

# Connector

Issue 9 | Autumn 2023



## EDITORIAL

by Mari Lahti (ESARDA President)

I must confess that the opening of the Joint INMM&ESARDA Annual Meeting, on behalf of ESARDA, held in Vienna on 22 May, was something much bigger than what I had imagined when considering candidacy for ESARDA's Vice-Presidency. This event was certainly the largest and most prestigious audience I have ever spoken to. Thankfully, I received great support from our former President Willem Janssens and INMM President Mark Schanfein. The whole preparation process that involved regular meetings, was a learning

opportunity and it was a pleasure to observe closely how such big events are professionally organised. The main responsibility for the arrangements was handled by INMM, but hopefully we were able to offer a useful European perspective and complement the planning with our expertise.

The programme that was compiled as a joint effort was impressive. The idea that had been brewing for many years of bringing the two *continued on page 2...*

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Technical articles covering the latest findings on fundamental issues.

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- Safeguards Implementation in Switzerland and Liechtenstein Complementary Accesses and Environmental Sampling





Photos of the INMM/ESARDA Joint Annual Meeting in Vienna Austria, in May 2023. In clockwise order starting from top left: 1. Plenary session open speech, 2. Remote speech of IAEA Director General Rafael Mariano Grossi, 3. Demo of Mobile robotics for the surveillance of fissile materials storage areas, 4. Participants during break in between sessions, 5. ESARDA President Mari Lahti giving her speech during plenary session, 6. Participants during a panel session.

professional societies together expanded the outreach and attracted new participants. I am sure that connecting the networks of INMM and ESARDA provided unique opportunities to get high-level speakers. We were pleased to see the Director of Euratom Safeguards, Dr Stephan Lechner, amongst the distinguished speakers of the Opening Plenary. We also appreciate that Ambassador Stephan Klement, the Permanent Representative of the EU to the UN organisations in Vienna, joined us for the opening of the President's Reception. In the Closing Plenary we had another European Safeguards Director, Mr. Jaakko Leino from STUK, giving insight into the progress of the Finnish Deep Geological Repository. I am grateful to the whole INMM and ESARDA community for making this great event happen. It was a rewarding and memorable experience in many ways, and I was proud to witness members thrive in panel discussions, chairing sessions and presenting the results of their work.

The themes of the meeting naturally reflected the worrying international developments that

affect also nuclear safeguards and non-proliferation. One such memorable session, organised by WINS, dealt with the Russian war against Ukraine and the future of nuclear order, and consequences for nuclear security, safety and non-proliferation. Hopefully, in addition to the darker perspectives, everyone received some professional and useful fresh knowledge, made many new contacts, and enjoyed the meetings.

One of the highlights of the meeting was when two of our previous Presidents, Irmie Niemeyer and Willem Janssens, received the INMM Fellow status as proof of their merits. In the Closing Session, Vice-Presidents of the two organisations, Tina Hernandez and Walid M'Rad Dali, announced upcoming events; the INMM Annual Meeting in July 2024 in Portland, US, and ESARDA's next Open Symposium in 2025 in Belgium. These two venues will certainly be something to explore, especially for beer connoisseurs.

If we move on to other highlights of the current year, there is ESARDA's engagement

with students which culminated again at the end of April for the 21st edition of the ESARDA course on Nuclear Safeguards and Non-Proliferation. This is very important work for educating future experts, for it is necessary that the young generation sustain interest in nuclear technology, safeguards and security aspects. We greatly appreciate the contribution of the JRC, the organising committee and lecturers for implementing this course. In this context, it should also be mentioned that the second edition of the European Commission-funded specialised Master's Course in Nuclear Safeguards will start in November 2023.

As I am writing this at the end of September, we have just thanked and bidden farewell to the participants of the second meeting of ESARDA's Final Disposal Working Group. Posiva was glad to host the event in Olkiluoto and the 33 attendees from around Europe and the United States. Working Group Chairs Klaas van der Meer and Mentor Murtezi had put together an interesting programme for the two days. We were also honoured to have JRC Director for Nuclear Safety and Security, Ulla



Engelmann, participating in the first day of the programme and hearing about the JRC's R&D activities in the nuclear field. I was rather anxious, up until the days before the meeting, as to whether we would be able to arrange a visit for the participants into the Geological Repository using our brand-new personnel lift. Luckily, the commissioning of the lift went as planned and we were able to offer a ride taking just over a minute to a depth of nearly 450 metres.

Finally, looking ahead to next year, the upcoming opportunities to meet within our community will be at the turn of January-February 2024, possibly at the JRC premises in Geel, Belgium, where we have plans to gather two Working Groups and hold Steering Committee and Executive Board meetings. Then, in mid-May we will have the traditional Annual Meeting in Luxembourg. I hope to see you all again at these events.

I wish everyone a rewarding last quarter of the year. Here in the north, the daylight starts to decrease, and the air gets colder, so it would be natural to look for a place to hibernate. But no such luck, there is still work to be done before starting the final disposal of spent nuclear fuel.

Mari Lahti  
ESARDA President



Visit to Geological Repository in Finland during the second meeting of ESARDA's Final Disposal Working Group

# news & events

Keeping you up to date with all the latest news of the association and its partners, as well as all the upcoming events in the near future.





## NEWS

### IAEA Bulletin Publishes Article on Applying Nuclear Safeguards During Decommissioning

The IAEA helps deter the spread of nuclear weapons through a set of technical measures known as safeguards, which work by verifying that countries are honouring their international legal obligations not to misuse nuclear material and technology. These obligations extend to decommissioning projects. As of March 2023, a total of over 200 nuclear facilities had permanently ceased to operate, either because they had reached the end of their natural life cycle or due to national policy decisions. Countries remain legally obligated to fulfill safeguards agreements throughout the process of decommissioning, and, in some cases, afterwards too.

Since decommissioning is a variable and lengthy process, the IAEA has established guidelines to ensure that safeguards continue to be applied until the facility has been determined to be decommissioned for safeguards purposes.

These IAEA guidelines require two main safeguards objectives to be met: the first is to verify that all nuclear material has been removed from the facility to a known location; the second is to ensure that all essential equipment

has either been removed from or made inoperable at the facility.

[Read more.](#)

### HAEA informs: IAEA inspectors' training in Hungary

The training of the IAEA inspectors about the Additional Protocol in the framework of the Hungarian Support Programme, was organised by the Hungarian Atomic Energy Authority between 15 and 19 May 2023. The purpose of the inspections according to the Additional Protocol is to assure the absence of nuclear activities in facilities undeclared by the state to the IAEA and the absence of undeclared activities in declared facilities.

[Read more.](#)

### SCK CEN and SABCA fly radiation detection drones

Demonstrating that drones can map radioactivity over a nuclear site or larger area - that is the mission of Belgian nuclear research centre SCK CEN and aerospace specialist SABCA. Last year, we already presented our first 'radiation detection drone' together. Now we are

also showing images of the heavier artillery. Indeed, in December 2022, the 'X-8 multicopter drone' made its first extensive test flight. Equipped with 3 rugged CsI (Cesium Iodide Scintillation) detectors, it mapped radiation levels over our own BR3 site..

[Read more.](#)

### VERTIC: NPT PrepCom Side Event on Irreversibility

Ambassador Aidan Liddle, the UK's Permanent Representative to the Conference on Disarmament, and Ambassador Susan Eckey, Permanent Representative of Norway to the United Nations delivered the opening remarks to the side event. Ambassador Liddle expressed his hope that irreversibility may reframe the disarmament conversation to envision practical steps towards a disarming world. Ambassador Eckey advocated the importance of building dialogue among States Parties on the concept of irreversibility, in addition to the dialogue currently taking place in civil society. Both ambassadors agreed on the importance of achieving a common interpretation of irreversibility, and continuing to fund research to examine the subject in all its technical, legal, political, economic and social aspects. However, Ambassador Liddle especially empha-





Participants of the 20 years celebration of ENEN.

sised that reaching a shared understanding of irreversibility is not a prerequisite for moving forward with disarmament.

[Read more.](#)

### In September ENEN Celebrated 20 Years of Activities

The European Nuclear Education Network has recently celebrated its twentieth year of activity. In 2019 ENEN signed a collaboration agreement with ESARDA in order to expand its reach in terms of education and knowledge transfer in the field of nuclear safeguards and non-proliferation. ENEN is an organization which was established in France, in 2003 by the efforts of the European Commission with the main purpose of preservation and the further development of expertise in the nuclear fields by higher education and training in Europe.

For this celebration, ENEN decided to develop a high-level Education and Training event which brought together Country Represent-

atives, European Commission Representatives, Education and Training institutions Representatives and civil society representatives.

In close collaboration with their partner institutions, European Commission, European Nuclear Society, SNETP, nucleareurope and OECD-NEA, an interesting debate was launched to tackle the perspectives of Nuclear in Europe and how the Human Resource can cope with the foreseen demand.

[Read more.](#)

### INMM Announces the 2023 J.D. Williams Student Paper Competition Winners

This award was renamed in 2003 to honor the memory of James D. Williams, INMM President in 2001-2002, for his energetic backing of young professionals and tireless support of the INMM to stimulate interest in, respect for, and proliferation of nuclear materials management principles.

