The State System of Accounting and Control of Nuclear Material in Argentina and the Y2K Issue

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ABSTRACT

The nuclear regulatory activities in Argentina are carried out by the “Nuclear Regulatory Authority” (ARN). To fulfil its responsibilities, the ARN has established, developed and enforced a regulatory framework for all nuclear activities in connection with nuclear safety and radiological protection, physical protection and the guarantees of non-proliferation.

The SSAC includes an independent verification system based on national safeguards inspections and a centralised accounting database of all nuclear materials in all nuclear activities performed in Argentina.

The ARN has implemented two computerised databases to optimise the programming of the inspections and their evaluation and to improve the issuing and submission of the accounting reports: the System of Control of Nuclear Material (SCMN) and the System of Safeguards Inspections (SIS).

In addition, to further improves the SSAC, the ARN considered important that each nuclear installation maintains a computerised accounting database (SOP) which would increase the quality of the operator’s accounting and control system. The SCMN, SIS and SOP are linked in order to achieve the maximum benefit in terms of effectiveness and efficiency.

The change of the millennium may have an impact not only in the dates of the safeguards documentation (i.e., general ledgers, source data, support documents, etc.) but also in some data generated by software or equipment in use at the installations that also feed facility level safeguards operating and accounting records. For instance, some software currently used for fuel elements management at the Nuclear Power Stations and the computerised control of stock of nuclear material at bulk installations need to be reviewed to assure that the change of the year 2000 will not cause any problem.

Additionally, some of the data generated by computerised systems at the level of the installation are inputs for the three integrated databases SCMN, SIS and SOP. Therefore, the ARN is in the process of reviewing all the relevant systems at the facility level.

The objectives and functions of this integrated system and some issues of the accounting databases system related to the 2KY are described in the present paper.

1 - The Nuclear Regulatory Authority role and the 2ky issue.

The “Nuclear Regulatory Authority” (ARN) performs all the nuclear regulatory activities in Argentina. To fulfil its responsibilities, the ARN has established a regulatory framework for all nuclear activities in connection with:

- nuclear safety and radiological protection,
- physical protection and
- the guarantees of non-proliferation.
The goals set by this regulatory system are as follows:

− to provide people with an adequate level of protection against the damaging effects of ionising radiation,

− to ensure a reasonable level of radiological and nuclear safety in all nuclear activities performed in Argentina,

− to ensure that nuclear activities and materials are not diverted for unauthorised purposes and that nuclear activities are performed in compliance with all the international commitments assumed by Argentina, and,

− to establish criteria and standards to prevent commission of intentional events that may lead to severe radiological consequences or the unauthorised removal of nuclear or other materials and equipment of nuclear interest (physical protection).

In the field of the guarantees of non-proliferation, the ARN should ensure that nuclear materials and activities are not deviated to any unauthorised purpose and that they are performed in compliance with all international commitments assumed by Argentina. In this regard, the National Standard AR.10.14.1. outlines the general requirements of the State System of Accounting and Control of Nuclear Materials (SSAC) to ensure the above mentioned objectives.

The “Agreement between the Argentine Republic and the Federative Republic of Brazil for the Exclusively Peaceful Use of Nuclear Energy” (Bilateral Agreement) is in force since December 1991.

The full scope safeguards agreement (INFCIRC/435) “Agreement between the Argentine Republic, the Federative Republic of Brazil, ABACC and the IAEA” (Quadripartite Agreement) was also signed in 1991 and entered into force on March 4, 1994.

Among its responsibilities the ARN must establish the terms and conditions and subsequently emit the operation licenses for each nuclear facility in Argentina.

In the framework of the organisations depending of the state, the management of the potential 2ky threat is centralised in Argentina by the Public Function Secretary who has required specific actions to the public organisms, among them to the ARN.

As a regulator organisation the ARN must ensure that all nuclear operators has an adequate strategy and action plan to deal with the 2ky issues in the areas of the nuclear safety, physical protection and safeguard. Taking into account the short time to reach the next millennium, the ARN has focused its efforts in the most critical areas in which the impact of the 2ky can directly affects the basics operations.

So ARN has establish a special team to regard that diagnostic and remediation action being planned and taken in the two NPPs stations: Atucha I and Embalse, particularly with respect to the SSSC. Between its generals missions and functions this team would:

- analyse and define the sources of potential issues (software, hardware, embedded systems etc.).

- make the requirements to the operators for checking the systems.

- make the control and auditing of the checking.

- analyse the results in order to ensure that the terms of the facility license will be compliance in the 2ky transition.

On the other hand the ARN must check that all its own systems and in particular those related with the State System of Accounting and Control (SSAC), will be 2ky ready.
2 - State System of Accounting and Control (SSAC)

The ARN has established a SSAC, which includes:

- an independent verification system based on national safeguards inspections which are classified in routine (interim and physical inventory verifications) design information verification and other inspections (special, audits, etc.).

