

## **EXPERIENCES AND FUTURE CHALLENGES ON EDUCATION AND TRAINING AT IRSN ON NUCLEAR SAFEGUARDS AND SECURITY**

Pierre FUNK, Camille DECROOCQ and Florian MATHON

*Institut de Radioprotection et de Sûreté Nucléaire, B.P. 17, 92262 Fontenay-aux-Roses Cedex,  
France*

### **ABSTRACT**

Because of the large nuclear program in France, French authorities decided to setup a Technical Support Organization, namely IRSN, which is a public institute with currently around 1800 employees. As one of its mission, IRSN contributes to education and training on its main field of activities. This paper first presents the overall training effort at IRSN in the areas of Safeguards and Security. The diversity of training, media and audiences is highlighted as well as the evolution of these practices over the past years. With dedicated lecture on nuclear Safeguards and Security in several master programs, IRSN raises awareness among students that could be later involved on these topics. IRSN also provides training for professional, for the sake of its own employees, but also for other national and international audience. These training includes e-learning and face-to-face training, tabletop exercises as well as exercises at a national level. Education and training at IRSN are one component of the larger concept of knowledge management. The paper addresses the methodology that is used at IRSN to identify critical knowledge. It considers skill and expertise, strategy, and weaknesses. The paper finally addresses future challenges: the priority actions on education and training - and more globally on knowledge management - that are proposed for the coming years for nuclear Safeguards and Security.

### **1. INTRODUCTION**

France has a well-developed nuclear energy industry composed of 58 electronuclear reactors and a whole nuclear fuel cycle going from the conversion of yellow cake, to the reprocessing of irradiated fuel, and the production of recycled fuel (MOX fuel or Recovered Uranium fuel). Therefore, France stands as one of the major world actors in the field of nuclear energy production. With more than 60 years of experience in nuclear industry, French training offer is large [1]. It includes education and training programs at several university levels as well as continuing education to train personnel for the industry and the research and development activities. The French expertise allows thereby to build highly skilled professionals.

IRSN, the French Institute for radiological protection and nuclear safety; is the French Technical Support Organization in nuclear and radiation risks. It provides technical support to all the government authorities involved in Nuclear Safety, Security and Safeguards, as well as radioprotection. As one of its mission, IRSN contributes to education and training on its main field of activities. The overall training effort at IRSN in the areas of Safeguards and Security includes:

- dedicated lecture on nuclear Safeguards and Security in several master programs to raise awareness among students that could be later involved on these topics,
- training for its own employees,
- training for professional, for both national and international stakeholders, including e-learning and face-to-face training, tabletop exercises as well as exercises at a national level [2].

Education and training at IRSN are one component of the larger concept of knowledge management. To this regard, IRSN is using a systematic approach to identify critical knowledge, considering skill and expertise, strategy, and weaknesses. The paper addresses future challenges: the priority actions on education and training - and more globally on knowledge management - that are proposed for the coming years for Nuclear Safeguards and Security.

## **2. NUCLEAR SAFEGUARDS AND SECURITY IN MASTER PROGRAMS**

IRSN provides lectures in master programs of French universities, that are not dedicated to Nuclear Safeguards or Security but rather to industrial risk, including nuclear. Within these programs, these lectures explain the international and national framework, for the students to understand the basics on Nuclear Safeguards and Security. It is a way to **raise awareness** to students that could later be involved in these domains. It is also useful to propose internship to the students and later to recruit them.

These programs are currently available at the engineering school INSA Centre Val de Loire and in two universities (Université Grenoble Alpes and Université de Nîmes).

It is very common to have students that discover these topics for the first time whereas they usually already have many academic courses on nuclear safety and radioprotection. In 2020 and 2021, due to the COVID-19 pandemic, the lectures were done using video conferencing system, with very little impact for the students. Indeed, the feedback from the students was very good.

