
Experience in the Application of French Regulations regarding the Control and Accounting of nuclear Material

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ABSTRACT : The Institute for Radiological Protection and Nuclear Safety and more particularly, the Radioactive Material Security Department of this Institute acts as technical support to the Authorities in the application of the Law of July 25th 1980 concerning the protection and control of nuclear material in France. This paper briefly describes the French system for nuclear material control and accountancy, with its legal support and IRSN implication. In the second part, lessons learned in implementation of the regulations are presented for each of the technical articles required by the regulation. It is followed by the inspectors' activities and other important induced implementations.

Keywords : nuclear material; inspection; regulation.

1 INTRODUCTION

Since February 22nd 2002, the *Institut de Radioprotection et de Sûreté Nucléaire* – IRSN has been legally independent from the Atomic Energy Commission (*Commissariat à l'Energie Atomique* – CEA). Within the IRSN, the “*Direction de l'expertise nucléaire de défense* – DEND acts as the technical support of the Authorities in the application of the Law of July 25th 1980 concerning the protection and control of nuclear material.

The IRSN performs various types of inspections in facilities dealing with nuclear material in order to ensure strict compliance with national regulations. In addition to the law and its associated decrees, the main text applied by the inspectors is an order dated of March 16th 1994. Articles of this order prescribe the technical conditions for the control and accounting of nuclear material.

This paper describes the French system for accounting and control of nuclear material, the inspection regime as well as experience gathered in France in several major topics dealing with accounting and control.

2 FRENCH REGULATIONS CONCERNING PROTECTION AND CONTROL OF NUCLEAR MATERIAL

2.1 The law of July 25th 1980

The law of July 25th 1980 and the associated regulations set up a national system for protection and control of nuclear material, including inspections of nuclear facilities and of nuclear material. These inspections are carried out by specialised, qualified and sworn in individuals. The law defines the principles and the general guidelines that must be implemented in order to prevent and, if necessary, immediately detect any disappearance, loss, theft or diversion of nuclear material. Those principles and general guidelines are applicable to all nuclear material located on the French territory. In these regulations, the intention of the legislator is expressed in the key words licensing, control and sanctions.

Licensing : Prior authorization, granted by the Competent Authority is required for whoever would exercise nuclear material import, export, storage, transfer, use and transport activities. Administrative and technical requirements complete the authorization in relation with the authorized activities.

Control : The administrative, technical and accounting aspects of authorized activities are concerned by verification procedures, as well as measures intended to prevent nuclear material unauthorized removal. It is carried out firstly by the operator and secondly by the Competent Authority who has at his disposal persons exerting this control, qualified and empowered by the appropriate Competent Authority, sworn in and bound to secrecy.

Sanctions : Significant actions affecting nuclear material have been designated as criminal offences leading to penal sanctions. Among these offences are, notably, the improper possession of nuclear material, the undertaking without authorization of the activities covered by the Law, the obstruction of the performance of control by the Competent Authority, failure to declare the loss, theft, disappearance or diversion of nuclear material or impairing safety. Certain actions affecting nuclear material have been established as criminal offences leading to penal sanctions, which can be severe at times (up to ten years' imprisonment). Since 30 July 1989, the law also punishes anyone holding, using or transporting outside the French territory, nuclear material covered by the IAEA Convention, without having been authorized to do so by the Competent Authorities concerned abroad.

2.2 The Decree of May 12th 1981

The Decree of May 12th 1981 specifies that the nuclear material concerned include fissile, fusible or fertile nuclear material, as well as any material containing one or more fissile, fusible or fertile elements, whatever their physico-chemical form, ores exempted. These materials are plutonium, uranium, thorium, deuterium, tritium and lithium 6. It should be noted that the last three radionuclides are not considered as special fissile nuclear material by the IAEA. It should also be noted that prior to irradiation, not all nuclear material can be considered as radioactive substances.

The enabling decree of the Law specifies the quantities of nuclear material involved respectively in the regimes of licensing, annual declaration and exemption. These three regimes are based on the following obligations of the operator :

Licensing : The requirement to obtain a prior authorization from the Competent Authority, on the basis of a file,

Declaration : the obligation to declare his stock of nuclear material to the Competent Authority annually,

Exemption : no specific obligation, but the quantities of nuclear material held must remain below the specified thresholds.