- and a centralised accounting database of all nuclear materials in all nuclear activities performed in Argentina. The centralisation of these information allows checking the coherence and consistency of the accounting data among the different “Material Balance Areas”.

The National Inspection effort and frequency are established taking essentially into account the type and complexity of the installation, the type and category of the nuclear material handled and the performance and adequacy of the operator’s accounting and control system (i.e. the nuclear material traceability through all operating and accounting information kept at the facility and the accuracy and precision of the facility’s measurement system).

The data collected during the inspections are gathered in an “Inspection Report” and used later on by the ARN to perform the corresponding evaluation.

Two computerised databases were implemented and put into operation by the ARN in 1996, in order to optimise the programming of the inspections and their evaluation and to improve the issuing and submission of the accounting reports.

- The System of Control of Nuclear Material (SCMN) aiming at centralise all safeguards accounting data, and,

- The System of Safeguards Inspections (SIS) to process all the national inspection data.

3 - Functions of the SCMN and SIS

Both databases are developed by a contractor in FOX PRO for WINDOWS. They are able to work in a net in a multi-user way and it is possible to export data to calculation programs like EXCELL or MATHEMATICALS FOR WINDOWS for different applications.

Starting from a zero level corresponding to the general administrator of the system who manages all the functions of the database, a tree structure of profiles can be defined in order to assign different levels of accessibility to each user.

Besides, each database has a consultation function based in a combination of logical propositions applied to the different fields, that allows its intelligent interrogation, which permit to obtain, combine, export and regroup the information for different applications. This is one of the most important tools from the point of view of evaluation of the information.

Regarding the SCMN, the software takes into account all the requirements arising from the safeguards agreements in force and allows defining the facilities with its corresponding MBAs, that may be configured in a way to fulfil the structure agreed in the corresponding Facility Attachment and the Design information.

The input data to SCMN are the accounting reports generated by the facilities for each Material Balance Area (MBA). These reports, MBR, ICR, PIL and Concise Notes follow the format specified in the Code 10 of the Subsidiary Arrangements-General Part of INFCIRC/435. These reports may be entered manually or magnetically and are numbered automatically in a sequential form.

Before the output of the reports to be sent to ABACC and the Agency, the system verifies the content and the structure of some of the fields of those records, carries out a matching of the
whole domestic transfers between MBAs, verifies that the MBR are consistent with the consolidated data of the ICRs and the total sum of the PILs.

The SIS allows for each MBA and for a given inspection, the issuing of the Inspection Report forms. The most important forms are the ones used for: the accounting audit, the destructive and not destructive measurements and the list of seals forms. Once the inspection is finished, all the gathered information is introduced in the SIS.

Finally, the possibility of exporting data from the SIS in combination with the interrogation function, allows making statistical inferences. Examples are the analysis of the tendencies of the MUF for a given MBA, the study of the analytical results obtained from the samples and of the non-destructive measurements and its errors.

Both systems link to each other in different ways. The SIS takes from the SCMN the following information:

- configuration of facilities and MBAs,
- the inventory of nuclear material and the inventory changes for the VRA and VRB forms.

If some discrepancies between the operator's records and the reports sent to ARN are found, the inspector in the corresponding form records it. Once the inspection is finished, the SIS will automatically transfer all the discrepancies into the SCMN pending accounting list.

Foreseeing the future impact of the 2ky problem the ARN has specified to the contractor to avoid future changes in the software due to that issue. So, all the fields of both databases related with date support four digits for the year, as well as all the routines involving date (i.e. the sum of inventory change between two date, the inventory at the date of the current inspection) do not need any reprogramming.

Both systems are implemented in the central server of the ARN in a mainframe of Windows, which has been tested to be 2ky ready.

4 – Operators System (SOP).

In order to further improving the SSAC, the ARN has considered very convenient that each nuclear facility maintains a computerised accounting database which would increase the quality of the operator’s accounting and control system, would diminish the occurrence of errors in the records and reports, will allow the sending of reports by electronic means to the ARN and will facilitate the operator and ARN activities in terms of control and auditing of items and batches of nuclear material and the examination of records and reports.

The software named “SOP” (“Operator’s System”) developed by the same contractor in FOX PRO for WINDOWS is actually being proved in some significant facilities.

The input data are the “transfer of nuclear material form” between MBAs, other documentation used to establish the inventory changes (e.g. measured discards, burn up, nuclear production) and operational data that shows the stock movement. Based on these data, the system automatically generates the accounting records (e.g. General and Subsidiary Ledgers and Transfer Documents as well as the itemised physical inventory listing) and reports (ICR, MBR and PIL). Therefore, the operator does not have easy access to change or alter the files.