To qualify, students must:

- Be a full-time student in an accredited educational institution.
- Have submitted an abstract by the submission deadline.
- Accept the speaking engagement.
- Register for and attend the INMM Annual Meeting.
- Submit a final paper no later than the established deadline (no exceptions).
- Not have won student paper awards at past meetings.

The Institute is pleased to announce the winners for 2023.

[Read more.](#)

## EVENTS

<p>2024 Jan. - Feb.</p> <p>29-01</p>	<p>29<sup>th</sup> January - 1<sup>st</sup> February 2024</p> <p><b>ESARDA Management &amp; WG Meetings</b>  <b>Joint Research Centre of the European Commission, Geel, Belgium</b>  ESARDA is hosting the in person annual Working Group meetings and Executive Board meetings at the JRC in Geel.  <a href="#">[Read more]</a></p>	
<p>2024 April</p> <p>15-19</p>	<p>15<sup>th</sup> - 19<sup>th</sup> April 2024</p> <p><b>22<sup>nd</sup> ESARDA Course</b>  <b>Joint Research Centre of the European Commission, Ispra (VA), Italy</b>  The JRC announces the 22<sup>nd</sup> ESARDA COURSE on Nuclear Safeguards and Non Proliferation to be held in spring 2024. The course is co-organised by the JRC and the Training, Knowledge Management Working Group.  <a href="#">[Read more]</a></p>	
<p>2024 May</p> <p>13-16</p>	<p>13<sup>th</sup> - 16<sup>th</sup> May 2024</p> <p><b>ESARDA 46<sup>th</sup> Annual Meeting</b>  <b>Luxembourg Congress Conference Centre, Luxembourg</b>  The 2024 ESARDA Annual Meeting is planned to be held at the Luxembourg Congress Conference Centre, Luxembourg, from 13-16 May 2024. This annual meeting is a closed meeting reserved to ESARDA Steering Committee, Executive Board and Working Groups' members,  <a href="#">[Read more]</a></p>	
<p>2024 July</p> <p>21-25</p>	<p>21<sup>st</sup> - 25<sup>th</sup> July 2024</p> <p><b>2024 INMM Annual Meeting</b>  <b>Portland Marriott, Downtown Waterfront, USA</b>  Join INMM in July for the 65<sup>th</sup> Annual Meeting. The INMM 65<sup>th</sup> Annual Meeting will discuss topics on Nuclear Materials Management.  <a href="#">[Read more]</a></p>	
<p>2024 April</p> <p>TBD</p>	<p>Second half April 2024 - Postponed from 20 September 2023</p> <p><b>Safeguards and Export Controls for the Export of Advanced Reactors</b>  <b>Organised by INMM California Chapter, LLNL, USA</b>  The Safeguards and Export Control Considerations for the Commercial Export of Advanced Reactor workshop will complement, yet differ from, past INMM workshops that explore AR security concepts by focusing on the potential safeguards and export control considerations.  <a href="#">[Read more]</a></p>	



# working group reports

This section of the Connector has the objective to inform the ESARDA Community about the latest undertaking of the Working Groups' activities during the last six months. Each Working Group Chair has been invited to provide a brief overview of findings in their fields of interest.



## CONTAINMENT AND SURVEILLANCE WORKING GROUP (C/S)

by Katharina Aymanns  
(C/S Working Group Chair), and  
Heidi Smartt  
(C/S Working Group Vice-Chair)

The Containment & Surveillance (C/S) working group (WG) provides expert advice on C/S instruments and methods and serves as a forum for exchange to a broad Safeguards community. The CS WG (18 participants) met on the Friday after the INMM/ESARDA Joint Annual Meeting (May 26, 2023) at the Austria Center, Vienna, Austria. In this meeting, Heidi Smartt (Sandia National Laboratories, United States) took over as chair from Katharina Aymanns (FZJ, Germany), and Vitor Sequeira (JRC, Ispra, Italy) took over as vice-chair from Heidi Smartt. Three presentations were provided during the meeting. The presentation on Project MUTOMCA (Muon Tomography for Shielding Casks) by Astrid Jussofie (BGE, Germany) discussed a field trial with the aim of verifying spent fuel enclosed in thick-walled self-shielding casks and differentiating between spent fuel assemblies and dummy elements using muon tomography. Final results of the field trial are pending data analysis. The second presentation was "A proposal for muon tomography proof-of-principle projects at the Grimsel test site" by Christiane Vieh (Germany) and discussed whether muon tomography is a feasible technique for safeguards and safety considerations in a geological repository. This project/testing will begin in January 2024. Finally, Vitor Sequeira presented the "R2P2," a reusable passive loop seal. The next meeting is expected to take place in the Fall 2023, though a location and final dates have not been finalized.

## EXPORT CONTROL WORKING GROUP (EXP)

by Henri Niittymäki  
(EXP Working Group Chair)

Integration of emerging technologies, the alignment of export controls with international protocols and the collaborative efforts required to address the overlaps between safeguards and export control policies. Through these discussions, the ESARDA EXP-WG has not only recognized the challenges but has also paved the way for pragmatic solutions, ensuring a harmonized and robust approach to export controls in this so called new era.

In November 2022, the Export Control Working Group convened for its 16th meeting, marking noteworthy progress in various areas to international export control efforts. One of the focal points of discussion was the European Export Control Association for Research Organisations (EECARO). Through collaborative efforts, participants explored the challenges and opportunities, working towards aligning export controls with the comprehensive guidelines outlined in EECARO.

A major part of the meeting was devoted to understanding the correlation between states' safeguards commitments and their ability to effectively implement non-proliferation measures. Discussions and shared views at the meeting highlighted key areas where sensitive technology and the implementation of robust export controls are compatible. This understanding will form the basis for the future development of export control strategies.

Experts within the working group engaged in valuable discussions concerning industry mapping related to items listed in AP (Additional Protocol) annexes. These discussions enhanced the accuracy and efficiency of export controls concerning specific items, paving the way for more precise regulatory frame-

works. Real-world scenarios exemplifying the overlaps between Safeguards and export controls were presented and analyzed, fostering a deeper understanding of these complexities. The practical case study provided essential insights, enabling participants to develop nuanced strategies to address such overlaps effectively.

Looking ahead, the group held strategic discussions on the future of the ESARDA Export Control Working Group for 2023 and 2024. Focusing on possible identified but also unidentified priorities and collaboration strategies with international partners, aiming to enhance the impact and effectiveness of the group's initiatives in the coming year.

The 16th meeting of the Export Control Working Group was marked by collaborative problem-solving, knowledge sharing, and proactive engagement. The progress made during these discussions is indicative of the group's collective dedication to promoting ESARDA's part of the global export controls practices. EXP-WG will ideally contribute to the ongoing evolution of international export control frameworks.

Furthermore, the EXP-WG identified topics and possibilities for a 17<sup>th</sup> meeting at the ESARDA-INMM meeting. There was not enough justification for this, still considering travel constraints. However, a couple of years ago, the group started discussions on closer cooperation with the corresponding working group of the INMM. These fruitful discussions and suggestions on topics such as ISO to minimize national export controls and the complexity of integrating Western, including European, electronics into Russian military systems were discussed with group members at the joint ESARDA-INMM annual meeting in Vienna in May 2023. The Chair suggested that these topics be kept on the agenda for the next meeting. The EXP Working Group can proactively respond to the changing dynamics of global trade by promoting cooperation.



## IMPLEMENTATION OF SAFEGUARDS WORKING GROUP (IS)

by Marko Hämäläinen  
(IS Working Group Chair), and  
Marianne Calvez  
(IS Working Group Vice-Chair)

*The Implementation of Safeguards Working Group (IS WG) is a horizontal issues working group of ESARDA. Its objective is to provide the Safeguards Community with proposals and expert advice on the implementation of safeguards concepts, methodologies and approaches aiming at enhancing the effectiveness and efficiency of safeguards on all levels. This WG is also a forum for exchange of information and experiences on safeguards implementation.*

In 2023, the working group organized a first meeting in connection with INMM-ESARDA annual meeting in May in Vienna. This meeting was organised jointly with INMM ISD (International Safeguards Technical Division) in-person, and it focused on e.g., the Safeguards by Design (SBD) and small modular reactors (SMR). The aim is to enhance co-operation between ESARDA and INMM experts on selected safeguards implementation topics also in the future and if possible, to organise the special event on SMRs. About 60 participants attended this half-day meeting.

The second meeting was organised virtually in June and the main topic of this meeting was State Level Approaches. Members were introducing to each other's how the SLA is implemented in their countries, and the IAEA and EC representatives gave their point of views on this topic. We heard about safeguards implementation in the round table describing how the SLAs are currently implemented and what challenges we have faced in different countries. In addition, we had short session on how the bilateral nuclear co-operation between the EU and particular states such as the UK have been implemented, and what this means to the users of nuclear energy and authorities. The meeting was found very useful, and it is our WG's aim to continue discussion about

the evolution of the SLAs and how it affects to the practical safeguards implementation in the states.

The third meeting was organised in hybrid form and was hosted by the STUK in its premises in September in Finland. More than 40 persons were attending to this two days meeting, either in-person or virtually. This meeting was focused on current safeguards topics and approaches in Finland, especially on how spent nuclear fuel disposal project is advancing and the safeguards is implemented in the EPGR facilities (Encapsulation Plant and Geological Repository). Current status of decommissioning of VTT FIR1 research reactor and how STUK implements safeguards on this was presented. Status of two Finnish SMR projects that are ongoing in Finland were introduced, in these projects the safeguards by design (SBD) plays an incremental role. During the meeting we had traditional round table too, where all participating members were requested to inform others what is going on in their countries in the implementation of safeguards.

