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Training course

Implementing Nuclear Safeguards in practice

Online Session, 2-12 December 2024

The training is for the benefit of employees of regulatory authorities and their relevant technical support organization that are in charge of nuclear safeguards. **Basic knowledge in the fields of nuclear energy and the international regime controlling it are pre-requisites for attending the course.**

Training course organization

Course hold remotely - for 9 consecutive days (excluding weekend) - using several educational methods:

- Bibliographic resources selected by all lecturers that will be asked to be studied on their own before the course. The transfer of this specific knowledge will be verified by a quiz. This reverse pedagogical approach is more demanding than passive listening to a presentation and therefore much more engaging.
- Recorded video by the lecturers
- Virtual classes:
    - At the start of the course in order to give all the information on the course modalities (planning, tools, user manual of the LMS)
    - One session per day to allow interaction with lecturers during sessions of question/answer (Q&A). This session is essential in order to have the feeling of the participants live and possibly to make up for any potential misunderstandings.
    - Practical cases will also be offered in virtual class. Work can be done in virtual sub-groups and restitution in plenary.
    - At the end of the course in order to allow the live exam as well as the round table at the end of the course

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Contents of the training

A2 A3. Non-proliferation treaty and IAEA verification
The objective is to present the context of the international Safeguards on nuclear materials to deal with non-proliferation issues. The historical aspects of the NPT are presented, explaining why this treaty was submitted to the UN and the goals of IAEA verification: to prevent any diversion of nuclear material, using the concept of significant quantity, timeliness and detection probabilities. The main agreements are mentioned i.e. INFCIRC 66, INFCIRC 153 obligation, and VOA.

B2. INFCIRC 153 in practice
This lecture presents the specific requirements for states with a comprehensive safeguard agreement (CSA), i.e INFCIRC 153 obligation.

B3. Small quantity protocol (SQP)
This lecture presents the specific requirements for states with limited or no nuclear material and activities. The main differences between a full comprehensive safeguard agreement (CSA) and an SQP are addressed. The example of implementation of such SQP is provided.

C3. Additional protocol & Complementary access
The historical context that lead to the introduction of an additional protocol is presented. Details of the content of additional protocol is addressed with regards to the objectives. A specific focus is provided on complementary access and the activities that can be achieved by the IAEA in this context, for instance the differences between an inspection and a complementary access. This verification tool that is used by the IAEA needs specific organization from the states. The case of France is presented as an example.

D2. Euratom and ABACC
The implementation of international Safeguards on nuclear materials within the context of a regional control, and most notably the EURATOM treaty and ABACC is then explained as well as an overview of the IAEA control within the context of EURATOM control in Europe. The obligations of the nuclear materials holders are detailed.

D3. EURATOM inspections
This lecture presents how EURATOM inspections are conducted: what the operator has to do in order to prepare and to answer properly to inspector's request. The different types of inspections' activities are detailed. Furthermore, the role of the regulatory authorities as well as operators is described.

E2 E3 F1. WG activity, SSAC Case study
During the working group sessions, the participants will work in subgroups to apply the concept of State System of accounting and Control. Each subgroup will evaluate and update its SSAC for a hypothetical facility.
During this exercise the participants will have to define:

- Material Balance Areas,
- Key measurement points,
- Systems for operation's recording.

Each subgroup will present briefly a summary presentation of its results to the group for discussion.

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F2 F3. Non-destructive assay: gamma-ray spectrometry

This lecture gives an overview on the use of gamma spectrometry for Safeguards purposes. Principles of gamma spectrometry techniques for the identification and characterization of nuclear material are explained. It includes examples of measurement of uranium enrichment and plutonium isotopic composition.

G2 G3. Non-destructive assay: neutron counting

This lecture gives an overview on the use of neutron counting for Safeguards purposes. Principles of these techniques for characterization of nuclear material are explained. It includes example of measurement of plutonium mass.

H2. Destructive assay

This lecture gives an overview on the use of destructive assay for Safeguards purposes, with explanation of the main advantages/disadvantages of these techniques.

H3. Containment/surveillance and monitoring

This lecture introduces the basic principles of containment, surveillance (C/S) and monitoring of nuclear material, with a focus on optical surveillance and sealing systems. It will make the trainees understand the specificity of C/S techniques, the different strategies and the techniques currently used, based on different example of the facility encountered in the nuclear fuel cycle.

I2 I3. Course closure

The course closure includes a conclusive lecture. It is followed by a final exam held to assess the trainees' learning based on a multiple-choice test. A course evaluation is also done by the trainees as well as the trainers in order to provide feedback to the module leader.

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Timetable of remote session

One session of Question and Answer (**Q&A**) is scheduled each day, to expand on topics from the day before.

Blue: virtual class (time will be defined according to the list of participants) **Red: recorded lectures**

Duration	**Monday (Day 1)**	**Tuesday (Day 2)**	**Wednesday (Day 3)**	**Thursday (Day 4)**	**Friday (Day 5)**
1h	A1 Module Opening & group presentation	B1 **Q&A** on A2 A3	C1 **Q&A** on B2 B3	D1 WG activity, AP and CA case studies	E1 **Q&A** on D2 D3
1h	A2 NPT, IAEA verification (1)	B2 INFCIRC 153 in practice	C2 WG activity, SQP case study	D2 Regional control - Euratom and ABACC	E2 WG activity SSAC Case study (1)
1h	A3 NPT, IAEA verification (2)	B3 SQP	C3 Additional Protocol & Complementary Access	D3 Euratom inspections	E3 WG activity SSAC Case study (2)
	Monday (Day 6)	**Tuesday (Day 7)**	**Wednesday (Day 8)**	**Thursday (Day 9)**	
1h	F1 WG activity SSAC Case study (3)	G1 **Q&A** on F2 F3	H1 **Q&A** on G2 G3	I1 **Q&A** on H2 H3	
1h	F2 Gamma-ray spectrometry (1)	G2 Neutron counting (1)	H2 Destructive assay	I2 Course closure (1)	
1h	F3 Gamma-ray spectrometry (2)	G3 Neutron counting (2)	H3 C/S and monitoring	I3 Course closure (2)	