

## **MODERNIZATION OF ABACC ACCOUNTING DATABASES**

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### **ABSTRACT**

To comply with the provisions of the Agreement between Argentina and Brazil for the Exclusive Peaceful Uses of Nuclear Energy (The Bilateral Agreement) ABACC developed in early 90s a Nuclear Material Accounting Data Bases and associated programs. Since then, ABACC has maintained them. However, due to changes in the technology and support for the system originally developed, it has become essential to migrate the Databases and develop new software to modern platforms that can work with the operating systems and hardware currently in use. Therefore in 2017 ABACC launched an ambitious project to develop a new Accounting Data Bases and associated programs. The project was successfully concluded in December 2020 and it is currently being used to process and evaluate the accounting reports submitted by Brazil and Argentina, submit these reports to the IAEA, generate the accounting data to be audited during joint IAEA-ABACC inspections, perform database queries and follow up of accounting pending issues.

This paper describes the different stages of the project. The main features of the new Accounting Data Bases are presented. In addition, the functions of the associated programs are summarized.

### **1. INTRODUCTION**

In July 1991, Argentina and Brazil signed an Agreement for the exclusively peaceful use of the nuclear energy [1], which established a Common System of Accounting and Control of Nuclear Materials (SCCC) to be applied by the two States. The same Agreement created ABACC to administer and implement this Common System.

In March 1994 a Safeguards Agreement between Argentina, Brazil, IAEA and ABACC [2] entered into force. According to this Agreement, in implementing safeguards the IAEA and ABACC shall, to the extent possible, work jointly and coordinate their work to avoid unnecessary duplication of safeguards activities.

Since the beginning of ABACC operations in July 1992, the accounting unit is responsible for establishing, implementing and maintaining the ABACC Nuclear Materials Accounting System.

The main functions of ABACC's Accounting Area are:

- to receive the accounting reports from the National Authorities (NA) and then process, evaluate and send them to the IAEA;
- to implement the procedures for auditing of records;
- to evaluate the results of the inspection activities referred to the auditing of records and its comparison with reports;
- to follow-up on discrepancies that results from reports evaluations and from inspection auditing activities; and
- to develop and maintain the software associated with the activities listed above.

## **2. AUTOMATED ACCOUNTING SYSTEM**

From the beginning of its operations, ABACC started the development and immediate implementation of its automated accounting system since accounting reports were received from the States almost simultaneously with the implementation of ABACC itself.

Taking into account the number of nuclear facilities in both countries and the characteristics of ABACC structure, the development of the system was absolutely necessary to fulfill the objectives of the accounting area. The system had to comply with the following requirements:

- be structured in accordance with the reporting system established in Annex I of the SCCC's General Procedures, that is compatible with Code 10 of the Quadripartite Agreement's Subsidiary Arrangements;
- be sufficiently flexible to allow the processing of data in other different formats;
- be able to provide in an effective and fast manner the information requested by other units of ABACC; and
- be able to match shipments to and receipts from the Material Balances Areas (MBAs).

Based on these premises, the first version of ABACC's nuclear material accounting software was completed in September 1992 using DBase III Plus. In 1995, the migration to a windows platform started and was completed in the second semester of 1996 [3], which was in operation for the last 23 years.

In 2017 due to changes in the technology, architecture and support for the system originally developed, ABACC launched an ambitious project to modernize the entire ABACC Nuclear Materials Accounting System, in addition to incorporating some improvements and flexibilities related to the operation and security of the System.

ABACC's accounting activities are based on two very particular systems. The first one is the General Accounting System of Nuclear Material. This database is managed by a software that processes and evaluates the Accounting Reports received from the countries. Once processed and evaluated, they are sent to the IAEA in a secure manner and encrypted files.

The System allows the updating of inventories, the evaluation of these inventories by Country or by MBA individually, in addition to carrying out a set of checks, controls, inquiries and the monitoring of accounting pending issues. The other very important function of the system is the ability to generate the content of the accounting activities that inspectors of ABACC and the IAEA will be carried out in the next inspection [4].