In connection with this most recent IS WG meeting, the joint half day meeting with ESARDA Final Disposal WG were organised. In this meeting, members of FD WG were presenting the current approach how safeguards for final disposal have been developed and what is going on in R&D field currently. Finally, we heard about knowledge preservation and the challenge to talk those who come after us.

The next years meetings have been already agreed by the group. ESARDA IS WG will continue to organise one meeting in a member country in future too: In autumn 2024 we will meet in Switzerland and in autumn 2025 we will meet in Netherlands. In addition, we will meet also in the annual meetings that will be organised in Luxembourg in 2024 and in Belgium in 2025. All these meetings are envisaged to be organized in a hybrid mode if possible, so that also those members who cannot travel or otherwise be present would have the opportunity to participate and contribute. It was shortly discussed that ESARDA IS WG can convene also virtually on specific topics if requested.

## MATERIAL BALANCE EVALUATION (MBE)

by Vincent Janin  
(MBE Working Group Chair), and  
Michael Whitaker  
(MBE Working Group Vice-Chair)

The Material Balance Evaluation (MBE) Working Group was established in November 2020 to share best practices and knowledge related to MBE in large bulk handling facilities (e.g., reprocessing and uranium enrichment). The main objectives are to (1) establish guidelines on MBE, (2) provide robust methodologies for in-process inventory verification and MBE, (3) share best practices and knowledge, and (4) contribute to international reference through publishing guidelines and ESARDA publications. During the last year, four subgroups were formed: 1) Regulations, 2) Methodologies and Statistical Assumptions, 3) Best Practices for Monitoring and Accuracy Improvements, and 4) Near-Real Time Accountancy (NTRA) Studies and Perspectives

The working group had an in-person + remote meeting in conjunction with the joint INMM-ESARDA annual meeting in Vienna at the end of May. During the meeting, the subgroup on methodologies and statistical assumptions converged to a shared view on uncertainty and began a more detailed discussion of how to estimate uncertainty for specific measurement systems (e.g., tank calibration and weighing systems). The subgroup on NTRA discussed a recent paper on THORP NTRA prepared by representatives from Sellafield for the annual meeting and received two papers from NMCC regarding simulation of a NTRA system in the Japanese MOX fuel fabrication plant. The subgroup on best practices distributed a survey to members to collect information on current practices and challenges; the responses will be reviewed and discussed during a separate subgroup meeting to be held in October. Planning is underway for the next in-person working group meeting in early 2024.



## TECHNIQUES AND STANDARDS FOR NON-DESTRUCTIVE ANALYSIS WORKING GROUP (NDA)

by Andrea Favalli  
(NDA Working Group Chair), and  
Alice Tomanin  
(NDA Working Group Vice-Chair)

In February 2023, Andrea Favalli (EC, JRC) and Alice Tomanin (EC, ENER) were elected as chair and vice-chair of the NDA Working Group, respectively. They joined Bill Geist (DOE-LANL) and Ram Venkataram (DOE-ORNL), who are both vice-chairs of the working group. The first focus of the new NDA board activity was organizing the ESARDA NDA Working Group workshop and co-organized joint NDA and DA working groups, both sessions during the 2023 INMM/ESARDA Annual meeting

### Workshop Summary: Joint INMM/ESARDA NDA Working Group

Date: May 26th, 2023  
Location: Vienna, Austria  
Chairs: A. Favalli, A. Tomanin (ESARDA),  
T. Aucott (INMM)

The workshop aimed to provide an overview of the current state of Non-Destructive Analysis (NDA) techniques, with a particular focus on imaging methods. It featured updates from distinguished organizations, including the IAEA and EURATOM (ENER). Here is a summary of the presentations:

1. The Next-Generation of Non-destructive Assay Tools for IAEA safeguards verification (A. Lebrun, IAEA): The presentation discussed key components of the NDA toolbox, emphasizing the use of the Fast Neutron Collars (FNCL), and the high resolution CZT module based on the H3D M400 sensor for gamma spectroscopy set to deploy in late 2023. It also covered developments in safeguarding spent fuel, such as Passive Gamma Emission Tomography (PGET), neXt generation Cerenkov Viewing Device (XCVD), and Robotized neXt generation Cerenkov

Viewing Device (RCVD).

2. Advancements in gamma-ray imaging for holdup determination (K.P. Ziolk, ORNL): The focus was on position-sensitive detectors and improving imagers' capabilities for holdup detection.
3. Recent development of PGET and PNAR verification for the geological disposal in Finland (R. Virta, STUK): Ongoing developments in Passive Gamma Emission Tomography (PGET) and Passive Neutron Albedo Reactivity (PNAR) were discussed. Preparations for geological repository safeguards were highlighted.
4. Project MUTOMCA (Muon Tomography for shielded CAsks (A. Jussofie, BGZ): The project aims to verify spent fuel in dry storage casks. A field trial performed in early 2023 was presented. Detailed specifications of drift tube detectors as necessary for the project were provided.
5. Applications of muon detection for safeguards at the geological repository (C. Vieh, BGE): The potential of muon radiography in nuclear safeguards was emphasized, including a proposed experiment at the Grimsel Test Site (GTS).
6. Overview of INCC6 List Mode Capabilities (D. Henzlova, LANL): INCC6's enhanced capabilities and advantages, including versatile data analysis and benchmarking results, were discussed.
7. Overview of Euratom activities in NDA for safeguards (A. Tomanin, EC, ENER): The main activities of ENER in NDA (in fresh and spent fuel verification) were presented. The importance of technical collaboration with partners such as the EC-JRC, the IAEA, the US DoE, research centres, operators of nuclear facilities and national authorities, was highlighted. Specific collaborative projects such as the dry storage casks verification based on fast neutrons, the development of PGET, PNAR and software to improve Digital Cerenkov Viewing Device (DCVD) image analysis were mentioned.

In conclusion, these workshop minutes offer a comprehensive overview of NDA techniques in nuclear safeguards, emphasizing the advancements and collaborative efforts in ensuring non-proliferation and security.

### Workshop Summary: INMM/ESARDA, JOINT DA-NDA Working Group

The focus of the joint NDA DA joint workshop was the update on the International Target Values (ITV) process. C. Norman (IAEA) provided the presentation and led the discussions. During this session, several key points and discussions took place:

The group discussed the progress of the ITV developments over the last couple of years, with a focus on the process that led to the creation of the latest version of the ITV (published in 2022). The presentation also introduced the use of the ITV Network on the IAEA NUCLEUS website which will be the platform for the future 'continuous review process' of the ITVs. Key highlights included the extended network of international experts for the ITV review process and the alignment of uncertainties quantification concepts, terminology, and methodologies in the last review.

In essence, this meeting was focused on reviewing progress and planning for the future continuous ITV review process. It included presentations, discussions on upcoming tasks, and emphasized collaboration in this field.

## TRAINING AND KNOWLEDGE MANAGEMENT WORKING GROUP (TKM)

by Riccardo Rossa  
(TKM Working Group Chair), and  
Pierre Funk  
(TKM Working Group Vice-Chair)

The ESARDA TKM Working Group (TKM WG) met with the INMM Education and Training (ETC) committee on Friday, May 26th after the 2023 INMM/ESARDA Joint Annual Meeting in Vienna, Austria.



The meeting attracted about 20 participants and was divided in two parts. During the first part a series of presentations described the activities of the ESARDA TKM WG, INMM ETC, and IAEA Safeguards Training Section. During the second part a discussion was held on current and future needs to Education & Training (E&T). In particular the participants focused on five topics: format, audience, content, effectiveness, budget.

The discussion will continue also in future meetings since the points were really appreciated by the audience. The additional topic of Knowledge Management will be added in the future.

In August 2023 the second edition of the First Level Specializing Master on Nuclear Safeguards, organized by the Politecnico di Milano and the European Nuclear Education Network (ENEN) in the frame of the SATE project (<https://www.nuclearsafeguards.polimi.it/>) was announced. The second edition is scheduled from November 2023 until January 2025.



# featured articles

This section presents prominent articles on the latest news and topics of interest in the safeguards community



## 2<sup>ND</sup> FINAL DISPOSAL WORKING GROUP (FD WG) MEETING

Olkiluoto, 20-21 September 2023

by Mentor Murtezi  
(FD Working Group Vice-Chair) and  
Klaas van der Meer  
(FD Working Group Chair)

For its second physical meeting the FD WG was invited by Posiva to the Visitor Centre at Olkiluoto. The meeting was attended by 33 on-site participants. On the first meeting, the morning session had 10 remote attendants as a joint session of the FD and the Implementation of Safeguards WG.

The meeting, apart from the FD WG members from the EU countries, Switzerland, UK and the USA, was attended by Ms. Ulla Engemann, Director for Nuclear Safety and Security from the European Commission Joint Research Centre and by Ms. Elina Martikka, head of International Cooperation Unit at STUK.

The idea of organizing the physical meeting at Olkiluoto, where the Finnish geological final disposal installations are located, was stimu-



Group photo of the 2nd Final Disposal Working Group Meeting in Olkiluoto on 20-21 September 2023

lated by the nearing date when the process of encapsulation and final disposal of spent nuclear fuel will start. Thanks to Posiva's hospitality and logistical support participants of this meeting had a unique opportunity to be among the first who went down the geological disposal installation using the recently installed personnel lift.

