

# Chapter 2

## Security of radioactive sources

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### 2.1. Background

#### 2.1.1. *The specific case of radioactive sources*

Radioactive sources (see Figures 23 and 24) are widely used all over the world, in many different sectors including industry, medicine, research, the agri-food industry and education. There are risks involved in activities which use radioactive sources due to the potential for excessive exposure to ionizing radiation. The possibility of excessive exposure as a result of a malicious act cannot be ruled out. Misappropriate use of radioactive sources must therefore be prevented in order to protect people and the environment. The approach must take account of the huge number of existing sources, their diversity (in terms of activity, radioactive half-life, the type of radiation, physical and chemical form, packaging, etc.) and the many different sectors in which they are used.

Strengthening security for radioactive sources with regard to malicious acts implies first identifying the sources that may be dangerous to humans and the environment if used with malicious intent and, secondly, taking measures to protect these sources in view of the potential consequences of such use. This approach entails prioritizing the sources according to the hazard presented and applying protection and control measures factoring in the risk of malicious use (in line with the principle of a graded approach) during their use, transport or storage. Within this framework, IRSN conducted a program aiming to better assess the risks of any potential malicious use of radioactive sources. The program was structured as below:

- listing radioactive sources and grouping them into different types or families;
- assessing the sensitivity of the different types or families of radioactive sources in terms of the level of the consequences of a malicious act involving their use;

- analyzing the vulnerability of the most sensitive radioactive sources;
- determining the technical and organizational measures to ensure the security of the most sensitive and the most vulnerable radioactive sources.



**Figure 23.** Reconditioning radioactive sources at IRSN, Fontenay-aux-Roses, France. © Olivier Seignette/ Mikaël Lafontan/IRSN.

The results of these studies were then used in an international framework and also to draw up French regulations in this area.

### **2.1.2. Theft and loss of sources**

One of the difficulties in the radioactive source security approach is the huge number of existing sources (around 47,000 sealed sources in France in 2014), the huge number of places where they are located and the huge number of movements of these sources.

In France, the theft or loss of high-activity sealed sources is extremely rare. On the other hand, the theft or loss of unsealed sources or low-activity sources is more common. Loss mainly occurs during transport, sometimes due to delivery error or when sources are not disposed of through the correct channels.

Worldwide, the theft or loss of high-activity sealed sources is also relatively uncommon and decreased in 2014, but can have dramatic consequences for workers and the population; they are the result of negligence or inadequate control. As in France, the main sources lost or stolen involve mobile devices and incidents usually occur during transport, sometimes as a result of a delivery error.

Two significant events which occurred in France in 1999 can be described here. The first involved a gamma radiography projector (Figure 25) containing a high-activity

source which was found on a beach, while the second involved a van also containing a gamma radiography unit which was stolen. In the first case, the police investigation pointed to a suspected malicious act by an employee of the company in question; in the second case, the vehicle and the source were found at a non-ferrous metal waste conditioning plant, leading one to think that the thieves did not intend using the source for malicious purposes but rather that they were more interested in the equipment in the van.

These cases serve to remind us of the importance of early detection when a source goes missing, reporting its loss or theft and the need to recover it as quickly as possible.

### 2.1.3. *Historical background*

In 1995, the IAEA launched a broad program aimed at combating the illicit trafficking of radioactive material and, more generally, reinforcing security for radioactive sources. This program resulted in the implementation of an action plan, approved in 1999 by the IAEA Board of Governors, and the organization of several international conferences on this subject. This all led to publication of the "Code of Conduct on the Safety and Security of Radioactive Sources", together with technical guides presenting, in particular, a categorization of radioactive sources and setting up a database of incidents involving radioactive sources.

The "Code of Conduct" was approved by the IAEA in September 2003 after reinforcing its scope, bearing in mind the attacks of September 11, 2001 which, although they did not involve radioactive material, demonstrated the level of preparation achieved by certain terrorist organizations.



