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## Joint Study of State Systems of Nuclear Materials Control and Accountancy in Russia and in France

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**ABSTRACT** : In the framework of the EU TACIS program, the All Russia Research Institute of Automatics (VNIIA), the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) and JRC-Intitute for Protection Security Citizen (IPSC) exchanged information on the state systems of nuclear materials control and accountancy (NMC&A) in Russia and in France. This joint study of state systems was a task in a JRC-TACIS project designed to support the Russian Federation (RF) in the development of instrumentation for NMC&A. The study confirms many features of good practice common to both systems. The aim of this paper is to present these elements of good practice along with other general points regarding the applications of the regulations on site.

### 1 INTRODUCTION

In the framework of the EU TACIS program, VNIIA, IRSN and JRC-IPSC exchanged information on the state systems of nuclear materials control and accountancy (NMC&A) in Russia and in France. This joint study of state systems was a task in a JRC-TACIS project designed to support the Russian Federation in the development of instrumentation for NMC&A. The joint study was based on detailed descriptions of regulations, implementing organizations and types of documents requested by the respective authorities (both French and Russian). It studied the two State systems in terms of the regulatory framework, the segmentation of organizational responsibilities and the technical means and procedures. The exchange of information also included visits to similar LEU fuel fabrication plants in each country: MSZ at Electrostal in Russia and FBFC at Romans sur Isère in France.

The State's control of the management of nuclear materials in the two countries, is in many ways similar, particularly in terms of technological options and in terms of objectives. This does not mean however, that the pattern of institutional responsibilities nor the approach for implementation, should necessarily be identical. In fact the two state systems are in different phases of their history. The French system is based on the law of 1980 and subsequent decrees and orders whereas the Russian system is based on the law of 1995 and its subsequent decrees and orders. As a result the French system is in a phase of consolidated experience of execution whereas the Russian system is in the final stages of a phase of active innovation designed to implement NMC&A in a new legislative, social and economic framework. Notwithstanding this important difference between routine execution on the one

hand, and elaboration of innovation on the other, the joint study confirms many features of good practice common to both systems. The aim of this text is to present these elements of good practice and other general points regarding the applications of the regulations on site. Naturally the resources devoted to this study were limited and hence the description and reflections contained here do not do justice to such an interesting subject.

## **2 KEY IDEAS IN RUSSIAN FEDERATION AND FRENCH STATE SYSTEMS OF NMC&A**

The aims of the Russian Federation and French State systems of NMC&A are described in French law [1] and in the decree n° 962 of the RF government [2]. These aims include ensuring effective State control of nuclear materials use and avoiding losses, thefts, disappearance or diversion of nuclear materials (NM). The requirements for ensuring the achievement of these aims are elaborated in additional decrees and orders [3,4]. These in turn have led to a number of ministerial requirements to ensure successful implementation. These and other documents, referred to below in this paper, are the references for the description of the two systems of NMC&A.

In each system, three similar key ideas are found: the "license", "controls" and "penalties" which are translated, in more or less details, by:

- the necessity of having a license to hold materials,
- the responsibility of the operator who ensures the first level of control,
- the inspection or supervision by state agencies of each facility accountancy and protection of nuclear materials,
- the materials accounting and its various levels,
- the controls of received materials,
- regular physical inventories,
- preservation of documents,
- operators' training.

These common points clearly appear in the Russian decree n° 962 of December 15th, 2000 and in the French order of March 16th, 1994 which represent the basis of the NMC&A systems.

### **2.1 Licence**

In both countries, a license is required to hold nuclear materials. It is delivered by essentially MINATOM in Russia and by the "Senior Civil Servant for Defense" (HFD) of the Ministry for Industry in France. This license is proper to holding nuclear materials: it is distinct from the license for operating which is delivered respectively by "GOSATOMNADZOR" (GAN) and by the "Direction Générale de la Sûreté Nucléaire et de Radioprotection" (DGSNR) on safety criteria. In both countries, every licensee has to take measures for the accounting, confinement, surveillance and physical protection of materials. In particular, he has to know precisely the nature and quantity of all the inputs and outputs of nuclear materials in his facility. He must reveal immediately any abnormality and make periodic inventories in order to verify that physical situation is in compliance with the accounting. In both countries, these plant arrangements are the object of state inspection and supervision.