The meeting was opened by Ms. Mari Lahti, Nuclear Safety Manager at Posiva Oy and ESARDA President. Welcoming of participants by Ms. Lahti was followed by Ms. Engemann's presentation of JRC R&D activities in the field

of nuclear safeguards, safety and security.

The three half-day sessions with 11 oral contributions were hosted by Mr. Mentor Murtezi, vice chair of the FD WG.

In the 1<sup>st</sup> session Mr. Victor Sequeira from JRC Ispra gave overview of JRC's R&D input to Final Disposal Safeguards presenting selected tools and techniques developed by JRC and used by Euratom and the IAEA inspectors. Mr. Murtezi from Directorate-General for Energy of the European Commission presented an overview of the process followed by the EC and the IAEA to shape safeguards for the EP and GR highlighting its cooperative and iterative nature and contribution of Posiva, the operator and STUK, Finnish Regulator. Special attention was given to the choices of tools and techniques to be deployed at EP and GR and to recent development of a dedicated IT tool, designed to aid safeguards inspectorates in application of safeguards to the final disposal installations. Mr. Sequeira presented results of August 2023 field trial of an autonomous robot, the "resident inspector" considered for potential deployment in the EPGR safeguards. Mr. Robbe Geysmans from SCK CEN addressed the long-term radioactive waste knowledge preservation challenge exploring the options of "how to talk to those who come after us".

Afternoon of the 1<sup>st</sup> meeting day was reserved for visiting of the disposal facilities. The participants, divided in three groups, had the opportunity to see inside of the EP, including



Group photo, left to right: Elina Martikka (Head of International Cooperation, STUK), Vitor Sequeira, (Project Leader, European Commission - JRC), Ulla Engemann (Director for Nuclear Safety and Security, European Commission - JRC), Mari Lahti (ESARDA President, Nuclear safety manager at Posiva Oy).



peeking into the hot cell where spent fuel will be inserted into copper disposal canisters, and the central area of the GR.

The 2<sup>nd</sup> day hosted seven presentations, four of them were focused on sensing techniques for geological disposal safeguards. Mr. Kirill Khurstalev from the IAEA presented results of the feasibility study of use of seismic monitoring for GR. Mr. Sean Stave from Pacific Northwest National Laboratory described potential application of autonomous 3D electrical resistivity tomography for GR safeguards. Mr. Lee Thompson from Geoptic UK, gave an overview of muon tomography techniques in GR safeguards and its planned test at Grimsel Test Site in Switzerland. Mr. Luis Ocampo from Idaho National Laboratory presented the case of using long-length scintillating fibers for monitoring of nuclear waste repositories.

Mr. Geysmans, focused this time on participation as a way to address social and technical

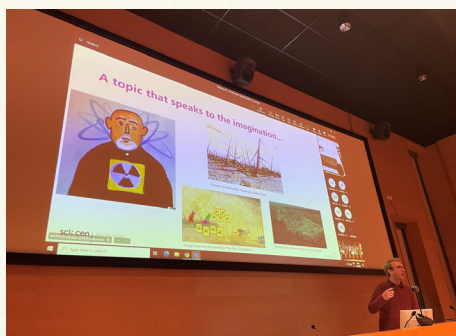
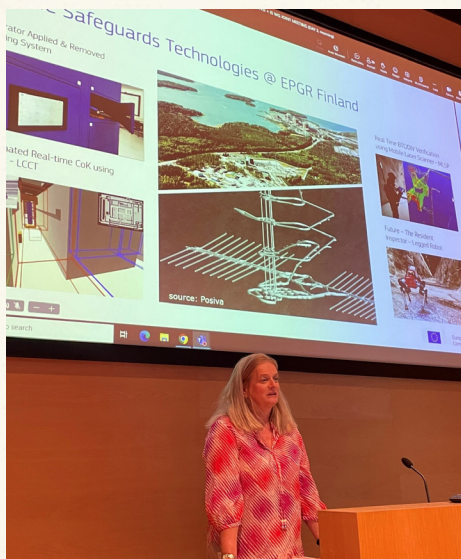
aspects of radioactive waste management identifying good practices and ways of involving all the "stakeholders". Mr. Jani Huttunen from Posiva described optimization process developed by Posiva for selection of fuel assemblies for disposal canisters. Mr. Olli Okko from STUK took participants on the journey almost 40 years back in time, revisiting the SAGOR and ASTOR recommendations to safeguard a geological repository.

At the end of the meeting short reviews of national activities with focus on implications for final disposal safeguards were given by representatives of Belgium, Czechia, Germany, Finland, France, Sweden, Switzerland, United Kingdom and the USA. Finland is the first to operate its nuclear spent fuel final disposal in 2025 but others may follow in not very distant future. Sweden is planning to have its own system operational by 2036. France is to start construction of its final disposal for high

level nuclear waste in 2025 and to operate it by 2035. Other represented countries are still at the site selection stage, nonetheless, the international nuclear safeguards will have to be gradually embracing these complex installations. FD WG constitutes important platform for exchange of good practices, expression of needs and sharing solutions.

This 2<sup>nd</sup> FD WG meeting was organized more than three years after the 1st one, hosted by SCK CEN Mol in Belgium in February 2020. Progress in construction of the EPGR installations in Finland and in installing technical infrastructure for safeguards application designed by Euratom and the IAEA was reflected in the very pragmatic and detailed presentations selected for this meeting and in the discussions that followed between the meeting's participants. Not forgetting about the past and looking into the future, now is the time to deploy tools and techniques withstanding the relevance test when matched with the objectives of safeguards applicable to the EP and GR.

FD WG chairs, Klaas van der Meer and Mentor Murtezi express special thanks to Ms. Mari Lahti and Sanna Mustonen for the great help in organizing this meeting.



Presenters during 2nd Final Disposal Working Group Meeting in Olkiluoto on 20-21 September 2023



## XIII MEETING OF THE CHAUDFONTAINE GROUP

by Quentin Michel  
(European Studies Unit (ESU),  
University of Liège)

The XIII Meeting of the Chaudfontaine Group was held from 1 to 3 October 2023 to explore the possible consequences of the ongoing geopolitical transformations and fragmentation on the future of multilateral export control regimes (MECRs), which could be useful for a new configuration of strategic trade control regimes.

### Objectives

The objective of this workshop was to explore potential future scenarios of strategic trade control regimes and to provide reasoned pros and cons for each scenario.

### Methodology

The participants had to classify the proposed scenarios into four categories and provide justifications for their classification, as well as the pros and cons arguments for each of the scenarios. The categories were as follows:

1. The less likely to happen.
2. The most likely to happen.
3. The least desirable to ensure the effectiveness of the non-proliferation objective of MECRs.
4. The most desirable to ensure the effectiveness of the non-proliferation objective of MECRs.

The meeting was organized into working sessions dedicated to the four categories mentioned above. During these sessions, participants discussed the pros and cons arguments.

### The main topic

The XIII edition of the Chaudfontaine Group Seminar started with an opening address by Pr. Dr. Quentin Michel (ESU, University of Liège, BE). During his speech, he explained the purpose of the meeting and provided details on the workshop's format and structure.

The potential scenarios for future strategic trade control regimes that were discussed include:

1. A series of miniature strategic trade control regimes.
2. A new alternative strategic trade control regime excluding countries that are non-compliant with the UN Charter.
3. A duplicate of the existing trade control regime(s) open only to countries respecting some conditions/values that would be defined in the founding.
4. Amending the decision-making process in the existing regimes, abolishing the consensus rule
5. Status quo.
6. Other scenarios proposed by participants.

### Work sessions

#### 1st session: The less likely to happen

During this session, each group presented their chosen scenario, emphasizing why they believed it to be less likely to occur. Key points of discussion included the criteria for determining a country's compliance with the UN Charter (in relation to the second scenario), the potential effectiveness of the scope, and concerns regarding the diminishing role of multilateralism within the geopolitical landscape and the possibility of weakening existing regimes by duplicating or replacing them. Additionally, participants highlighted the difficulties of changing established decision-making procedures (consensus vs majority voting), both in terms of contemporary practices and historical precedents.

#### 2nd session: The most likely to happen

Participants concurred that the first, fourth and fifth scenarios hold the highest likelihood of occurrence. Alternative scenarios, including miniature strategic trade control regimes were also brought into the discussion. The first scenario was favoured due to its ease of implementation,

while concerns were raised regarding the management of many different lists of technology items by customs authorities which may be counterproductive.

#### 3rd session: The least desirable to ensure the effectiveness of the non-proliferation objective

The choice of the least desirable scenario to ensure effectiveness was marked by fragmentation. The primary focus of the discussion was about the potential necessity of a politically and legally binding mechanism that encompasses all relevant countries and imposes sanctions on violators. However, questions emerged concerning the implementation of such a mechanism, particularly in light of the target country's power dynamics and alliances.

#### 4th session: The most desirable to ensure the effectiveness of the non-proliferation objective

The focus of the session tied into the ongoing discussion about the 5<sup>th</sup> scenario, the status quo. Participants engaged in an extensive debate regarding the status quo, particularly its meaning. They highlighted that maintaining the status quo might delay conflicts without necessarily overcoming underlying issues. Conversely, they acknowledged that regimes can naturally evolve as the new challenges are identified. Ultimately, participants provided a comprehensive exploration of the challenges and prospects associated with preserving the status quo as a potential future scenario of strategic trade control regimes.