**Figure 24.** Sealed radioactive sources in their lead box, Université Toulouse III - Paul- Sabatier (France).  
© Albin Millot/IRSN.



### **2.2.2. "Code of Conduct"**

The aim of the IAEA's "Code of Conduct" on the safety and security of radioactive sources is to attain a high level of safety and security for the most dangerous sealed sources. To this end, it presents guidelines on the principles of protection to be implemented and on the regulations relative to the safety, radiological protection and security of radioactive sources (physical protection). It is intended as a guide to Member States, particularly in drawing up and harmonizing their policy and regulations regarding the safety and security of radioactive sources. In this Code, only the first three categories out of the five mentioned above are subject to recommended security measures, excluding unsealed sources, nuclear material and defense-related sources which come under specific regulations.

In addition to the "Code of Conduct", the IAEA guidance relative to imports and exports of radioactive sources recommends a system for notifications between States to improve tracking of Category 1 and 2 sources.

### **2.2.3. Euratom Directive**

The EU directive known as the "Euratom Directive" on the control of high-activity sealed radioactive sources (HASS) and orphan sources makes certain sources subject to specific requirements. This directive, the main purpose of which is not the security of radioactive sources with regard to malicious acts but radiological protection, nonetheless includes general measures related to security, such as the obligations regarding labelling sources, the need for holders of radioactive sources to obtain prior authorization, the need for a competent authority in charge of keeping a register of all holders and the sources held, etc.

## **2.3. French organization**

### **2.3.1. Regulatory framework**

The French regulations relative to the use of ionizing radiation are primarily contained in France's Public Health Code and Labor Code. The regulations factor in the recommendations contained in the IAEA's "Code of Conduct" on the safety and security of radioactive sources and the provisions of the Euratom Directive on the control of high-activity sealed radioactive sources (HASS) and orphan sources.

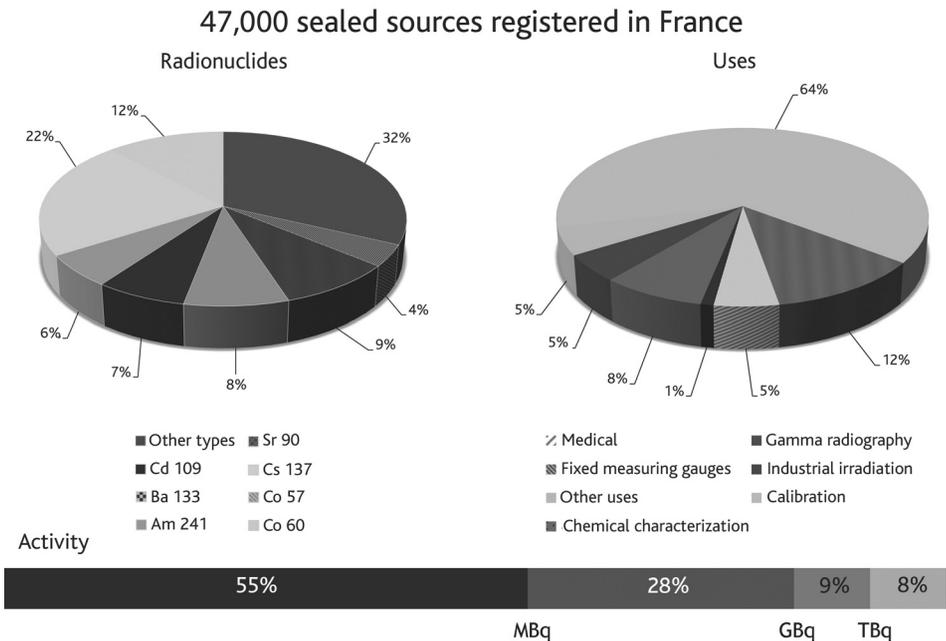
The Public Health Code has been extended, in addition to radiological protection concerns, by provisions relative to the security of radioactive sources. This Code specifies, for every radionuclide, the activity level above which a sealed source is a high-activity sealed source and provides for general measures for tracking such sources:

- identification and labeling;
- submission to the competent authority of an annual inventory of sources held and the capability of the holder to conduct an emergency inventory at any time;
- a control system for transfers of sources with submission to the competent authority of a source movement report by suppliers.