These clauses also indicate the conditions for the granting of the licenses for the undertaking of one or more of the activities covered by the law, the obligations of the licensee and the general provisions concerning in particular the inspections and any penalties.

In addition, the regulations for licensing specify the quantitative and qualitative classification of sensitive nuclear material into three categories, comparable, excepting a few features, to that of the Convention on the Physical Protection of Nuclear Material (INFCIRC/274).

The decree specifies also the minimum level of physical protection required for each category of nuclear material as follows :

Category III : Use and storage within a zone to which access is controlled.

Category II : Use and storage within a protected zone, to which access is controlled, which is under constant monitoring by guards or electronic surveillance equipment and which is surrounded by a physical barrier with a limited number of adequately supervised access points.

Category I : Use and storage within a highly protected zone, i.e. a protected zone defined for category II material, access to which is, in addition, restricted to persons that have been subject to stringent background checks, and which is under constant monitoring by guards, who maintain close links with the public response forces (police or other public order forces).

With regard to nuclear material accounting for and control, the decree obliges the licensee to make all necessary arrangements for the following :

- a) Accurately determining the quality and quantity of all incoming and outgoing nuclear material,
- b) Locating at any time the nuclear material and determining their use, movements and transformation,
- c) Detecting any anomalies as quickly as possible,
- d) Checking by means of periodic physical inventories that the actual situation of the nuclear material possessed corresponds to the accounting records.

The nuclear material control and accounting (NMC & A) system, should be organized by the licensee in such a way that the Competent Authority can verify its efficiency and reliability, centralize the accounting of nuclear material and, whenever necessary, be informed without delay of the nature and quantity of missing materials. The Competent Authority can, at any time, order a physical inventory verification and compare it with the accounting records.

2.3 The Order of March 16th 1994 on the technical conditions of nuclear material accounting for and control.

This regulatory text stipulates technical arrangements relating to the accounting of nuclear material possessed by the operator and to their centralization by the IRSN which technically supports the Competent Authority. The text concerning the operators under the licensing regime is focused on several major provisions which detail the provisions of the decree :

- Nuclear material control : A physical inventory of all material must be performed at least once a year according to a written procedure. The operator has to correlate the inventory-taking figures determined by this method with the book inventory. He should declare to the IRSN any discrepancy in the inventory and perform an analysis to determine its cause and rectify it.
- Accountancy approach : Any inventory change in the facilities is reported to the central accounting data office of the IRSN through given rules : accountancy units, type of information, justifications needed. He has to keep bookkeeping records of inventory changes on a daily basis. This book must be protected against alteration and must be in a form suitable for producing a calculation of each nuclear material inventory at the end of the month.
- Quality Assurance : All the activities performed in the frame of nuclear material control and accounting for should comply with the international quality assurance standards especially for shipment, receipt and physical inventory.
- Receipt acknowledgement : Each licensee who receives nuclear material must physically verify the consistency of what is shipped within 24 working hours compared to the technical and accounting documents to the shipment. He shall submit an inventory change report to the IRSN in connection with the physical verifications mentioned above. This report may be different from the shipper's report to the IRSN (input data mistakes, measurement uncertainties, etc...). Those differences are analysed by the IRSN and technical justifications are normally requested from the operators.

3 PRESENTATION OF THE FRENCH EXPERIENCE

3.1 Answers given in the implementation of the main regulation articles

3.1.1 Quality Assurance Policy

An important effort of procedure drafting has been initiated by the Order of 1994 to meet the requirements of a quality assurance policy. The nuclear material activities have been treated as all other activities submitted to quality assurance, with the same reference frames (ISO standards). As far as the implementation of the Quality Assurance is concerned, we may distinguish two types of operators:

The first group deals with operators who work in the field of nuclear activity and who belong to the licensing regime, the second one is made up of operators mainly belonging to the declaration regime.

The main operators who work in the field of nuclear activity know fairly well the law and have the financial and human resources to apply it. These operators are EDF, CEA, and AREVA, and the application of the ministerial Order of 1994 does not pose a major

problem. They all have decided to centralise the responsibilities of the accounting of nuclear material, so it is the headquarters of these companies that have the responsibility to implement the quality policy required by the regulation. A real difficulty regarding this quality policy sometimes appears when trying to make the personnel in the facilities understand that the range of regulations concerns not only the nuclear material used in the main nuclear fuel cycle, but also the products used for chemical analyses for example, or any device made with depleted or natural uranium. This can lead to not declaring these nuclear material. The inspectors must check, in every site, how these types of articles are taken into account.