### Forthcoming publication

The outcomes will be published in the coming months and made available on the ESU website.

[Read more](#)



Group picture of the participants of the XIII Meeting of the Chaudfontaine Group held 1-3 October 2023



## UPLIFTING NUCLEAR SAFEGUARDS IN AFRICA – PROGRAMME OF SUPPORT TO AFCONE BY THE EU, FINLAND AND STUK

by Ossi Lång  
(STUK - Radiation and Nuclear Safety Authority, Finland)

The African Nuclear-Weapon-Free Zone (African NWFZ) Treaty (the Pelindaba Treaty) was opened for signature in Cairo, Egypt, on 11 April 1996, and entered into force on 15 July 2009. Under the Pelindaba Treaty, each State Party undertakes to conduct all activities for the peaceful use of nuclear energy under strict non-proliferation measures. The African Commission on Nuclear Energy (AFCONE) is the executive body of the African Nuclear-Weapon-Free-Zone Treaty. It is the specialized agency for nuclear activities on the African continent under the framework of the African Union and has its headquarters in Pretoria, South Africa.

The European Union, Finland and AFCONE have initiated a 5-year programme to strengthen International Nuclear Safeguards in Africa, build capacity in Pelindaba Treaty States Parties, and enable the States to fulfil their obligations in accordance with the Pelindaba Treaty, Comprehensive Safeguards Agreements and

Additional Protocols. In practice, this programme will develop and expand capacity to support IAEA inspection activities, improve reporting under Comprehensive Safeguards Agreements, Additional Protocols, and the Treaty of Pelindaba.

AFCONE is a relatively young organisation that established its Secretariat in 2018. The unique feature of the programme is, that it will also support AFCONE to leverage its wide mandate, and to stand as a strong regional organization, supporting its States Parties in effective IAEA safeguards implementation. The programme, running from 2023 to early 2028, is funded by the European Union (4,4M€) and the Government of Finland (0,5M€), managed by STUK, the Radiation and Nuclear Safety authority of Finland, and implemented under leadership of AFCONE. Partnership of STUK and AFCONE builds on strengths of these two organisations: STUK having a long experience on supporting the IAEA in safeguards implementation and working together with State Regulatory Authorities all over the world in practical way and “as simple as possible”, while AFCONE having a unique mandate and network in Africa, that can be mobilised for this collective learning endeavour.

African States are in different stages of development with regard to the civil applications of nuclear energy, and many need to build the capacity necessary to fully enjoy the benefits of peaceful uses of nuclear energy. For exam-

ple, many countries in Africa have announced plans to include nuclear power in their energy mixes, and are at different stages in meeting the various regulatory and technical requirements.

### “Pilot Year” - Learning by Doing

Programme preparation started in early 2022, and took into account experiences from previous capacity building activities carried out by other organisations. In August 2022, STUK and AFCONE carried out a fact-finding mission to Pretoria and visited the South African Nuclear Energy Corporation SOC Ltd (NECSA) campus that hosts the Regional Collaboration Center of AFCONE in South Africa. This campus includes different types of nuclear and training facilities, including the SAFARI 1 research reactor that is currently used for medical isotopes production. This visit was very useful and helped to clarify roles, responsibilities and expectations in the cooperation. While planning for the first programme activities, we realised that this might be the first time when safeguards trainings are organised in Africa under leadership of African organisation, at least in this magnitude. This lead us to think how to ensure sustainability of the results, and how to design the programme in way that would ensure knowledge transfer, ownership and would build new networks and contribute to structures to support safeguards implementation in Africa.

As both STUK and AFCONE were now in front of new approach, we decided to accept cer-



Participants at certificate distributing ceremony in Pretoria, October 2023



tain incompleteness in our programme design. We would have to learn many things related to substance, management and context, through practise. Therefore, the training programme was planned to be open-ended so that core training programme of 2023 would be followed by tailored trainings and other activities based on lessons learned and real needs identified on the road.

In early 2023 a needs assessment survey was sent to the safeguards regulators of the first ten States that were invited to the programme. The first “pilot group” of States that were invited to the programme were selected based on their activities in the Uranium supply chain: proven resources, mining, mineral processing or exports.

The first training event under the programme took place in Pelindaba Centre of NECSA in South Africa in May 2023, focusing on international obligations, national legislation and SSAC processes. The subsequent training events executed so far, have focused on hands-on training of safeguards inspectors: inspections planning, HM5 measurements,

inspections processes and reporting to the IAEA. In August 2023 such training was organised in Swakopmund, with support of Namibian government, where the participants were able to carry out inspection exercise at the Husab Uranium mine operated by the Swakop Uranium Ltd. and then to follow the road of the UOC all the way to the Walvis Bay harbour, where lessons were learned on co-operation between port and customs authorities, the mine operator, as well as the safeguards regulator. Similar training event was organised in October in Pelindaba Centre of NECSA, with support of the Department of Mineral Resources and Energy of South Africa (DMRE), while adjusting the programme to the facilities in Pretoria. Inspection exercise was now done at the waste storage facility at the Pelindaba Centre, and the group then had another field demonstration at Gammatec NDT Supplies SOC Ltd. that is a provider of non-destructive testing equipment.

Currently, STUK and AFCONE are putting together lessons learnt during the implementation of the first months of the programme, to develop a long-term implementation plan for

2024-2025. The core training programme has proved successful, and we will also hold on to programmatic approach, where focus is on limited number of States at time, which will allow the AFCONE and STUK to follow-up on questions raised during the trainings. However, the goal is to steadily expand the programme and to offer an opportunity for a large majority of safeguards regulators of the Pelindaba State Parties, to benefit from the trainings by the end of 2025. The programme planning for the last two years 2026-2027 will be done later, again based on lessons learnt and the progress made until then.

### Outreach and Support for Regional Structures

Experience has shown that safeguards improvements require sustained attention not only at the operational, but also at the governmental level in partner countries. The commitment and ownership of safeguards by National Regulatory Organizations is essential for the success in achieving this programme's goals. Nuclear safeguards is a specific subject matter, that is perhaps generally less known than the other two cousins in the series of Ss (safe-



Familiarising with Uranium production at Husab mine





Familiarising with HM5 in Swakopmund, August 2023

ty and security). However, the effective IAEA safeguards is the precondition for peaceful use of nuclear energy, and thus creates potentiality for the benefits (i.e. health and prosperity) that these nuclear technologies may provide. While safeguards is also a State obligation under Nuclear Non-proliferation Treaty, it is often more productive to explain the benefits before jumping to the details following from national commitments. This is one of the lessons learnt so far in the outreach component of the programme, that STUK and AFCONE have been delivering in parallel with the training programme. Purpose of the outreach component is to explain and discuss what commitment to the safeguards means in practice at different levels of public administration, and how this is related to the State's plans to benefit from peaceful uses in the future. Several events have been organised so far, in occasions such as NPT PrepCom, African Union Summit, and INMM/ESARDA symposium. These events have been greatly supported by the European Commission and Ministry for Foreign Affairs of Finland.

As the purpose of the programme is not only to improve capacity in State Regulatory Organisation, but also to help AFCONE in ramping up its role as the regional knowledge-hub and coordinator for safeguards activities, the programme also aims at fostering discussion on role of regional structures in safeguards implementation in Africa. Task number one here is to build a robust picture of existing safeguards frameworks and challenges related to the implementation. It is also important to coordinate actions with other organisations that are active in Africa in safeguards capacity building, most importantly the IAEA and INSEP.

### The Way Forward

Experiences of this first "pilot year" will be taken into consideration in planning the activities for the following years. The idea is to maintain the programmatic approach and to offer the possibility for intensive hands-on training activities for a limited number of regulators at a time. At the same time, momentum will be maintained and sustainability ensured via

outreach activities aimed at national decision makers; and follow-up engagements with previously trained experts. For example, site specific safeguards challenges, which may come up during the programme may be addressed through site-specific trainings.

STUK and AFCONE also intend to take advantage of opportunities to continually raise awareness and garner support for the programme in relevant international and multilateral events, as well as to organise discussion on topics such as regional legal frameworks and the future of safeguards in Africa, legislative reform needs and long-term targets. Towards the end of the programme, it will be important to prioritize activities that ensure that the process that is now emerging will continue, and the results will be sustainable. At the same time follow-up and monitoring of developments must continue and needs based prioritisation will be done.



## FINNISH & BELGIAN EXPERIENCES ON CONTRIBUTING TO THE PEACEFUL USE OF NUCLEAR MATERIAL DURING THE ENTIRE FACILITY LIFECYCLE

### Conclusions of the Workshop on the Safeguards by Design concept and provisions in the legal and regulatory framework

by Walid M'Rrad Dali  
(Belgian Federal Agency for Nuclear Control - FANC)

#### Background

Safeguards by Design (SBD) is commonly understood as an approach whereby early consideration of international safeguards is included in the (pre-)design process of a nuclear facility or of a change within an existing nuclear facility, or of wherever safeguards considerations have to be taken into account during the construction, the operation and also the decommissioning phases. From a broader international point of view, SBD also means awareness within the nuclear community, including designers of components and installations, of the need to consider international safeguards as early as possible in the lifecycle of a nuclear project and understanding of the potential impacts design decisions might have on safeguards implementation. It is considered that SBD allows informed design choices that are the optimum confluence of economic, operational, safety and security factors, and of course of international safeguards.