IRSN is also participating in the new coming specializing Master on Nuclear Safeguards, sponsored by the European Commission and organized by Politecnico de Milano (POLIMI) and the European Nuclear education Network (ENEN) [3]. The first period of this master is scheduled for the period October 2021 – October 2022. Within this master, IRSN will coordinate the module on **Nuclear Security**. The corresponding session is schedule in May 2022 for two weeks. It will be based on pre-recorded videos, home-based assignment, working group assignment, and live session with both the students and the teachers.

### 3. TRAINING FOR PROFESSIONAL

IRSN provides training for professional, for the sake of its own employees, but also for other national and international audience.

#### For IRSN's employees

- On Nuclear Safeguards, for the initial training of new staff members working in the non-proliferation department of IRSN, an internal process of training is in place with a mentoring period managed by a senior expert of the department. This process is composed of training units provided progressively over a year punctuated by milestones and covers the extensive general knowledge on Safeguards. Some specific job tasks allow the trainee to go into more details for particular topics. This process ensures to address the workforce renewal challenges and knowledge continuity. New staff members also take the ESARDA course on Nuclear Safeguards and Non-Proliferation, co-organised by the JRC's Nuclear Safety and Security directorate and the ESARDA Training and Knowledge Management working group.
- On Nuclear Security, there is a 3 days training module under development with two objectives. The first one is to have a complete understanding of national stakeholders. The second one focuses on the process that is in place at IRSN for providing expertise on Nuclear Security (e.g. typology of Nuclear Security topics, interfaces with safety, etc.). The target audience is any IRSN staff members involved in Nuclear Safety or Nuclear Security expertise.

#### National training

These training includes e-learning, face-to-face training, tabletop exercises as well as exercises at a national level.

- E-learning on the new French regulations governing the security of radioactive sources. IRSN put a learning module online in December 2020 to support those responsible for implementing, as of this year, the decree on the protection of ionizing radiation sources against malicious acts [4]. This module is intended for those responsible for nuclear activities owning, using, manufacturing, distributing, importing, exporting or transporting ionizing radiation sources, as well as personnel authorized to access and transport ionizing radiation sources. This e-learning has already met a diverse audience, whether it be hospitals, universities, or nuclear operators (ORANO, EDF, etc.).
- Tabletop exercise on Nuclear Material Accounting and Control (NMAC) and State System for Accounting and Control (SSAC).  
The tabletop exercise developed by IRSN has a standard duration of two days. It is a role-playing game where the missions of the main actors in the management of nuclear material are attributed to the participants. The purpose is to provide each participant with the information necessary to a global understanding of the principles of nuclear

material management as requested by the French regulation (decree and order on "physical follow-up and accountancy of nuclear material") as well as in the EURATOM Regulation No 302/2005 of 8 February 2005. Therefore, both NMAC and SSAC point of views are addressed:

- Organizational and human separation between follow-up, accountancy, physical protection, management of transport;
- Daily information flow of nuclear material associated with an ongoing cross-checking of accounting and transportation data at central level;
- Separated databases deterring malicious action.
- Practical implementation in order to fulfill both Safeguards and Security commitments.

Participants may be facility operators as well as regulators and technical support organization.

To this end, a facility that handles and processes nuclear material is considered. Participants have to carry out all physical follow-up and accountancy activities of nuclear material by simulating the physical operations to be carried out on such materials. It concerns for instance the receipt of nuclear material, its transformation, followed by its internal and external transfer. At the end of these operations, a physical inventory is carried out at the facility as well as a Material Unaccounted For (MUF) calculation.

- Exercises developed at a national level.  
There are of two types.
  - a) "Protection and security assessment exercises", namely EPEES exercises, are national exercises managed by the French *Nuclear Security* authority. The overall organization of the response to a malicious act at a nuclear facility is tested. This means that safety and security response plans are implemented, and the coordination and interaction of entities involved are tested. These exercises are based on the Design Basis Threat with the deployment of local and national response forces. *Safety aspects are simulated.*
  - b) Safety drills where the initiating event is a nuclear security event, are exercises managed by the French *Nuclear Safety* authority. The decision-making processes between Safety and Security authorities and the operator is tested, this is done at local and national level. *Security aspects are simulated in those exercises.*

### International training

The title of the on-going training course is "Implementing Nuclear Safeguards in practice". This training course, proposed in the framework of the Instrument for Nuclear Safety Cooperation of the European Commission (INSC MC3.01/18), is managed by IRSN. The objective is to strengthen the capabilities of regulatory authorities and technical support organizations in charge of Nuclear Safeguards in fulfilling their countries' international Safeguards obligations by providing adequate training.