The second system is the New Software for Join Auditing of Records (NSJAR) [5], which is used jointly by ABACC and IAEA during accounting audits in nuclear facilities under safeguard in Brazil and Argentina. The data used by the NSJAR, as mentioned above, are generated and exported by the General Accounting System of Nuclear Material. Once the accounting verifications have been carried out, the results are imported into the General Accounting System of Nuclear Material for its analysis and consistency, thus maintaining the accounting inventories verified by ABACC and allowing the generation and updating of the inspection accounting pending issues.

### **3. STAGES OF THE PROJECT**

The main stages that were taken since 2017 for the development of the new Accounting System are described below:

#### *Evaluation of the architecture of the previous software*

Thinking about modernizing a system entails several challenges, one of them was the compatibility of the databases since there are records in it since the beginning of ABACC's activities. For this reason, a detailed study of programming and databases had to be initiated. This process was very time demanding.

#### *Data migration (DBF/SQL)*

This was a critical stage from control standpoint since we had to ensure that 100% of the data can be reliably reproduced in the new database, it was also necessary to add fields and tables in the new structure, as well as to delete those that were no longer being used. It was necessary to carry out several tests with the migrated data to ensure its validity.

#### *Creation of the system access module*

Various possibilities for access to the system were evaluated. Finally, it was decided on the access in two levels. Users must be part of the ABACC domain and be enabled with a username and password for which the administrator will create sets of privileges allowing / forbidding access to different menu and submenu of the system.

#### *Definition of the menus and screens*

The system menus were defined based on the needs of the accounting sector to carry out the load and export of data, the evaluation of these data, and access to the queries that would be

made by the other sectors. A practical and intuitive order was chosen to access the different menus, which forced the creation of new screens, options and configurations.

Module programming

This stage was the most laborious of the project since in parallel to the programming of the different modules, the programming of some modules could only be started when other related modules were finished and tested. A very large number of functional tests were carried out to ensure correct system operation.

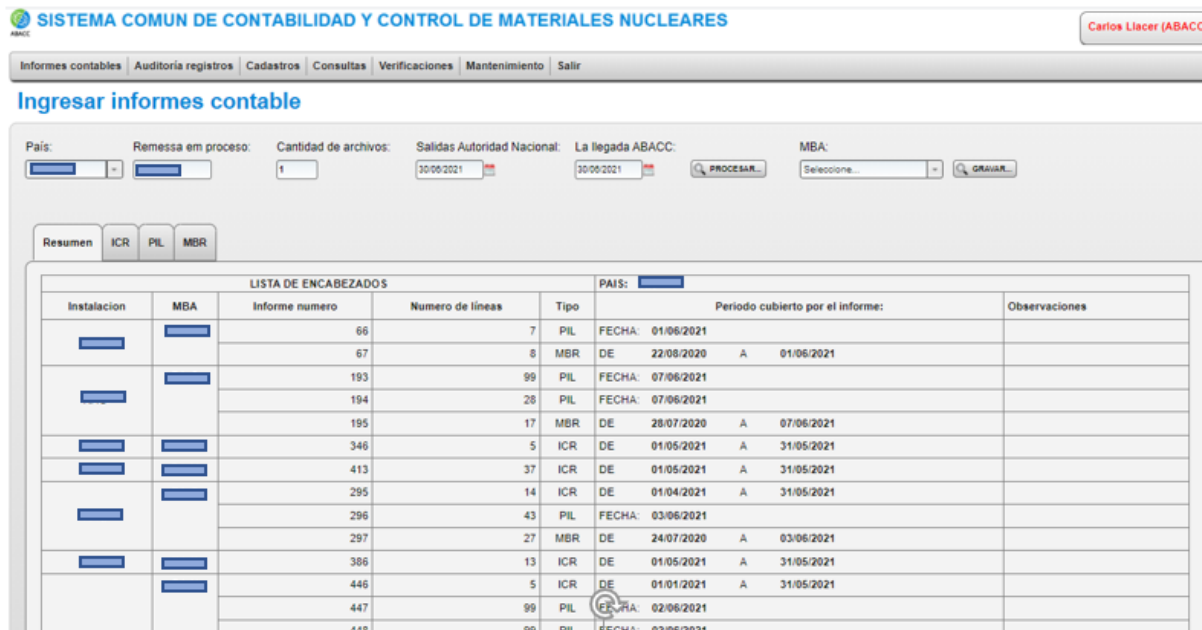
The system was created on the Microsoft Visual Studio 2017 platform, the programming language used was Visual Basic and the database manager, is SQL Server 2017.