The Finnish Radiation and Nuclear Safety Authority (STUK) and Belgium's Federal Agency for Nuclear Control (FANC) have gained extensive knowledge of safeguards implementation in nuclear newbuild, plant modification and decommissioning projects over the past decades. We have independently observed the issues related to the traditional implementation of safeguards and the benefits of the SBD approach. In this perspective, we have decided to jointly explore ways to improve the



implementation of safeguards through raising awareness amongst the overall nuclear community and further developing the SBD approach.

STUK and FANC officially launched a collaboration on this matter by organizing a virtual workshop to exchange experiences on the implementation of safeguards and especially on SBD in April 2021. After encouraging feedback on the workshop, we laid a foundation for further international cooperation on SBD with the publication of a White Paper on "Safeguards by Design - Finnish & Belgian experiences on contributing to peaceful use of nuclear material during the entire facility lifecycle" that was presented for the first time during a side event of the 65<sup>th</sup> General Conference of the IAEA. Since this date, STUK and FANC further spread the word by distributing the White Paper and by presenting STUK and FANC initiative in the European Safeguards Research and Development Association (ESARDA) meetings. On March 2023, STUK and FANC organised the first international workshop in the framework of this collaboration in Vienna. This workshop focused on the SBD concept and provisions in the legal and regulatory framework.

#### Introduction to the workshop topic

In the White Paper, STUK and FANC presented five Reflection Points (RPs) to explore to further improve the SBD concept implementation worldwide. As expressed in the White Paper, further collaboration is directed to address these points while still aiming to contribute to the enhancement and the improvement of safeguards worldwide. The first Reflection Point (RP-1), SBD concept and provisions in the legal and regulatory framework, was identified by STUK and FANC to be the most logical starting point for a continued collaboration to spread knowledge of SBD in the nuclear community and to address, at least partially, the challenges and opportunities associated with this point.

One of the important SBD-relevant cases iden-



tified in the White Paper is the provision of initial design information of a facility to the IAEA. That is the de facto starting point of the international safeguards implementation in many countries. In the Subsidiary Arrangements of the Comprehensive Safeguards Agreements, the time limits for provision of preliminary and final design information are generally tied to the start of the construction of the facility and the reception of nuclear material, respectively. STUK and FANC have experienced that without separate national or regional legal requirements, and intervention by or guidance from the regulatory authorities, project management and short-term economic factors motivate the operator to provide the information in one consignment close to the deadline. At that point, safeguards solutions are not appropriately integrated to the facility design and project organization which may cause difficulties in the safeguards implementation, extra costs or even delays. Addressing RP-1 helps in exploring how national and regional nuclear legislation and regulation could offer a solid but practical foundation for the SBD concept and better facilitate the safeguards implementation in nuclear projects.

#### Overview of the workshop

On 30 March 2023, STUK and FANC organized a workshop on the SBD concept and provisions in the legal and regulatory framework at the Embassy of Belgium in Vienna. The workshop was primarily directed at national safeguards authorities. The IAEA, Euratom and the national authorities from eleven countries, namely Canada, Norway, Switzerland, United Kingdom, and EU countries (Belgium, Czech Republic, Hungary, Slovakia, Sweden, Finland, France) were represented in this workshop. The objective during this day was to share and exchange on how the SBD concept and provisions in the legal and regulatory framework could contribute positively to the SBD in particular, and to effective and efficient safeguards in general.

The workshop began with a welcome and introduction from the Ambassadors and Per-





Group picture of the participants of the Workshop on the Safeguards by Design concept and provisions in the legal and regulatory framework

manent Representatives of Belgium and Finland, respectively H.E. Caroline Vermeulen and H.E. Pirkko Hämäläinen. After technical opening remarks by STUK, FANC and Euratom representatives, the IAEA and Euratom jointly presented their perspectives on SBD. Their words were followed by presentations and discussions on the status of SBD in the legal and regulatory framework in Finland, Belgium, Czech Republic, United Kingdom and Canada.

In the afternoon, the participants formed groups and discussed the role which current and potential provisions on SBD in the nuclear legislation and regulations play or could play in the future for more effective and efficient safeguards implementation. The findings of the group discussions and interactive polling questions sessions held during the workshop were used as focus areas for a panel discussion between invited expert panelists.

The workshop was followed by a reception at the Embassy of Belgium where the workshop participants continued to have productive discussions among themselves and with invited participants.

### Summary of discussions and polling questions

The workshop participants had a possibility to

voice their views by answering eight polling questions throughout the workshop. The first session with four questions was held between the presentations by the national authorities while the second one was held before the panel discussion.

According to the answers, all early safeguards work, even without the involvement of the IAEA, benefits overall safeguards progress in projects. Project information should be provided to the national authorities even without prior involvement of the IAEA. It should not be limited to the contents of the design information questionnaire (DIQ) or, in Euratom countries, basic technical characteristics (BTC) whose delivery schedules do not facilitate an early launch of the SBD process in the initial stages. Following the vast majority of the participants, binding provisions on SBD should support and obligate the stakeholders and operators to start their safeguards-related work with both the authorities and the potential suppliers, designers and vendors well before the end of the pre-design phase. These provisions should clarify which important aspects are to be taken into account at the different steps of the project and what information should be provided to the authorities throughout the different phases. International cooperation and sharing of information are very much recommended, both for general awareness and for

the sharing of best practices.

The afternoon session of the workshop was started with a group discussion on the current and potential provisions in the legislation and the regulation of the participants' countries. In general, few countries have direct and clear SBD provisions in the legislative and regulatory framework. Finland was the only represented country that had set concrete requirements related to the early provision of information. In Belgium, recommendations-level provisions exist for specific projects but binding general provisions are not yet included in the legislative and regulatory framework. Also, many countries are considering to introduce the SBD provisions either in their legislation, in their regulations or in safeguards-specific guidelines. Binding provisions in the legislation were seen to be more effective for the introduction and the support of the SBD concept and for influencing stakeholders. Due to the generic nature of the nuclear energy legislation in many countries, binding provisions in the regulations, including in the guidelines, were considered to be better suited for defining practical and technical SBD requirements. However, the groups emphasized the need for flexibility when drafting SBD provisions in anticipation of new technologies and safeguards methods that will appear in the future, considering the rapidly changing nuclear landscape worldwide. In this regard, the need to tackle the challenges and opportunities associated to the emergence of small modular reactors (SMR) and advanced modular reactors (AMR) were briefly mentioned. Some trends, such as increasing remote monitoring and data transmission, are already visible.

The final part of the workshop was a panel discussion that reflected on and summarized the views presented during the day. The panel participants came from the IAEA, Euratom, STUK (Finland), FANC (Belgium), ONR (United Kingdom) and SUJB (Czech Republic). The panel stressed that SBD is not limited to the introduction of legal or regulatory requirements even though those are well recommended. Raising awareness, building relationships between the stakeholders, taking into account the safeguards needs from the (pre-)design phases onward and following up each declaration of information to authorities



with necessary clarifications were considered at least equally essential for the SBD concept. Safeguards provisions in the legal and regulatory framework should be drafted in a way that supports the aforementioned points. As long as safeguards needs do not play a strong role in design decisions in the nuclear industry, safeguards considerations will be rather only added onto the design than being also integrated to it. This will lead to less effective and efficient results. The success of safeguards work and follow-up in projects relies heavily on leadership by the national regulator and other national central stakeholders involved in the non-proliferation and safeguards. All these stakeholders should properly communicate together in order to have a comprehensive picture of the situation. The responsibilities and mandates regarding safeguards and especially in this regard SBD should be clear for everyone.

According to the panel, currently safeguards awareness starts with the operator and their safeguards responsible staff but should spread to the safety and security experts, designers and vendors who are not safeguards experts. Internal trainings organized by operators with a direct outreach to vendors and designers are opportunities for spreading safeguards awareness and culture. Vendor design review processes, where designers must consider authority expectations on safeguards, and open international meetings with designers, vendors and suppliers are seen as good practices. In this perspective, there was a strong support from the participants on the idea that international associations such as the European Safeguards for Research and Development Association (ESARDA) and the Institute of Nuclear Materials Management (INMM) could play a role towards performing studies and proposing solutions regarding SBD in support to and at the demand of national, international and/or regional authorities. This could be done by working on and publishing best practices on, for example, the inclusion of provisions in the national legal and regulatory frameworks, and by reaching out and facilitating the contacts at the international level between all the stakeholders including the vendors and designers. The fact that these associations have members of different fields (in particular of regulatory bodies, uni-

versities and the industry) is seen as a strong asset in this purpose. However, it was clearly underlined that any recommendations given in such publications would be considered purely voluntary. International training on SBD has rarely been offered as there has thus far not been a standard approach to SBD which could serve as the basis of such training.