The course was expected to be held 6 times during the period 2019-2021. The pilot session of the course was held in December 2019. The COVID-19 breakout resulted in the halting of international travel and the 3 sessions scheduled in 2020 have been eventually canceled. It was agreed at the beginning of 2021 to move on to virtualized sessions of the training and the first one is scheduled on September 2021. The learning outcomes will remain the same - application of Safeguards and verification activities based on practical case study - using as much as possible interactions between participants to promote their engagement.

The virtualized course will be hold for 9 consecutive days using the following educational tools:

- Bibliographic resources selected by the lecturers that will be studied by the trainees on their own before the course. This reverse pedagogical approach is more demanding than passive listening to a presentation and therefore much more engaging.
- Pre-recorded video by the lecturers on dedicated topics.
- Short videos of the module leader between each module to make the link between the topics.
- One virtual class per day to allow interaction between trainees and lecturers. It will be dedicated to Q&A sessions and to present the practical cases. This daily live session is essential in order to make up for any potential misunderstandings.
- Throughout the course, a forum will be open on the internet in order to allow participants to interact with each other either individually or in groups.

After the attendance to the course, the trainees will:

- understand the international and EURATOM Safeguards agreements including the Additional Protocols and the Small Quantity Protocols;
- be able to contribute to the practical implementation of Safeguards in their country in applying the principles of nuclear material accountancy and control;
- understand differences and interfaces between Nuclear Safeguards and Nuclear Security;
- be able to describe Safeguards techniques and to practically use some of them.

#### **4. KNOWLEDGE MANAGEMENT AND FUTURE CHALLENGES**

Education and training at IRSN are one component of the larger concept of *knowledge management*. IRSN has used a systematic methodology to identify critical knowledge within its Nuclear Security Expertise Department. It started with a data collection process on two axes with regards to Nuclear Safeguards and security topics:

1. the first one is on skill and expertise ⇒ what we do;
2. the second is on strategy ⇒ what we should do, from the management point of view.

Crossing these two axes, it was possible to identify priorities, weaknesses, and to set-up a pluriannual action plan.

This action plan focuses on priority actions that are proposed for the coming years for nuclear Safeguards and security, not only on education and training but more globally on knowledge management. It is organized around four key words:

- Capitalize: books, reports or procedures that need to be written
- Share: establishment of technical and scientific database
- Transfer: tutoring for new employees
- Valorize: scientific and technical workshop to organize, and education and training to conduct.

Here are some examples of actions that were identified: capitalize and transmit to new staff members the necessary knowledge on the security of nuclear material transport; complete the inventory of required cyber skills for Nuclear Security; capitalize the knowledge related to the nuclear material measurement laboratory; ensure the sustainability of skills and knowledge concerning nuclear material accountancy. Last but not least is the priority for the Nuclear Security Expertise Department is to develop the attractiveness of Safeguards and Security topics for young professional.

As described in this paper, the IRSN training offer regarding Nuclear Safeguards and Security is large in order to respond to the need of multiple relevant stakeholders. For IRSN's own employees, the objective is to maintain a high level of skills and expertise in line with the global strategy: it should consider national regulation as well as international good practice; it should use the experience of experts as well as real-life cases; and it is an element that considers more globally knowledge management

## **REFERENCES**

[1] <https://i2en.fr/en/>

[2] <https://formation.irsn.fr/>

[3] <https://www.nuclearsafeguards.polimi.it>

[4] <https://formation.irsn.fr/elearning/>