**4. PROGRAM MENUS**

This point describes the main functions of each module of the system.

Accounting Reports Menu

From this Menu it is possible to load an Accounting Report, Cancel it (only possible if this Report has not been sent to the IAEA yet) and send it to the IAEA. Figure 1 to 3.



**Figure 1. Example of loading of Accounting Reports.**  
(Country data, MBA, etc. are not shown for confidentiality reasons)

**Proceedings of the INMM & ESARDA Joint Virtual Annual Meeting  
August 23-26 & August 30 – September 1, 2021**

Remessa em processo: RA0733

IMPRESION SE CIERRA

Pais	Instalação	MBA	Informe Numero	Tipo informe	Erro
			104	PIL	CRITICO

Erro cabeçalho

Erro corpo

Entrada número	Descripción
25	El código del isótopo no corresponde a la categoría N
26	El código del isótopo no corresponde a la categoría N
27	El código del isótopo no corresponde a la categoría P
28	El código del isótopo no corresponde a la categoría P

**Figure 2. Critical errors detected before data entry to the database**

VERIFICACION DE PENDENCIAS DE AUDITORIA

IMPRESION SE CIERRA

MBA	Informe numero	Entrada número	Observaciones
		*****	***** Existen RD/SD no verificadas - REVISE -
		*****	***** Existen RF/SF no verificadas - REVISE -
		*****	***** Existen EQ/DQ/EU no verificadas - REVISE -
			Correccion VRB[0210.03] no efectuada!
	216	1	ICR hasta 31/05/2021 - VRC hasta 30/04/2021
	216		No Hay Pendencias de Actualizacion (VRC)
	216	1	No existen entradas de ICR no identificadas

**Figure 3. Discrepancies detected after data entry to the database**

Records Audit Menu

From this Menu it is possible to load a new Mission of accounting inspection, Import/Export of Mission data to/from NSJAR, perform evaluation when importing mission data and verify the accounting pending issues by Country/MBA. Figure 4 to 7.

SISTEMA COMUN DE CONTABILIDAD Y CONTROL DE MATERIALES NUCLEARES

Carlos Llacer (ABACC)

Informes contables | Auditoría registros | Censos | Consultas | Verificaciones | Mantenimiento | Salir

**Histórico misiones**

Filtrar:

Data inicial: 30/12/2020 Data final: 30/07/2021

+ INCLUIR SERIE

Serie	MBA	Tipo inspección	Inspección anterior	Inspección actual	Fecha inicio de auditoria	Fecha fin auditoria	Fecha PIT	Fecha inspección	RRF		Coment. general	Erro libro x ICR		
		PIV	12	13	05/06/2017	08/06/2021		08/06/2021	08/06/2021	+				
		PIV	30	31	27/07/2020	14/06/2021		14/06/2021	14/06/2021	+				
		INT	112	113	28/02/2021	31/05/2021		07/06/2021	30/04/2021	+				
		PIV	29	30	23/07/2020	10/06/2021		10/06/2021	10/06/2021	+				
		PIV	40	41	22/07/2020	09/06/2021		09/06/2021	09/06/2021	+				
		PIV	7	8	06/06/2017	18/06/2021		18/06/2021	18/06/2021	+				
		PIV	10	11	09/06/2017	18/06/2021		18/06/2021	18/06/2021	+				
		PIV	29	30	03/08/2020	15/06/2021		15/06/2021	15/06/2021	+				
		PIV	33	34	17/07/2020	16/06/2021		16/06/2021	16/06/2021	+				
		PIV	28	29	31/07/2020	17/06/2021		17/06/2021	17/06/2021	+		SIM		

**Figure 4. New mission ready to export to NSJAR**

PENDENCIAS CONTABLES RESULTANTES DE LA MISION

34

MBA	INSP. N°	OBSERVACIONES
	29	PE(E): Valor Isotopo Verificado
	29	BA(N): Valor Elemento Verificado
	29	PE(N): Valor Elemento verificado
	29	BA(D): Valor Elemento Verificado
	29	PE(D): Valor Elemento verificado
	29	No existen más Pendencias de MBR (VR-A)
	0	No Hay Pendencias de Corrección (VR-B)
	0	No Hay Pendencias de Actualizacion (VR-C)
	125	No Hay Pendencias de MBR (VR-A)
	125	FECHA:ICR(12/12/19)<->Ins(13/12/19)-Cor.ICR[367,4]
	125	FECHA:ICR(12/12/19)<->Ins(13/12/19)-Cor.ICR[367,5]