Finally, the panel elaborated on the importance of developing and supporting a common understanding of the SBD concept in the nuclear industry, raising in this regard two important points. First, both the aspects of proliferation resistance and safeguardability should be clearly understood and taken into account by all the stakeholders, especially when new nuclear technologies and solutions are studied and proposed (e.g. for SMR and AMR). Addressing all proliferation resistance aspects, including the safeguardability, could significantly contribute to serve the goals associated with the non-proliferation commitments worldwide. However, even with highly developed proliferation resistance achieved as a result of other factors, challenges may arise in addressing the safeguards objectives afterwards if the safeguardability aspects have not specifically been included in the early considerations. Second, the question of when and how to introduce safeguards aspects into the projects can be understood differently from the operator's, the national regulator's and the international inspectorates' perspective. This can be alleviated with active discussions and follow-up. This is also applicable when dealing with plant modifications and decommissioning projects: understanding what kind of changes are safeguards-significant is difficult. As plant modifications are very frequent, raising awareness on safeguards requirements is the best way to ensure that those requirements are accounted for in a timely manner. The legislative and regulatory framework could support that, e.g. by developing provisions associated with the safeguards culture.

### Conclusions of the workshop and ways forward

Based on the findings of this workshop, the organizers can give the following recommendations regarding inclusion of Safeguards by Design in the legal and regulatory framework primarily to the attention of the regulatory bodies:

- Support early consideration of safeguards with SBD provisions, at least from the pre-design phase, in the legal and regulatory framework. Provisions may range from principles on safeguardability and proliferation resistance of facilities to concrete requirements to allow necessary containment and surveillance methods. Strict and clear time limits for providing design information should be set.
- Set futureproof prescriptive provisions to account for new technologies and safeguards methods, considering the rapidly changing nuclear landscape worldwide. In this regard, these provisions are needed to tackle the challenges and opportunities associated to the emergence of the SMR and AMR technologies.
- Supplement binding legal and regulatory provisions with national and/or international informative and non-binding guidelines and clarify all these provisions with authority expectations to operators, vendors and designers to facilitate the SBD process.
- Follow up early safeguards reporting with discussions and meetings to promote common understanding. Clarify leadership in the process, including in the legal and regulatory framework.
- Raise safeguards awareness and build relationships between international inspectorates, national authorities, operators, vendors, designers and suppliers. In this perspective, provisions associated to the safeguards culture should be developed in the legal and regulatory framework.

### Acknowledgements

STUK and FANC wish to thank the participants of the workshop and those that otherwise participated by expressing their interest and giving feedback on the collaboration. We think that the workshop was a suitable next step after the White Paper. Nuclear legislation and regulation are naturally a shared area of interest for the national and regional regulatory authorities who were the primary target group of this first workshop. Many of the participants had also been previously discussing and collaborating with STUK and FANC on the



SBD development through ESARDA working groups, and other fora. The workshop gave encouraging results on the interest in the SBD approach and on the motivation of States to implement the concept in their nuclear legislation and regulation.

The first and already successful workshop on the Reflection Points of the White Paper opens new opportunities. STUK and FANC wish to keep promoting the SBD concept in the legal and regulatory frameworks with new regulator audiences and to expand the scope even more and move on to the other four Reflection Points. Further collaboration that is considered by STUK and FANC include, for example, seminars on SBD best practices for operators and suppliers and further side events at international events to spread awareness of SBD in newcomer countries.

STUK and FANC are happy to welcome any interested parties to collaborate on the development of the SBD concept. We would like to invite everyone who could contribute directly or indirectly to safeguards and non-proliferation to share the White Paper, the present paper and in particular the recommendations given here to a broader audience. Finally, STUK and FANC invite all regulatory bodies to reflect on the interest of implementing these recommendations.



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# SAFEGUARDS IMPLEMENTATION IN SWITZERLAND AND LIECHTENSTEIN, COMPLEMENTARY ACCESSSES AND ENVIRONMENTAL SAMPLING

by Fausto Medici<sup>1</sup> and Uwe Georg<sup>2</sup>  
(Swiss Federal Office of Energy - SFOE)

## 1. Introduction

This short paper presents an overview of Complementary Accesses (CAs) performed in Switzerland since the entry into force of the Additional Protocol (AP [1]) and of the environmental sampling performed by the International Atomic Energy Agency (IAEA) at Swiss nuclear facilities and locations outside facilities (LOFs).

## 2. Complementary Accesses

CAs were introduced by the AP as an additional measure for the IAEA to assess compliance of a state with its non-proliferation commitments. However, CAs are not meant as a routine measure like the inspections performed under the Comprehensive Safeguards Agreement [2].

The main goals of CAs are:

- to resolve questions and inconsistencies;
- to verify the absence of undeclared material; and
- to verify the decommissioned status of a facility/LOF.

### 2.1 CAs in Switzerland

The first CA was performed in Switzerland in 2005, the year of entry into force (EiF) of the AP. As expected during the first years after EiF of the AP several CAs took place at facilities and at "historical nuclear" locations. Those CAs were performed mainly to assess the past nuclear activities in Switzerland. After all initial questions and clarifications could

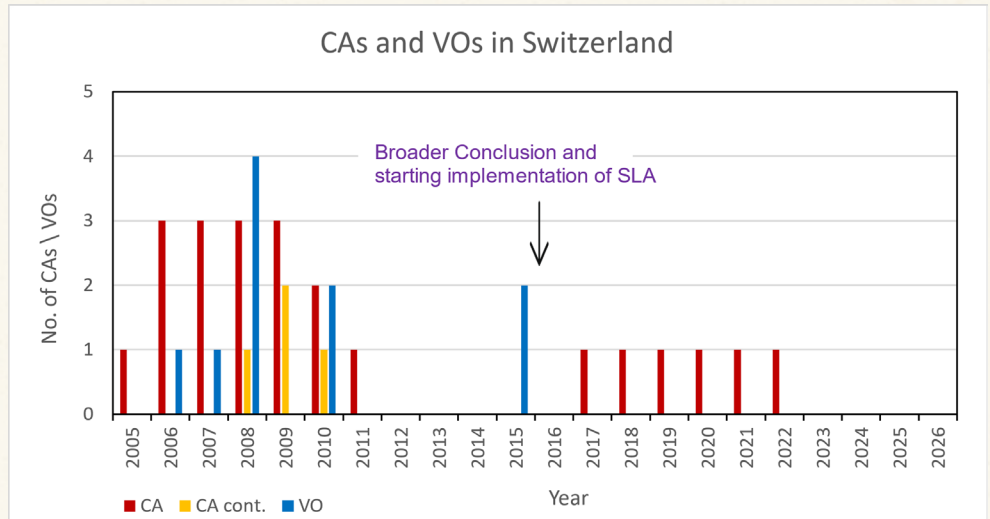


Fig. 1: CAs performed in Switzerland since EiF of the AP. In orange, CAs that could not be completed during the same year (mainly due to the temporary inaccessibility of some areas in a facility) and that their remaining activities were postponed to the next year. In blue the voluntary offers according to Article 8 of the AP (see text).

be satisfactorily answered, during three years (2012, 2013, 2014) no CA was performed. The Broader Conclusion (BC) was given at the end of 2015 and subsequently the State Level Approach (SLA) was implemented. Since then, each year one CA took place (see Fig. 1). As a matter of fact, it seems that the Swiss SLA requires at least one CA every year even if there is no actual reason to perform it. Some facts suggest that this assumption could be correct. First, the goals of these last CAs were very unspecifically formulated; e.g. of the last six CAs four were justified by "to verify the absence of undeclared material". This formulation can be considered as fit for all purposes, when there is no specific issue that need to be clarified. Second, once the location was not specified, only the Site but not the facility the IAEA was interested in (this particular Site includes several facilities). Third, most of these last CAs were conducted similar to a detailed Design Information Verification during which no specific goal-oriented questions were asked or only routine measurements performed. Last, an astonishing episode has to be mentioned that also undermine the credibility of the Safeguards system especially towards the facility operators. In 2020, during COVID (with restrictions that made the logistics more challenging than usual), the annual PIV at Hot Laboratory at PSI was performed as usual. Just one week later a CA was performed inspecting almost the same rooms as during the PIV. During both the PIV and CA one ES was taken.

Figure 1 also shows Voluntary Offers (VOs) according to Article 8 of the AP. Usually this type of inspections/visits are performed when the State is not sure about what it has to declare at some locations or if those locations need to be declared at all. It has to be noted that some of these VOs were not really voluntary since in some cases the IAEA was reluctant to call for an "official" CA. Switzerland kindly provided the possibility for visits/inspections under the VO-scheme.

### 2.2 CAs in Liechtenstein

The Principality of Liechtenstein ratified the AP in November 2015 [3]. See paper [4] for explanations about this late ratification. In Liechtenstein there are no nuclear facilities but only one LOF. The LOF encompassed in 2016 two companies which handled small amounts of nuclear material. Currently only one company is left in the LOF. In 2016 the first ever IAEA inspection according to the Comprehensive Safeguards Agreement was performed and both companies were inspected. Afterwards, the IAEA expressed the wish to perform a CA during the same year. It turned out that the only goal of that CA would have been to check if all measures were in place to perform such activity timely and correctly. The IAEA could be convinced that since the same authority is responsible for Safeguards implementation both in Switzerland and Liechtenstein there

<sup>1</sup>Deputy Head of Safeguards

<sup>2</sup>Head of Safeguards



was no need to perform such checks. Up to now no CAs were performed in Liechtenstein.

