Chapter 12
Introduction

Said Abousahl

This panel addresses future perspectives in the field of nuclear safeguards and identifies the main current and upcoming challenges from a technological viewpoint, but also in terms of human resources availability and capacity.

Listening to the former speakers and the panel discussion of the previous session on nuclear safeguards, one challenge can be easily identified. It is on the increasing amount of nuclear materials and number of nuclear facilities to be verified/inspected by the IAEA.

Another challenge is related to the new type of materials and facilities that will need to be verified/inspected in the near and mid-term future.

The second challenge (that has not been pointed out in the former sessions) is on understanding the emerging and future nuclear energy technologies and the innovative processes that would impact the nuclear fuel cycles. Small and modular reactors will be very soon a reality. Generation IV reactor will start to be demonstrated in the coming decade before it becomes a reality in two/three decades. What will be the nature of the fuel that will be used by these concepts? What will be the nature of the spent fuels? The wastes generated? Most of the Gen. IV systems are closed cycle systems. What reprocessing scheme will be developed (Pyro? Advanced Purex?,…)? Which fuel fabrication process will be developed? Which enrichment process will be developed and used in the future (Laser technology? Plasma?…)? Are we prepared for safeguarding the nuclear of the future?

Although technologies and methodologies will be at the heart of tackling these challenges, the two challenges deserve different approaches and strategies. The first challenge is mainly on the optimisation and maximising of the resources e.g. automatization of the processes in order to cope with workload generated by the

S. Abousahl (✉)
European Commission, Directorate General Joint Research Centre, Brussels, Belgium
e-mail: said.abousahl@ec.europa.eu

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increasing inspection missions and activities. This can be done by using adapted new technologies and new approach such as the one based on the State Level Concept. Different Gen IV systems and related advanced fuel cycles will bring their own specific safeguards related challenges e.g. Molten salt reactors.

The third challenge is on nuclear safeguards human resources. Safeguards are implemented by inspectors using technologies. How the inspectors are prepared to carry out their missions? Do we have enough vision for the future on human resources capacities in the field of safeguards?

Although the nuclear safeguards mission (the "what") remains unchanged, i.e. to detect and deter the diversion of nuclear materials through accountancy and verification, some open issues as well as new developments oblige us to rethink the "how" and the "who" of nuclear safeguards.

Thanks to the intervention of the three panellists, the three main challenges were identified: 1—new technologies for effective and efficient verification of the current and increase amount of nuclear materials and number of facilities, 2—new technologies to cope with verification of future new types (physical and chemical) nuclear materials and advanced nuclear fuel cycle facilities, 3—the availabilities of competent human resources to implement current and future safeguards with the mentioned challenges.

The panellists have addressed the challenges in their presentations:

Anne Harrington and Yosuke Naoi's interventions mainly focused on the crucial importance of the "human factor".

With specific reference to the central role of the IAEA safeguards system, Anne Harrington underlined how competence of the inspectors is a key factor for the efficiency and excellence of the whole system. The focus should be then put on training, communication and outreach in order to create a young generation of professionals in this discipline.

Yosuke Naoi presented the activities of the Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN) of the Japan Atomic Energy Agency (JAEA), stressing the importance of the capacity building and of the international and regional dimensions for the harmonization of Human Resource Development.

William Janssens's intervention focused on new technological developments, however putting more emphasis on the opportunity that they represent for enhanced nuclear safeguards. The use of virtual reality, the access to big data as well as laser measurements, pattern recognition and similar advancements, represent an important contribution to better prepare the inspections. Moreover, these tools can improve the outcome of the inspection while at the same time attenuating the human resources scarcity. Nevertheless, the intuition and empathy of the inspector, together with the capacity to analyse and revise the data obtained, will continue to play a central role.

In conclusion, the session identified two main areas of potential concern to nuclear safeguards: availability and competence of human resources, namely inspectors; and new technological developments. The "human factor" can be seen as a crosscutting issue for the whole nuclear domain, as highlighted by the results of

the *European Human Resources Observatory for the Nuclear Sector* (EHRO-N), to be urgently addressed also for areas such as nuclear safeguards.

From the perspective of new technologies, it can be concluded that they remain a key element in the challenge to the implementation of nuclear safeguards. Innovative technology provides a valuable opportunity for enhancing the safeguards performance and compensating for some of its weaknesses. The development of Innovative safeguards technologies for the innovative fuel cycle concepts is crucial and the big support programmes to the IAEA in safeguards (US, EC, Japan,..) have an important responsibility in this regard.