In France, the concession of a license by the HFD is on the basis of a document (the "License and Control dossier", DAC), presented to the authorities for approval. The

satisfactory elaboration of this document is compulsory for obtaining the license to hold nuclear materials. It must be produced by the plant and is subject to a detailed analysis by the authorities assisted by their technical support body, the IRSN [3,5].

The license delivery for operating with nuclear materials in Russia is a GAN prerogative, and the possession of the nuclear materials is on the basis of a MINATOM contract with the “State Entity for Federal Property” authorizing transfer of the materials for holding [6]. In Russia, section 8 of [4] establishes that each enterprise holding nuclear materials must develop a document defining the organization, techniques and procedures for all aspects of NMC&A and plant control of NMC&A. To enable plants to develop this document, MINATOM has issued guidelines [7] to help facilities to develop their own “Facilities Provision on NMC&A”. In both countries, the operator must be able to satisfy the regulations and these include a facility responsibility for monitoring of NMC&A performance.

## **2.2 Control**

In both countries the nuclear materials control has the same objectives i.e. to avoid losses, thefts or diversions. Control focuses on the technical and accounting aspects of all operations, as well as the measures taken to avoid any problem. In a relatively similar way in both countries, this control is carried out at two levels: requirements imposed on the operator of a plant and a control role for authorities of the state.

### *2.2.1 Control by public authorities*

In making control effective, both states are concerned to ensure:

- an independent authority which provides independent oversight of the performance of the plant NMC&A,
- efficient and effective use of resources in the State system of control of NMC&A,

In the French system, the operational achievement of these functions are embodied in the activities of the IRSN. Under the authority of the HFD [3], IRSN performs assessment files and carries out regulatory inspections (article 5 of [1] and article 20 of [3]). The Institute is also in charge of the centralization of NM accountancy and of the definition of rules necessary for this. Because of these functions, IRSN is equipped with a range of technical expertise in its various departments. In France, the Ministry of Industry controls both civil and defense materials and is supported technically by IRSN in both spheres. In Russia, materials allocated to defense, is controlled by the Russian Ministry for Defense and not by the same authority as for the civil materials.

In the Russian Federation system, supervision on NMC&A performance for civil materials is the responsibility of GAN. In addition to this, MINATOM, as the Ministry responsible for the major part of the nuclear fuel cycle (civil and defense), carries out its own ministerial audits [4] which are concerned to ensure that plants, coming under its responsibility, meet all state requirements for NMC&A and meet the requirements of GAN supervision. Since MINATOM is also the Ministry responsible for a large number of important R&D institutes, the ministerial audits teams are ensured of technical expertise both in the inspection function and in any R&D aimed at improving plant performance.

The types of inspections or audits carried out by both national systems are rather different from inspections carried out by IAEA or EURATOM. Verifications carried out by these international organizations are heavily focused on verification of accounting data for any

Materials Balance Area (MBA). The national systems can have recourse to verification of data where required, but there is a considerable emphasis on verification of the quality of the operators procedures and their implementation. French control, for example, has the possibility of inspecting any aspect covered by the regulations and this power is extensively employed. In the international system, the onus of responsibility is on the State as signatory of an international treaty, whereas in both national systems, the responsibility is on the facility holding nuclear materials subject to national law.

MINATOM oversight of NMC&A, in plants under its jurisdiction, includes verification of all aspects relating to accountancy requirements, verification of procedures regarding Physical Inventory Taking (PIT), access control, correspondence between records and reality, quality of measurement procedures and equipment, and procedures for eventual anomaly follow-up [4]. In the RF, GAN employs a suitable mixture of quality control of methods and procedures along with independent verification. In this way, GAN supervision and MINATOM inspections are designed to ensure, autonomy of supervision on the part of GAN, while avoiding wasteful duplication of effort and resources. A GAN inspector is always present in each big facility. This is in contrast to the French approach where inspectors are not only non-resident but inspect many facilities a year. Under article 25 of [8], the responsibility of GAN includes supervision of physical protection as well as NMC&A. Similarly, the Ministry of Industry in France is in charge of the supervision of physical protection of NM [9].