Figure 5. Analysis of discrepancies after import of NSJAR

**SISTEMA COMUN DE CONTABILIDAD Y CONTROL DE MATERIALES NUCLEARES**

Informes contables | Auditoría registros | Censos | Consultas | Verificaciones | Mantenimiento | Salir

**Pendientes contables**

Resumen por país | Detalle por MBA | Retirar

País: Argentina

RESUMEN DE PENDENCIAS CONTABLES				
País: Argentina		ACTUALIZADO AL: 30/06/2021		
MBA	FECHA INSPECCION	VR-A	VR-B	VR-C
	30/04/2021	NO	NO	SI
	28/02/2021	NO	NO	SI
	30/04/2021	NO	SI	NO
	31/07/2020	NO	SI	SI
	31/07/2020	SI	NO	SI

Figure 6. Analysis of discrepancies by Country

**SISTEMA COMUN DE CONTABILIDAD Y CONTROL DE MATERIALES NUCLEARES**

Informes contables | Auditoría registros | Censos | Consultas | Verificaciones | Mantenimiento | Salir

**Pendientes contables**

Resumen por país | Detalle por MBA | Retirar

País:  MBA:

LISTADO DE PENDENCIAS CONTABLES	
MBA: <input type="text"/>	ACTUALIZADO AL: 30/06/2021
INSPECCION N°	OBSERVACIONES
0	No Hay Pendencias de MBR (VR-A)
0	No Hay Pendencias de Corrección (VR-B)
0	ICR hasta 31/05/2021 - VRC hasta 28/02/2021
128	VR-C[128,4] No fue verificada
128	Nro ITEMS:ICR>[383,13](0) <-> Ins(-1)>VR-C[128,15]

Figure 7. Analysis of discrepancies by MBA

### Register Menu

In this Menu it is possible to configure MBA´s and Users

The Submenu MBA allows grant / withdraw and configure the different options for each MBA, e.g., bulk facilities, items, types of nuclear material, units, measured discard limits, sigma MUF for MBA, etc.

The Submenu allows to register internal or external Users and configure the types of access on each Menu/Submenu.

### Inquiries Menu

Various types of inquiries can be made from this Menu, some of them are mentioned below: Accounting Reports; accounting form of pre and pos inspection; timeliness of delivery of accounting reports to ABACC / IAEA; Inventory Changes between different dates; Accounting Inventories at a given date; flows of nuclear material for a given period and MBA; number of audits performed and reports received per period; exempt material; perform and check nuclear material balances for a selected period; date of the last PIT and limit alarms of the next PIT. All queries have the option of printing or exporting to different file types. Figure 8.