These measures are supplemented by general provisions also relating to the security of sources:

- a system of authorization licenses for manufacturers, suppliers and users, and also for the transport of radioactive material;
- recovery by the suppliers, by an approved entity or by another licensed holder, of sources at end of life or after 10 years, with the supplier under obligation to inform the competent authority of any source not returned within the set periods;
- the implementation of security measures at storage sites (a locked room with controlled access).

Based on the IAEA’s categories of sources and the measures mentioned in the “Code of Conduct” and the Euratom Directive, it can be observed that, of the 47,000 sources registered in the French national inventory in 2014, approximately 10% (4,600 sources) are HASS in the meaning of the Euratom Directive, liable to cause severe exposure to ionizing radiation. Figure 26 shows the breakdown of sealed sources registered in France by activity, by radionuclide and by type of use. The security measures deployed in France mainly apply to these high-activity sources in accordance with the principle of a graded approach and based on the IAEA’s categories. The approach adopted is primarily prescriptive (as opposed to a performance based approach developed for the protection of nuclear material) insofar as it applies to a diverse range of operators, some of which (hospitals and universities, for example) do not have the necessary resources to design a



**Figure 26.** Range of activities in which sealed sources are used in France, broken down by activity, radionuclide and type of use.

protection system for their sources and manage sensitive information specifying, for example, the threats against which they need to be protected.

To ensure the desired level of consistency between safety, radiological protection and security requirements, a single authority, the French Nuclear Safety Authority is in charge of enforcing these regulations in France.

In addition, the regulations impose requirements for the radiological protection of workers which may be useful in ensuring security of sources, such as the technical control of sources and the conditions in which they can be used and stored or the existence of internal procedure to be followed in the event that a sealed source is lost or stolen.

The regulations also provide for improved security training for personnel who have access to high-activity radioactive sources.

An implementing order specifying the tracking and physical protection measures for radioactive sources according to a graded approach will soon be added to this system. Within the framework of implementing these new regulatory measures designed to tighten security of radioactive sources, IRSN will be providing technical support to the French Nuclear Safety Authority.

### **2.3.2. *France's national register of sources***

One of the key measures recommended in the IAEA texts is to keep records of and track radioactive sources, particularly of Category 1, 2 and 3 sources, by means of a national register of sources.

In France, IRSN is responsible for national tracking of sources. It requires that:

- anyone responsible for a “nuclear activity” as defined in the Public Health Code shall provide information to IRSN on the characteristics of the sources, identification of the places where they are held or used and details of their suppliers and buyers. The procedures for maintaining the inventory of ionizing radiation sources, including keeping an up-to-date national register of radioactive sources, are defined in the regulations;
- all holders of radionuclides in the form of radioactive sources, or of products or devices containing them, must be able to demonstrate at all times the origin and destination of the radionuclides present on their premises for any reason whatsoever. For this purpose, they shall set up a tracking system on their premises to ensure that the inventory of products held is available at all times.

To track radioactive sources at national level, IRSN has developed a management tool and an Internet portal accessible to all source holders. For every holder, the following information is registered using this management tool: the source reference, the radionuclide, its activity, its source number where available, the source supplier and also the device reference and number if the source is contained in a device. No source can be moved unless the required information has been recorded in the management tool. Furthermore, IRSN receives annual inventories submitted by the source holders and users, compares these data with any movements of sources registered in the management tool, analyzes any differences and regularly updates the national inventory of ionizing radiation sources.