are typically higher than for the classical samples (see Table 1), but the estimated prospective overall relative uncertainty for ABACC-

Cristallini method (calculated with 16 LEU samples) is less than the respective current International Target Value for $LEUF_6$ (0.038%< 0.1 %).

Table 1. Relative difference between ABACC-Cristallini and classical sampling method

$$RD=\left|\frac{(\%wt\ U-235\ Cristallini - \%wt\ U-235\ Classical)}{\%wt\ U-235\ Classical}\right|$$

Enrichment (wt% U-235)	Laboratory scale (Average RD x 100)	Industrial scale (Average RD x 100)
< 0.3%	0.019	0.060
0.3% < U-235 < 1%	0.001	0.055
1% < U-235 < 5%	0.014	0.031

The Consultants Group Meeting on International Target Values 2020 for Measurement Uncertainties in Safeguarding Nuclear Materials was carried out in June 2021. In this meeting the uncertainty values of ABACC-Cristallini were presented and discussed, a general consensus was reached regarding the importance of additional paired data collection. Argentina and Brazil through its respective MSSP, participated in the discussion sharing their respective experiences in the use of ABACC-Cristallini method.

3. ACTIONS AT THE LEVEL OF THE NATIONAL AUTHORITY, OPERATORS AND LABORATORIES RELATED TO THE GRANTING OF LICENSES AND THE ANALYZES TO IMPLEMENT THE METHOD IN NUCLEAR FACILITIES WHERE UF_6 SAMPLES ARE TAKEN

3.1 Argentine National Atomic Energy Commission (CNEA) and the Nuclear Regulatory Authority (ARN) of Argentina

In Argentina, facilities and laboratories dedicated to R&D in uranium enrichment technologies, such as Gaseous diffusion and Laser Assisted Isotope separation, use the ABACC-Cristallini sampling method in its research and development activities. From the operator experience, the method allows them to perform UF_6 sampling in a faster and safer manner in comparison with the traditional method. In addition, the waste management of the sampling process has a positive impact in the reduction of the amount of waste to treat.

Some initial tests were carried out in one facility to evaluate the sampling taking procedure and the method itself. Several samples were collected by the traditional method and the ABACC-Cristallini method, from UF_6 cylinders with different enrichment levels and then uranium isotopic content measured by Mass Spectrometry techniques was compared. The results of this evaluation do not observe significant difference amongst their values. In the other facility, the samples were directly collected by the ABACC-Cristallini method and subsequently analyzed by thermal ionization mass spectrometry. Argentine regulatory scheme is based on a performance approach which makes operator to submit a safety evaluation to the ARN, the regulator, before the authorization or license issuing. In that context, the materials, components and procedures used in the ABACC-Cristallini method are well known and documented in the nuclear industry practice. This knowledge facilitates the safety evaluation an approval of the method for regular use.

3.2 The Brazilian National Nuclear Energy Commission – CNEN

The only difficulty initially faced by the national authority to implement the ABACC-Cristallini UF_6 method was the lack of an international standard to allow the use of sampling ampoules in PCTFE in UF_6 process lines. However, the problem was easily solved and well accepted by the safety national authority, by using the stainless-steel ampoules, which is the same material of CROFT sampling ampoules used in the traditional method.

4- FINAL CONSIDERATIONS AND NEXT STEPS FOR THE APPLICATION OF THE ABACC-CRISTALLINI UF_6 METHOD AT ABACC AND IAEA INSPECTIONS

4.1. IAEA Perspective

The last goal to achieve in order to complete the task is to assess the impact of the uncertainties associated with the ABACC-Cristallini method on the detection of potential diversion of nuclear material. More field-testing data (sample pairs) is needed to accelerate the validation of the ABACC-Cristallini method for Safeguards verification activities, and the IAEA is seeking support from other Member-States to conduct field testing campaigns at other enrichment plants. A demonstration test has been recently successfully held in Brazil (sampling to cascade process lines) and the IAEA is looking forward to receive and analyze the corresponding additional sample pairs that should contribute to confirm the good performance observed so far with the ABACC-Cristallini method. Future implementation of the ABACC-Cristallini method by the IAEA Department of Safeguards would strengthen its capabilities to collect UF_6 samples at UF_6-handling facilities under international safeguards.

4.2. ABACC Perspective and Remarks

The "ABACC-Cristallini" UF_6 Sampling Method constitutes a substantial contribution to effective and efficient safeguards in relevant nuclear facilities.

Since the conception of the method by Osvaldo Cristallini, ABACC has been carrying on various activities and coordinating efforts to test and validate the "ABACC-Cristallini UF6 Sampling Method" for routine SCCC/Safeguards use in Argentine and Brazilian facilities. The IAEA has joined ABACC´s endeavor soon in the process of testing the method.[5]

Several tests have been carried out successfully, demonstrating that the method is adequate for safeguards verification and other uses. Since the mid-2000s onward, ABACC has been engaged in validating the method under the framework of the technical cooperation with Argentina, Brazil, the IAEA, DoE and other key partners A validation exercise was carried out with the participation of laboratories of excellence. This work led to the issuing of the ASTM Standard ASTM C1880-19: "Standard Practice for Sampling Gaseous Uranium Hexafluoride Using Alumina Pellets".

From ABACC standpoint, the "ABACC-Cristallini" UF6 sampling method has demonstrated the effectiveness and the adequacy for routine sampling of both UF6 cylinders and process production lines at enrichment facilities with the P10 PCTFE ampoules because of the advantages already noted. However, ABACC is also aware of certain requirements that national /international institutions may have in place. Thus, ABACC is prepared to continue working hand in hand with the IAEA, the

[5] A first paper about the "ABACC-Cristallini" UF6 Sampling Method was presented at the INMM in 2007.

National Authorities of Argentina and Brazil, ARN and CNEN, as well as with Operators of relevant nuclear facilities towards the implementation of the method taking into account any boundary conditions that may be posed by licensing safety authorities and the IAEA requirements to approve the method for routine safeguards use.

It is also worth highlighting the cooperation of Argentina and Brazil, under their participation in the IAEA MSSP, the excellent level of technical cooperation between the IAEA and ABACC, as well as the recent successful results obtained by Urenco and Brazil in testing the method. A demonstration of the results of the tests at INB-enrichment facility were carried out in June 2021 to both agencies to share these good results and the experience obtained. As part of this technical activity, samples were taken by the IAEA and ABACC. Once the results are obtained, the next steps should be defined.

The validity and advantages of the "ABACC-Cristallini" UF_6 Sampling Method have been briefly highlighted. Among them, it is worth noting that this method will enormously simplify the sample taking and their transportation worldwide. The transportation of UF_6 samples is increasingly difficult, thus the implementation of this method will improve the efficiency while maintaining the effectiveness of this important safeguards' verification measure.

Finally, as it is known, ABACC and the IAEA have to cooperate in the implementation of the safeguards of the Bilateral and the Quadripartite Agreements and to coordinate their verification activities to the extent possible to reach independent safeguards conclusions. Within this context, ABACC will continue accompanying and contributing to the process that the IAEA deems necessary to carry out to approve the use of the method for safeguards purposes. [4, 5].

ACKNOWLEDGMENTS

Special appreciation is expressed to the following people for their respective contribution of the institutions to this paper: Mauricio Fernández, Erica Zubillaga and Marta Bavio (CNEA); Claude Norman, Maxim Penkin, Urska Repinc, Marc Humphrey, Gwang Sub Kim, M. Teresa Alvarez-Dieguez (IAEA).

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