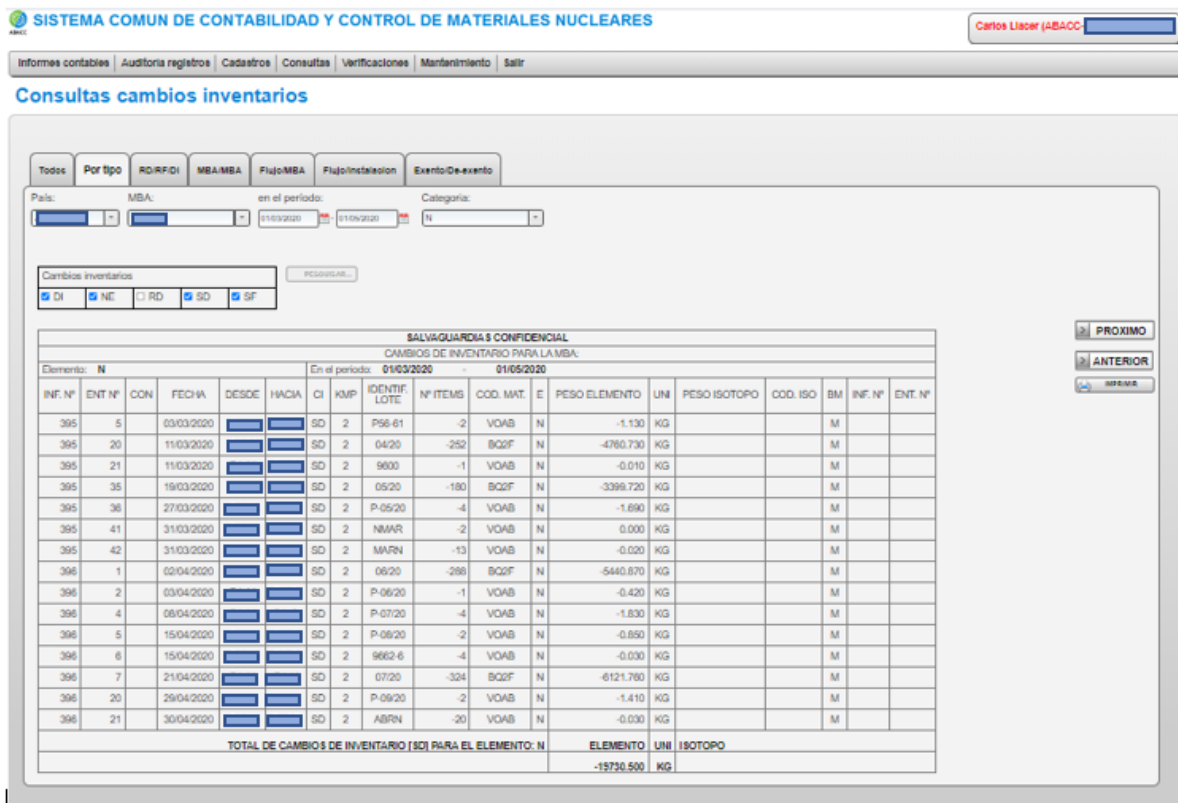


Figure 8. Query on types of inventory changes for a given period.

### Verifications Menu

All transfers that for some reason cannot be matched are listed in the transfer verification submenu. After the Accounting Officer performs the analysis, it is possible from this submenu to perform the matching manually.

On a semi-annual basis, the IAEA sends the accounting inventories of the Argentine and Brazilian facilities for checking with the inventories registered in the ABACC databases. The Semi-Annual Declarations submenu allows you to upload IAEA inventories electronically and verify any differences.

### Maintenance Menu

Once a day a backup is performed automatically. Additionally, backups are performed automatically by the system every time the database is modified.

From this menu it is possible to create a database backup when the administrator deems it necessary.

From this menu it is also possible to restore the databases from:

- Last Backup or;
- Before including an accounting report;
- Before sending an accounting report to IAEA;
- Before importing an inspection;
- Before creating a mission.

## **5. CONCLUSIONS**

The system was created on a modern, multi-user platform that allows to be operated simultaneously by the accounting sector and consulted by the other authorized ABACC's units.

The system is installed on the ABACC Server with Firewall protection implemented in accordance with ABACC security policy, the access to the system is carried out using a two-level cryptographic key, which allows it to be operated via VPN, which was very useful during the actual pandemic period.

Backups are performed automatically, allowing you to perform them manually, if necessary, then having a more reliable system.

Some improvements such as the access controls to the system and the configuration of access to the menus for each user allow us to have a more solid and secure system.

The MBA's can be configured allowing to create checks, alarms, and make exchanges for each MBA without the need to modify the programming,

We can conclude that the system developed has shown to be highly satisfactory and reliable to fulfill ABACC's objectives.



## **6. 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/- ABACC's System for Accounting and Control of Nuclear Materials, Ruben Nicolás, Esarda 2001.

/4/- IAEA/ABACC Procedures for the Joint Auditing of Accounting Records, Neville Whiting, Kim Warthan, Toshio Okubo (IAEA) - Ruben Nicolas, Lilia Palhares (ABACC) - Esarda 2005.

/5/- The New Software for Joint Auditing of Records ABACC-IAEA, Leonardo Dunley-Carlos Llacer, INMM & ESARDA Annual Meeting 2021.

## **ACKNOWLEDGMENTS**

ABACC wishes to thank to Mr. Ruben O. Nicolás and Mr. Luis A. Giordano from Nuclear Regulatory Authority of Argentina, for the valuable support during the previous period to the development of new system, where the analysis of the previous software was studied in detail.