MINATOM and the French Ministry for Industry have similar roles regarding the definition of the respective regulation, its implementation and its evolution if needed. In each country an annual report concerning the state of the NM system must be prepared. MINATOM must prepare this for the Russian government and the French Ministry of Industry (with the help of IRSN) prepares it for the French Parliament.

### *2.2.2 Control by the operator*

The laws, decrees and regulations of both countries specify what operating plants must do to achieve the objectives of the national system of NMC&A. In the French case, this is incorporated in the decree n° 81-512 [9] and in the order of May 16<sup>th</sup>, 1994. In the Russian case, it is incorporated in the Basic Rules developed in collaboration by MINATOM and GAN [4] and in the arrangements for NMC&A in the plants of MINATOM [7]. In each case these documents go to considerable lengths to lay out the NMC&A objectives of operators and as well as the supervisory role of designated state bodies. The operating facilities are required to have accountancy based on high quality measurements, with conservation of accounting information. Measurement quality is to be maintained by a measurement control program. The facilities must be able to detect possible anomalies through following rigorous shipper/receiver procedures and PIT procedures. The roles of supervisory bodies (IRSN, MINATOM, GAN) are reflected in requirements for reporting of accountancy information including regular materials balances and reports of any anomalies encountered.

## **2.3 Penalties**

Possible penalties for infringements are defined in the texts of both systems. In the French case, significant actions defeating the objectives of NMC&A have been designated as criminal offences leading to penal sanctions (law 80-572 of July 25<sup>th</sup>, 1980 and law 89-434 of June 30<sup>th</sup>, 1989). The sanctions, which include imprisonment or fine, are applicable to identified physical persons. In the Russian Federation case, the law 68 of May 12<sup>th</sup>, 2000 (administrative responsibility) provides for financial penalties for organizations failing to respect to the requirements for control of nuclear materials. In addition, the Criminal Code of

the RF provides for fines and imprisonment for persons violating rules with regard to nuclear materials.

### **3 SOME FEATURES OF THE TWO SYSTEMS OF NMC&A**

The respective systems are detailed in the French order of March 16<sup>th</sup>, 1994 and in the MINATOM order [7], which gives effect to the requirements of [4]. These texts present many common features, some of which are described briefly below.

#### **3.1 Accounting Features**

The system set up in Russia essentially contains three levels of accounting i.e. the level of the operating facility (based on MBAs), the centralized accountancy of the holding company (e.g. Joint Stock Company for MBP/Electrostal) and the accounting of the federal level. In addition to this, each Ministry is responsible for archiving and processing accounting information coming from those holding companies coming under its jurisdiction.

An essentially similar hierarchical accounting structure is found in France: the local accounting of the operator, the centralized one at the headquarters for the most important holders (EDF, COGEMA, CEA) and the national accounting confided to IRSN.

We note however that, in the Russian Federation system, MINATOM has a dual role. Firstly, it is a Ministry having holding companies under its jurisdiction and thereby acquires the many NMC&A related responsibilities of any such Ministry [2,4]. Secondly, it has what are called the Federal level responsibilities of maintaining the Federal Information System with concomitant responsibility of reporting to the RF Government and also of providing methodological specification of the whole State system. In this regard, the Russian decree [2] requires inter alia, that MINATOM ensures certification of technical means and instrumentation, develops Federal Regulations and defines the form of reports, their frequency and the procedures.

In each facility holding NM, the results of the non-destructive and destructive measurements, are the basis of the accounting of all the NM transfers and transformations. France and Russia practice similar approaches to measurement, and good practices exist in each facility that was visited. Uranium reference samples and mass standards are used to calibrate and verify the operating state of the equipment. In Russia, procedures validated by GOSSTANDARD, describe the different actions to be carried out at each stage of the fabrication process to qualify and quantify the NM. The measurement methods and their uncertainties are well defined.