For the operators who belong to the declaration regime, the point is different. In fact, most of these companies hold depleted uranium either as a biological protection in the devices which use gamma ray sources or counterweight for mechanical purposes. The inspectors often have to inform these operators because they do not correctly know the regulations concerning nuclear material. They feel the regulation as a burden with no clear relevance to their main activity. The implementation of the quality policy is sometimes incomplete, but the accounting is generally done correctly.

3.1.2 First and second level checks

The Order of 1994 imposes two level checks so that the receiver can determine in quality and quantity the nuclear material received. This point provided a better mastery in nuclear material exchanges.

In the 24 hours following the delivery of the nuclear material, a first level of check is applied to ensure that there are no discrepancies in relation to the shipper's information, using fast, non-destructive assays (item counting, label checking, weighing, radiation measurements, etc..).

Later on just before actual use, a second level of check is carried out to verify accurately the quality and quantity of the nuclear material received. If this check is not possible at the facility, the receiver of the materials should carry out audits or have them carried out at the shipper's facility. In fact the operators rarely choose this second possibility.

3.1.3 Acknowledgment of receipt

For a long time, upon a shipment-reception of nuclear material between two installations, the national accountancy decremented bookkeeping stocks of the sender and incremented automatically those of the receiver for exactly the same quantities. Now the addressee declares by an "acknowledgment of receipt" what it estimates really to take. In this way, he remains fully responsible of his own bookkeeping. When nuclear material are shipped, the receiver will be only credited of a value well identified as provisional state in the national database. This one will be replaced later on by the declared value by the receiver. That avoids the creation of anomalies in declarations in case of a transport cancellation for example. Furthermore this obliges operators to take into account immediately the nuclear material exchanged and the national bookkeeping can more efficiently monitor all materials in transit.

This working procedure is practically standardized for all French nuclear operators.

3.1.4 Shipper receiver protocol

The Order of 1994 introduced a shipper-receiver protocol, which is obligatory for plutonium and uranium enriched to more than 20 %. The regulation does not formally impose a threshold for the writing of protocols. The operators have to produce a document even in the case of the dispatch of waste, samples or standards. These protocols allow the definition, in advance, of the respective roles of the shipper and the receiver of nuclear material. Protocols must be checked and passed by the Ministry of Industry before any transport. This allows the Competent Authority to know both the controls applied by receiver at the arrival and the controls before the implementation of the nuclear material. The IRSN takes charge of analysing these documents.

These protocols have many advantages. As the protocol studies all cases of rejection, it reduces the risk of being refused by the receiver. Another example, if a dispute occurs over the quality or the quantities of the nuclear material between the shipper and the receiver, the protocol provides that a laboratory is appointed to arbitrate the issue. That makes the protocol define clearly the acceptability threshold values and the name of a referee laboratory. It is also possible for the receiver to have assurance about the accuracy of the reliability of the shipment of the nuclear material through an audit of the quality policy of the sender. Some times ago, the first versions of protocols were often refused because they did not include that type of information. That is no longer the case.

Moreover, the same principle has been extended by certain operators on a voluntary basis, to the transportation of nuclear material, such as depleted uranium or uranyl-nitrate solutions. These types of protocols are now particularly used when transfers between two operators require regularly transportation.

3.1.5 The ledger

The presentation of stock variations is henceforward exclusively realised from computerised databases. For the most important nuclear sites the ledgers of all entities are edited either by the accountant of the site in a single document (AREVA), or by the accountant named in each entity (CEA). For most small owners of nuclear material, the ledger is often an edition of an extracted datasheet. To warrant authenticity of the values, inspectors demand a manual signature on monthly stocks. Although the paper support remains an official reference, inspectors ask for their checking on database interrogations.