### 3. Environmental Samples (ESs) in Switzerland

Environmental sampling as a safeguards measure is used by the IAEA for two main purposes: verification of the absence of undeclared nuclear material and check the correctness and completeness of States' declarations. The first ESs were taken in Switzerland in 1996 at the Hot Laboratory at Paul Scherrer Institute (PSI), see Fig. 2 and 3. The trigger

for such activities was the confirmation of the IAEA Board of Governors in 1995 that the Safeguards strengthening Part 1 measures identified by the "Programm 93+2" [5] could be implemented under the provision of the Safeguards Comprehensive Agreement. Environmental Sampling was one of the Part 1 measures identified by this committee. All 20 ESs in 1996 were taken at PSI. As shown in Fig. 2 the implementation of the AP in 2005 did not affect the frequency and the number of ESs taken in Switzerland. However, it seems that the SLA for Switzerland calls for more and more frequent ESs (see Fig. 4).

During the first years after EiF of the AP in Switzerland only two facilities seemed to be in focus for Environmental Sampling (see Fig. 2). Now the IAEA portfolio is much more diversified, but never an ES was taken at an NPP. Although diversification makes sense, it can be argued if the current intensity (and number of samples) is really necessary/justified? A significant increase of sample taking can be noticed after the BC (see Fig. 4). What does this mean? Is this a coincidence? Does a State with BC become more suspect? Is the increase due to increased analytical capacities? What about the IAEA technical objectives in the past and at present?

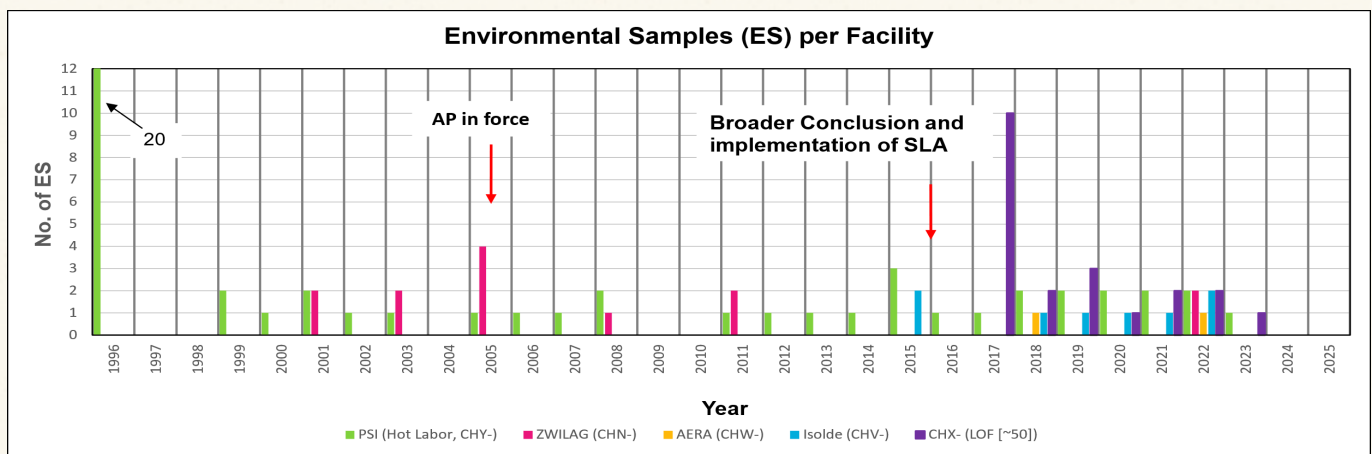


Fig. 2: Overview of ESs in Switzerland. Note the increase of ESs taken after BC, especially after 2017. The figure for 2023 is not complete (date of this paper is August 2023).

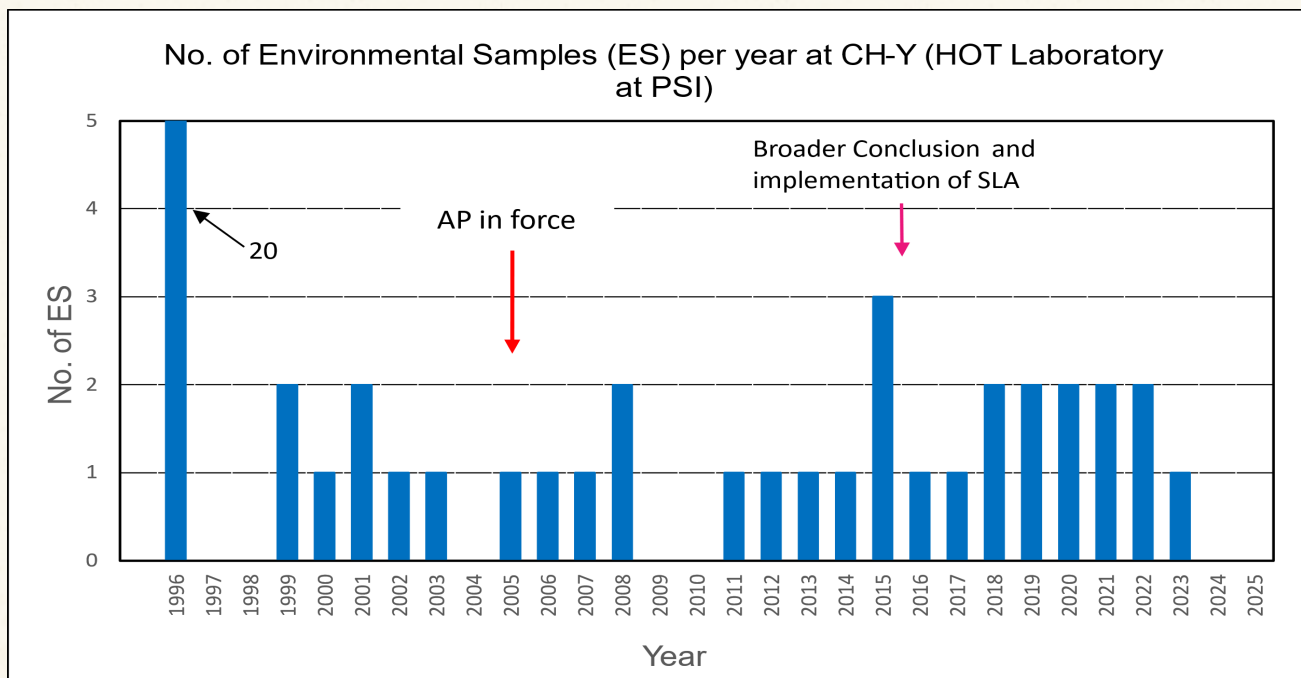


Fig. 3: Overview of ESs taken at Hot Laboratory at PSI. Note that from 2018 each year two ESs were taken. The figure for 2023 is not complete (date of this paper is August 2023).



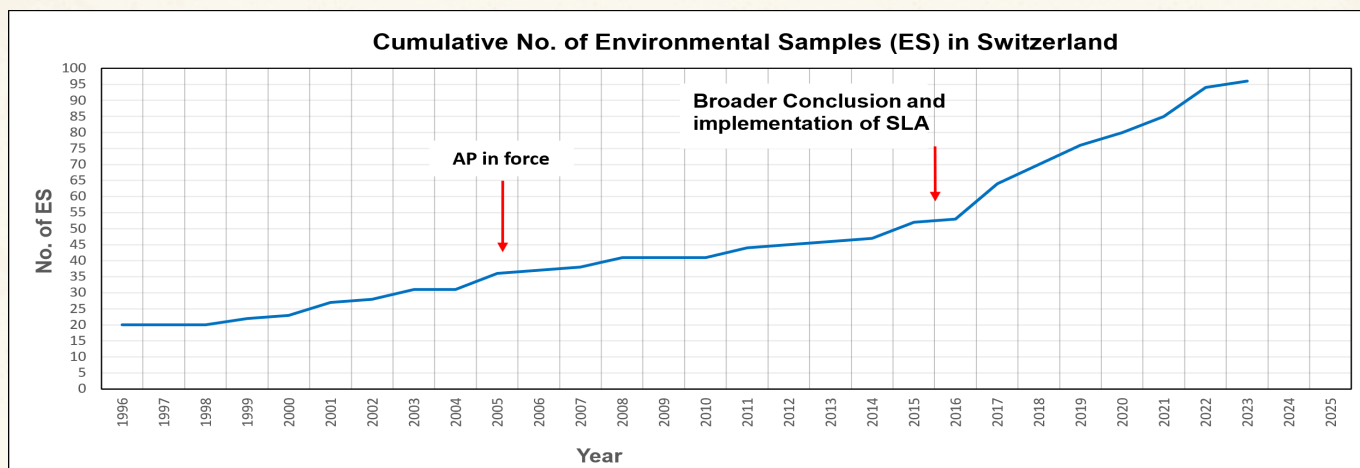


Fig. 4: Cumulative view of ESs in Switzerland. Note the clear increase of ESs starting in 2016

No ES was ever taken in Liechtenstein.

#### 4. Conclusions

The authors suggest that the CA verification measure should be used in a more effective way and in the spirit of the AP. This means utilising the CA when it is really needed and not as an exercise tool. Facility operators should not get the impression that a CA is performed as a routine inspection without a specific goal-oriented question. Concerning the ESs it is not clear why at Hot Laboratory the frequency has increased and why at some (new) locations one ES has to be taken every year. In general, some more transparency about the technical goals that the IAEA would like to achieve would be welcome. The use of CAs and ES should be driven by a concrete need. At least in many cases for the Safeguards authority and even more for the facility operators the background of some measures under the current verification regime remains obscure.

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