#### **3.2 Document preservation**

The obligation to preserve all documents related to accountancy is contained in both regulations. In the French case, the facility is required to preserve accountancy documents at least for 5 years from the departure of materials from the facility. In the Russian case, documents must be conserved for 10 years. In both systems, access to accounting information is restricted and under security control. The response to erroneous accounting information in both systems is the same, in that the incorrect document may not be modified.

Instead its effect must be nullified by an error correction document and the erroneous document must be preserved [7].

### **3.3 The “declaration regime”**

The French decree dated of May 12<sup>th</sup>, 1981 states that below certain nuclear materials quantities held in the facility (for example: 3 grams of plutonium), the operator is no longer subject to the “license regime” but to the “declaration regime” set out in an order dated of March 14<sup>th</sup>, 1984. In Russia, there are in fact two systems of accountancy of radioactive materials. One is the nuclear materials accountancy system being discussed here and the other is a state accountancy of radioactive sources which encompasses many small materials amounts.

### **3.4 Quality Assurance Features**

The need for a quality assurance program for French follow-up and accounting of nuclear materials, clearly appears from the first article of the order of March 16<sup>th</sup>, 1994. Under this order, quality assurance must cover follow-up and accountancy and in particular, shipments and receipts, recognition and measurement of NM, as well as PIT. The facility is required to have adequate documentation of the quality assurance policy and plan. To implement follow-up as required by Article 4 of [3], the French system divides MBAs into materials control zones which are themselves accountancy areas based on measurement (i.e. sub-MBAs). This allows the facility to have a near real time knowledge of the location of materials throughout the MBA. The measurement systems and data generation of this follow-up system are subject to quality control.

In the Russian Federation, a quality assurance system for measurements is stipulated in the Government decree [2]. The ‘Basic Rules’ [4] stipulate that quality assurance must be in place for measurements and that certification is required for measurement methods and procedures. For measurement, rules of good practices are described in a production guide that is part of the quality system of the plant. In MSZ for example, the measurements methods, systems and standards used in the plant are described.

In addition to reflecting the importance of measurement quality control, the MINATOM guidelines [7] require that an ‘accounting control group’ carries out checks on aspects of data generation and the correspondence of data to reality (PIT and materials balance are only part of this role). The Basic Rules [4] lay down a very severe quantitative criterion for the level of validity of data in records affecting accountancy. In order to ensure data quality for MBA accounting, the RF MBAs are, in practice, segmented into materials control zones where internal transfers are accounted for. For example, MSZ/Electrostal represents a single MBA but was, at the time of the study, split into 7 internal sub-MBAs, each one including Key Measurement Points (KMP) and accounting control points (the number of sub-MBAs has subsequently been increased). At MSZ, each article has a passport, written by hand by the operators, in which useful data are recorded. These data concern the quality and quantity of NM, measurement systems used for characterization and localization of NM. The MBA of FBFC/Romans is divided into 13 sectors (6 workshops, 6 storage areas and an incinerator). At FBFC, any movement of NM between sub-MBAs, is recorded in a database by an authorized operator.

### 3.5 Operator level organization

In French law, every operator is autonomously responsible for the accountancy and protection of the nuclear materials that he holds, provided that he satisfies the objectives fixed by the order [3]. The order stipulates fundamental obligations such as: follow up, PIT and shipper-receiver protocols. The French decrees and orders indicate the facility's obligations, but leave freedom as to how the obligations must be achieved. Hence, the details of how the obligations are to be carried out, are determined by what is agreed in the License and Control dossier or by whatever emerges from IRSN statement and recommendation following assessment of files or inspection activities. No compulsory organization exists for the French operator, but, in practice, all the important facilities have a group specialized in protection and control of the materials. Under French law, each operator is obliged to appoint an employee who has a penal responsibility to alert the authorities in case of theft, etc. In practice, the operators appoint a person responsible for accountancy and a person responsible for NM "follow-up".