3.1.6 Inventories

The Order of 1994 requires operators to make a yearly physical inventory of the nuclear material present in their installations, and to send a written report in the following 45 days. Some operators thought that they could avoid doing so because being under the quality assurance policy, they knew at any given moment the nuclear material present on the site. They thought that they were on a "permanent physical inventory". In this case, the inspectors were obliged to explain that the aim of the law is to detect a theft or a false declaration and only a physical inventory can provide knowledge about the presence or absence of an article. There are several methods of carrying out a physical inventory. One of them used by a lot of operators is computer accounting, which extracts a listing and checks the presence of an article with weighing when it is possible. This method allows for the detection of a theft or a false declaration. This method was accepted especially for operators who have many references in a same installation. On the other hand, for

operators using biological shielding with uranium, only an identification of the articles is required because the uranium is not often accessible. One point that operator must understand is the conservation of the technical documentation signed by the on-site personnel who carry out the annual physical inventory. In fact, many operators working on the document used to clean it by erasing all traces of notes taken by the personnel as well as the signatures, which justified the work. These practices have been given up and the inspectors now have all original drafts.

3.2 Inspections and analysis activities in nuclear material control and accountancy

The law of July 1980 institutes a checking of the efficiency and of the reliability of dispositions taken by nuclear material owners. This checking is mainly realised by inspectors of the IRSN commissioned by the Competent Authority. The Radioactive Material Security Department employs about 50 inspectors, 15 of whom are domestic safeguards inspectors who inspect all nuclear facilities holding nuclear material in France except the military facilities. 3 inspectors are specialists in accountancy, 5 are specialists in nuclear material measurements, and the others are in charge of physical protection. Since the inception of the national control system in France, the inspection effort concerns each year facilities under the authorization regime as well as the declaration regime. In France, there are approximately 250 facilities holding nuclear material under the authorization regime and more than 500 small owners under the declaration regime recorded in the national accountancy. The majority of these facilities are part of nuclear sites, such as research centres, industrial complexes and nuclear power plants. These facilities cover the entire nuclear fuel cycle, from mining of uranium to the storage of waste and plutonium recycling in the manufacture of mixed oxide (MOX) fuel, and include spent fuel reprocessing.

3.2.1 Inspection activities carried out with licensees

The number of inspections in the field of accounting and control is about 100 per year, which represents a global effort (preparation, inspection, drafting) of about 70 man-months. The experience of the IRSN is based on different types of inspections with different aims, and may concern :

- Physical control,
- Accountancy,
- Measurement of nuclear material,
- Physical Inventory taking or checking,
- Receipts and shipments,
- Documentation checking,
- Quality assurance,
- Data processing system evaluation,
- Vacuity report.

Two inspectors are generally involved for each inspection. Moreover, if the scope of the inspection is accountancy, measurement of nuclear material or data processing system evaluation, the inspector in charge of the facility, often calls on other inspectors from specialised divisions of the IRSN. This is always the case when measurements with spectroscopic devices are requested on specific containers with nuclear material or wastes. This also applies to accounting inspections which require specific extractions from the database of the national accounting system, and an on-site analyse, with a laptop computer.

3.2.2 Inspection activities carried out with small holders of nuclear material

As seen above, the French protection and control system of nuclear material is an original system based on detailed and comprehensive regulations, taking the small users of nuclear material into account in a specific way. They are submitted to the declaration regime and called “declarants”. The main nuclear material detained by small owners are depleted uranium and thorium. These materials are present in manufactured equipment (radiation shielding in industrial gammagraphy and radiotherapy, collimation devices and other accessories). The control and accounting are often difficult because the nuclear material are present in devices without the possibility of accessing it. For example, the weight of uranium shielding is associated with a model and masses are determined by the manufacturer. So the masses have the same values for one type of equipment all over France.

Declarants have to meet requirements such as, annual declaration of stock and inventory changes, annual physical inventory and physical protection of nuclear material. Inspections carried out in such facilities allow to check the enforcement of regulation and also to provide information to the operator about this regulation.

Up to now, about 30 “declarants” are controlled each year, which represents a global effort of about 7 man-months.

3.2.3 Analysis activities

In order to be allowed to hold nuclear material, an operator is requested to produce mandatory files to the Competent Authority. The analyses performed by the IRSN cover technical and organisational provisions. They strongly complement inspections that consist of on-site verifications. For each analysis, the engineer in charge of the facility receives the document with the analysis request issued by the Authority. Considering the topic of the file, he can perform the evaluation himself or refer to specialists. A technical visit of the facility is also possible to discuss specific points with the operator.

Each year about 150 files or documents in the field of accounting for and control, 150 inventory reports and 15 shipper/receiver protocols are analysed by written reports by IRSN. Apart from inventory reports, the analyses of these files are submitted to the Authority who finally notifies its decision to the operator.