Although SOP is prepared to manage four digits in the year fields, the software takes the data, for example the data of input the records in General Ledger, the data of the physical inventory list, the data for the movement of items of stock, from the real internal clock (ROC) of the hardware where is installed.

In Argentina the nuclear material is distributed in a total of 44 facilities and LOFs subject to the State System of Accounting and Control applied by the Nuclear Regulatory Authority. The nu-
clear fuel cycle devoted to power generation comprises all facilities from uranium mining to nuclear power plants. Other facilities are research reactors, analytical, research and development laboratories and storages.

Due to the differences in the hardware resources of all the areas, the ARN is actually requiring to the operators that all the futures hostess of SOP be 2yk compatible. In addition, in cases in which the control of the stock has yet been made by a computer (i.e. the NPPs or the fuel fabrication plant), the software of control would be linked to SOP and so the software and the hardware would had to support the 2ky transition.

5- The accounting systems in the NPPS Atucha I and Embalse.

Atucha I is the type of On Load Reactors using natural and low enriched uranium (less than 1%) as fuel and heavy water as coolant and moderator material. The rate thermal output is 1179 MW(th) with 357 MW(e).

The control of the NPP and the management of the fuel elements are made by a central server which has installed, among others, two software: PRODEC and PUMA

The management of the fuel elements is made by an on line program PRODEC in DBASE which allows to know on real time the physical place (fresh pools, spent pools, reactor core grid), potential history, content of uranium, U235 and plutonium, burn-up of each fuel element from its fresh state up to definitive storage in the spent pools. PRODEC allows to know in any time the inventory list and calculate the records for the General Ledger of Plutonium.

PUMA is written in FORTRAN and allows to know in each channel the axial neutron flux, taking into account the position of the control rods, the axial neutron flux. Those date are one of the input to PRODEC to possibility the calculation of burn-up, potential history and nuclear production.

The detectors in the refuelling machine send to the central server a signal in the moment in which is introducing a fresh or semispent fuel into the core, or changing a fuel of channel or taking off a fuel from the core. When the signal arrives to the server the Real Time Clock gives the data and hour to PRODEC and, if is an introduction, the operator manually input the identification of the fuel.

PUMA needs as input data from the flux detectors, the detectors of position of fuel rods, and reads the power from the central console. But in each case the date are manually entered.

So the operator actually is checking that the RTC is 2yk compatible making a progression in real time from 31/12/1999 up to 01/01/2000 and verifying that the 2000 year is a leap year. At the same time is verifying that there is no embedded system in the console central, refuelling machines, detectors of position of fuel rods which can influence the data.

Foreseeing the installation of the SOP in every facility, actually the ARN and the operator are analysing and trying to implement the links between SOP and PRODEC. The Transfer Documents for fresh fuels are one of the input date of SOP which would transfer these data to PRODEC. PRODEC allows to transfer to SOP the inventory list in any time and calculate the records for the General Ledger of Plutonium.

The situation in Embalse NPP is quite similar. Is a PHWR Candu type with 2015 MW(th) and 600 MW(e). It has also developed an appropriate system for controlling the NPP and the management of the fuel elements. The nuclear production is calculated by a software supplied by Canada: POWER PUFS-V.

The operator is now reviewing not only the national and supplied software and the hardware, but identifying all the embedding system supplied by the contractors that can affect the accounting systems.
6 - Conclusions and forecast

In the framework of the SSSC, the routine application of the SCMN and SIS has reduced significantly the errors in the reports sending to ABACC, the accomplishment of the specific deadlines in sending the reports has been improved dramatically and the prompt evaluation of the inspection results and the allocation of human resources has been improved.

The links between SCMN and SIS have also permitted a more efficient identification and resolution of some inventory or accounting problems and discrepancies.

As both systems were specified, developed and installed no problem with the 2yk transition is foreseen.

In a near future the ARN will request the implementation of SOP in all nuclear facilities. The ARN together with the operator is actually analysing the implications of implementing the SOP at the facilities that already have software to control the operation of the plant. Probably, the automatic transfer of data will require the development of some additional software that links the output of existing software with the SOP.

Due to the narrow links between SOP and the operator’s systems of control and accounting of nuclear material, particularly in the NPPs, the safeguards and no proliferation sectors of the ARN has focussed its efforts in implementing a project to detect the problematic points in the chain of accounting information, from the source data up to the reports, in order to require and help the operators to reach appropriate solutions.

Due to the few time up to the millennium the main goal were the two NPPs but in a near future the situation in the fuel fabrication plants and the conversion plants will be analyse in the same sense.

REFERENCES

Quadripartite Agreement, General Part Subsidiary Arrangements, Code 10.