In Russia, the orders and decrees tend to specify in more detail certain aspects of how obligations are to be achieved. For example, the government decree [3] lays down that each facility has to have a division for accountancy and that a measurement quality control program is mandatory. The Basic Rules [4] require that each MBA should have one or more NM custodians who are responsible for the accounting and control of NM. They also require that transfers from custodians to other persons must be documented and that transfer of responsibility at the end of shifts must be documented. The MINATOM guidelines [7] stipulate that there must be a list of persons responsible for NMC&A and that their duties and responsibilities must be defined in documents.

In addition in RF, the guidelines [7] specify that there must be documents for PIT and resolution of anomalies, documents on the measurement techniques for each KMP, documents describing all NMC&A paperwork to be carried out, (by whom it is to be filled out and to whom it is to be transmitted, etc.). Every job description must be documented in every aspect relating to NMC&A (e.g. measurement, data generation, data checking). This covers processing, internal transfer, shipments and receipts, transportation.

Documentation required by [7], must describe all aspects of the computer system and its use for NMC&A. Documents must also specify the scope and procedures for internal control audit as well as the persons responsible. And finally there must be a document describing the organizational structure of the facility's NMC&A functions. Overall there is a very extensive requirement for documentation of procedures. The existence of such documents not only expedites the performance of the tasks but also facilitates the application of internal audit.

An example of these different approaches is given by the case of measurement methods. In Russia the facility has to use certified types of instruments to perform the measurements according to certified procedures and with certified standards. The systems, methods and calculations are specified and validated according the Russian Gosstandard rules. The French operator is legally free in the choice of his apparatus and methods; In practice however, he may follow CETAMA recommendations which give a similar assurance of quality.

### **3.6 Materials movements between facilities**

In Section 3.4 (Quality Assurance), we have already spoken about the fact that transfers or transformations inside MBAs are subject to internal accounting based on measurement (follow-up). Special attention must however be given to the reliability of accountancy when transfers are made between MBAs. This is particularly important when transfers of ownership or import/export are involved. For this reason, any materials movement between facilities entails complex obligations for the shipper and for the receiver. Both regulations proceed in the same logic.

In France the relevant requirements are stipulated in [3] and in Russia the requirements are to be found in [4]. The accounting data to be transmitted are comparable in both systems. Both systems require that the data must arrive to the receiver in time to permit the first level control of the shipment. In France, usage wants that the file containing the data is confided to the carrier of materials. Once materials have arrived, the Russian receiver has 3 working days to undertake the first level controls and to make a preliminary acceptance of materials. In France the time allowed is only 24 hours, but apart from this, the first level control is identical. Both French and Russian regulations require that information regarding a shipment must be sent to IRSN [3] or to MINATOM [2] within 24 hours of the event.

Differences between regulations appear with the 10 days given to the Russian receiver for his control of second level, whereas the French plant may wait for this control, up to the introduction of the materials into its process. Facilities, in France, have the alternative option of using the shipper's data for accountancy, provided there has been verification of the quality of the shipper's measurement procedure. In Russia, provided there is no significant shipper-receiver difference, the shipper's data will be used by the receiver. In France, a written agreement between shipper and receiver is requested for the most sensitive materials. This protocol has notably to appoint an arbitrating technical body and to be approved by authorities, prior to the shipment. In the Russian regulation, if there is a problem between shipper and receiver, a mixed committee meet to try to solve the point. If need be, a report is passed on to the authorities.

In France, any movements involving export are subject to the law 80-572 which requires prior Ministerial authorization of export and also requires measures to ensure that after export, control is exercised to ensure conformity with all French international agreements. In Russia permission for export is required by advanced notification to the authorities (MINATOM, etc) at least 15 days before the proposed shipment [4].

Naturally both systems have regulations dealing with the protection of materials during transport and the related responsibility of informing relevant public authorities [9]. Transport protection was however not an element of this joint study since the project was concerned only with the development of measurement instrumentation for NMC&A.