3.3 Other important induced implementations

3.3.1 Training courses for the operators

The training department of the CEA “Institut National des Sciences et Techniques Nucléaires”, (INSTN) organizes every term a session of 5 days specially devoted to the management of nuclear material. This session applies to all interested persons by this subject without no circumscription. It allows to strengthen the operator’s personnel training in order to improve their qualification and to obtain an external proof of the teaching implementation to be presented in case of inspection or audits. Trainers are mainly experts coming from the different departments of the IRSN, each with their specialty (Accountancy, Transportation, Nuclear measurements..), as well as representatives in charge of nuclear material management in CEA centers.

3.3.2 Exercises of inventory in case of emergency

The crisis situations for nuclear material in nuclear facilities are provided for in the French regulation, as the decree of May 12th 1981 specifies, " In any circumstance, the Ministry of Industry can order a physical inventory of the materials and its comparison with the accountancy records ". Such an inventory can be ordered in facilities holding plutonium or high-enriched uranium, in case of a theft, a blackmail to a theft or a suspicion of materials theft for example. The operators must be able to provide an answer to the question "can the stolen materials come from my facility ? " within a few hours.

To test the organization set in the concerned sites, at the operators and Competent Authority levels respectively, seven exercises of increasing complexity have already been carried out in the following facilities :

- Test fuel fabrication laboratory (1993)
- Uranium metal processing workshop (1995)
- Research centre for defence (1997)
- Research reactor (1999)
- Research laboratory and reprocessing pilot facility under decommissioning (2000)
- Nuclear material storage facility (2002)
- Mox-fuel fabrication plant (2002)
- Physical inventory taking, involving two different sites (Mox and reprocessing plants) at the same time (2003).

All these exercises allowed for setting up a methodology in the preparation and the execution of the exercises of inventory in case of emergency. The main events, which could occur in case of a crisis situation, have been tested. Moreover, the increased complexity of the exercises makes possible to develop the preparation of the installations as well as the organization of the authority for a real crisis.

All these exercises made possible to establish models of the useful documents in the event of a crisis, and this for various types of facilities. The lacks or inaccuracies noted in these documents at the time of the first exercises were corrected.

These exercises have made the operators involved, as well as the companies they depend on, sensitive to the importance of an efficient training for this kind of occurrence.

Finally, the achievement of exercises made possible to implement a crisis center at the State level and to equip it in means of communication. This crisis center is set up under the responsibility of IRSN. A procedure for the activation and operation of this crisis center has also been written. In turn, this document will be improved with the experience feedback of the next exercises.

3.3.3 Security studies

The French Competent Authority requires, by ministerial instruction that specific studies, known as security studies, be carried out to assess the effectiveness of the security arrangements taken for the most sensitive types of nuclear material. These studies cover the physical protection area and the nuclear material control and accountancy area.

A specific tool has been developed by the IRSN to study the ability of a facility to detect the disappearance of material by the control and the accountancy systems. Preliminary security studies in the field of material control and accountancy have been performed by operators of two different types of facilities, the results of which are very encouraging. A more detailed security study was carried out for a nuclear manufacturing facility.

3.3.4 *The use of seals*

The use of seals has been developed broadly over the last 10 years. The first goal sought by operators is to simplify the annual inventory. When nuclear material are identified as out of use for a long time they are regrouped in a safe or the room of a building, which is to be sealed. They constitute a means of quickly detecting a diversion or an attempt of diversion or of dissuading from such actions. Conversely their installation on an empty packing can guarantee vacuity of it.

Since certain provisions at the time of the installation of seals are respected, the only checking of non violation of the seals makes possible to avoid remaking physical checks of the material confined or in emergency situation.

The choice of the type of seals must be adapted to containment concerned and must allow to guarantee a satisfying level of reliability. The IRSN Department in charge of measurements has proposed different types of seals particularly well adapted to the needs of operators and has advised the Competent Authority to require such type of seals for the purpose of the national safeguards. Furthermore, it has identified other types of seals as not acceptable for the national safeguards.

The installation of seals by the owners is done according to a written procedure and gives place to the drafting of an official report established according to a specific procedure. An exhaustive inventory must be carried out and validated by at least two persons, prior to the sealing.

The management of the seals is ensured by means of a register held by the operator.

The breaking of the seals is performed according to a written procedure. It must take into account the control of the seals broken (identification and checking of the claw, if necessary) and their rigorous registration before destruction.