### **3.7 Physical Inventory Taking and Physical Inventory Report**

In both systems, physical inventory taking (PIT), and a report of the PIT results to the authorities, are considered an essential part of quality control of accounting system performance. This point is explicit in both regulations [3,4]. In the French system a PIT is required once per year and IRSN may choose to be present. In the Russian system, the frequency is determined by the category of materials in the MBA. In each case, the PIT procedure is developed by the facility following guidelines established by IRSN and

MINATOM respectively. In Russia the execution of the PIT requires the appointment of an "Inventory Taking Commission" with specific powers under [4]. In both systems, a comparison of physical stock and accountancy data are performed. The materials balance is compared to its limit of error (LEMUF) calculated from the uncertainties of measurements and, in each case, a PIT report must be prepared.

In the French case, this report must be sent to IRSN within 45 days. In the Russian case, it must be sent within 15 days to the accountancy department of the facility and then the holding company must send it to MINATOM within 40 days [10]. However, if the PIT (in Russia) reveals some anomaly, the report must be sent to MINATOM and GAN within 24 hours [4]. If no anomaly is revealed by the materials balance analysis (in Russia), the book inventory is used as the beginning inventory for the subsequent balance period [4]. In France, the value resulting from the physical inventory is used for the subsequent balance period. The accountancy is adjusted with declaration of materials balance.

### **3.8 Training in the management of nuclear materials**

In Russia, job-specific training is foreseen both for operators and for inspectors. Training for operators is even accompanied by tests of capability and must be renewed every 3 years [2,4]. Specific education and training courses are organized at IPPE in Obninsk, for nuclear materials control and accountancy. These cover the regulations and basic principles of NMC&A, statistical methods, NM measurements methods (both theory and practical assays), containment and surveillance, etc...

In France, training courses are organized regularly by the National Institute of Nuclear Sciences and Techniques (INSTN). These courses concern the regulation, nuclear materials accountancy, statistical methods to evaluate MUF and LEMUF and a brief description of the measurements methods used for NM (destructive and non-destructive measurements). No formal aptitude test is involved. Specific training sessions are also offered on general destructive and non-destructive measurements methods with NM (both theoretical presentations and practical assays).

## **4 CONCLUSION**

The overall purpose of a state system of NMC&A is to ensure effective management of nuclear materials [1,8]. It includes ensuring that legitimate use of NM avoids any risk of losses, thefts or diversions of NM. A major feature of a state system is therefore to ensure protection of nuclear materials by the holders of those materials [9]. The system of protection covers materials in facilities and during transport.

In this paper we have mentioned a limited number of features of two State systems of NMC&A. These features included the regulatory framework, the technical requirements and how these requirements are met by defining the specific roles for facilities and State institutions. The technical emphasis however has been on those features that ensure the creation of accurate accounting data. These features include:

- (a) Measurement systems with known characteristics which are backed up by the infrastructure to ensure that they are working properly and that they are used in the intended way. This has been a major component of the project which gave rise to this study and is discussed fully elsewhere [11].

- (b) Data generation about masses, locations and identities which is as much as possible free from unintended error. Achieving this in complex facilities, is ensured by rigorous procedures throughout the chain of creation and management of information.
- (c) Procedures such as follow-up, shipper-receiver controls, PIT and materials balance which are designed to detect and correct any inaccuracies which may have entered into the system. In this paper we have focused on these three aspects of ensuring data quality but there are many other detailed aspects of data quality control that are not described here. These include automatic registration of data, computer checks of data against other data to ensure reliability and organizational aspects such as validation of data by more than one person at point of creation.

State systems for ensuring accurate NMC&A encompass therefore a number of aspects which are not treated in this paper. A fuller description could also include:

- the organization and the functioning of the centralized accounting (federal or national) of the State, the form of declarations, the comparisons with local accounting, the actions in case of discrepancy,
- the conditions of exercise of the control (inspection, supervision) by State agencies: preparation, notification, development, conclusion, report and post control letter with possible corrective actions requested.
- facility organization and techniques for ensuring accuracy and reliability of data being generated for NMC&A.

For brevity in this paper we have focused on just part of the common thread of good practice reflecting the objectives common to both systems. The difference between the two systems lies in a different pattern of institutional responsibilities and in variations of the implementation procedures for what are common objectives.

## 5 REFERENCES

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