



Report

Symposium on International Safeguards

Reflecting on the Past
and Anticipating the Future

31 October–4 November 2022
Vienna, Austria



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International Atomic Energy Agency

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Editorial note

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Safe guards



Foreword

Massimo Aparo

IAEA Deputy Director General and
Head of the Department of Safeguards



The 14th Symposium on International Safeguards took place in a year that marked important historic milestones: year 2022 marked 60 years of IAEA inspections, 50 years of comprehensive safeguards agreements, and 25 years of additional protocols. These inspired the theme – ‘reflecting on the past’ to understand how and why safeguards have evolved over time, and ‘anticipating the future’ to identify what lies ahead and prepare for effective safeguards in the coming decades.

Reflecting on the past provided key insights and lessons learned about the importance of adapting legal authorities, concepts, approaches, methods and technologies to ensure safeguards adjust to the ever-changing operating environment, address emerging challenges and meet stakeholders’ expectations. History has also shown that keeping the safeguards system robust requires political will and unity among IAEA Member States. The development and implementation of safeguards has been, and will continue to be, a truly cooperative effort, involving the entire global safeguards community, including State regulatory authorities, facility operators, the R&D community, as well as academia, NGOs, and the private sector.

In anticipating the future, we can already see new and more complex nuclear facilities under development, with some to be deployed in remote locations. We will soon need to prepare for naval nuclear propulsion in States with comprehensive safeguards agreements. In the longer term, we may see innovative reactor deployment scenarios, such as for commercial maritime shipping or outer space exploration. At the same time, promising technological advances offer potential solutions to safeguards needs, including advanced measurement systems, satellite imagery, remote sensing, unattended monitoring systems, artificial intelligence, and innovative data analytics.

It is clear that our operating environment will keep changing, and we will need to keep pace to stay effective. The Symposium established a good foundation for this. Together we have identified the challenges to be faced as well as the innovations that can enable our collective success. Drawing from the Symposium insights, this report offers ideas for the community’s consideration in this regard. Our challenge now is to work together to move the most promising ideas forward and translate them into action, and to prepare the IAEA safeguards system and our organizations for success in a dynamic future.

The Symposium at a glance

Participants

38%
Women +9%



79
Grants



Sessions

70
Sessions

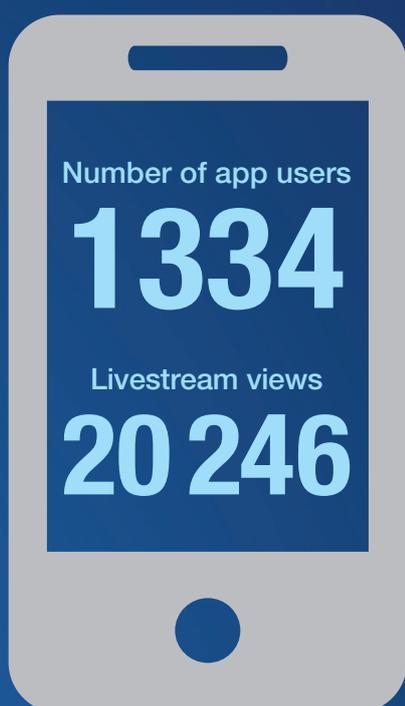
49

ESPACE
presentations and
demonstrations

110
E-posters



Conference app



Media



166 000+ Impressions

4 200 Interactions

5 News
web stories

2 Videos

7 Flickr albums

Executive Summary

In October 2022, the IAEA held the 14th Symposium on International Safeguards on the theme “Reflecting on the Past and Anticipating the Future.” The IAEA holds the Symposium every four years to bring together global stakeholders in support of IAEA safeguards, including Member State safeguards regulatory authorities, the research and development (R&D) community, industry, and civil society to identify challenges and opportunities for IAEA safeguards, showcase research, share ideas, and build partnerships.

The year 2022 marked notable milestones commemorating 60 years of IAEA safeguards inspections, 50 years of comprehensive safeguards agreements (CSAs), and 25 years of additional protocols (APs).

These historic anniversaries inspired the objectives of the Symposium:

Reflect — celebrate the historical anniversaries and achievements thus far; build a common understanding of the experience gained that has shaped safeguards; and reflect on the lessons learned from decades of safeguards implementation.

Anticipate — anticipate nuclear energy’s role in addressing global challenges; envisage how the IAEA’s operating environment is likely to evolve over the coming decades; and identify what this means for safeguards by way of both new challenges and new opportunities.

Inspire — based on lessons from the past and insights into the future, to identify actions, stakeholders, and partnerships towards ensuring a safeguards system that is well prepared for continued success in the decades ahead.

Insights

In the course of the Symposium, the 970 participants, coming from 124 States and 15 organizations, discussed a variety of topics in 70 sessions. The following themes featured prominently:

- Changing nuclear landscape
- Safeguards legal framework
- National capacity for safeguards implementation

- Safeguards data and information
- Verification technologies and techniques
- Organizational performance

The Symposium generated several insights, under its three objectives. These include:

Reflect

- The IAEA’s experiences and safeguards findings starting in the 1990s, in particular the discovery of undeclared nuclear material, changed the expectations of the IAEA safeguards system; setting in motion efforts to strengthen the safeguards system. The system’s evolution offers lessons relevant to circumstances today and the future.
- Strengthening the IAEA safeguards system has required communication and close consultation with Member States and the IAEA’s policy-making organs in order to establish unity of purpose and ensure their support.
- IAEA safeguards function within the broader geopolitical context and as part of the nuclear non-proliferation regime. The safeguards system is only as strong as the legal framework underpinning it and States’ determination in upholding it.
- Competent and imaginative leadership within the Secretariat, and reliance on the judgement and professionalism of motivated, experienced and qualified inspectors and analysts has been key to the IAEA’ technical competence and its success.
- Prior to 1991, the IAEA possessed the mandate to detect undeclared nuclear material, but it had not fully exercised all of its authorities. It is vital to fully exercise the IAEA’s legal authorities to ensure they do not erode.
- The evolution of safeguards necessitated a change in organizational culture to embrace a more analytic and inquisitive approach to safeguards implementation for better detection purposes.
- Technology has been and will continue to be a key enabler for safeguards implementation and

organizational resilience, and partnerships with States, both in technology development and in adopting new technologies for safeguards implementation, are essential.

Anticipate

- The growing geopolitical tensions are further stressing the nuclear non-proliferation regime, necessitating diplomatic efforts to prevent its erosion, and the IAEA's role in verifying peaceful use will be key to maintaining trust and confidence.
- Emerging and future broader trends and developments (e.g., energy, environment and economy) will directly impact the IAEA and its verification mission, particularly in relation to the ongoing energy transition.
- Nuclear energy has substantial potential to address climate concerns and enhance economic development but specifics will depend on a multitude of factors, including, geographical limitations, supply chain issues, societal acceptance, non-proliferation and the availability of financing.
- Advancements in nuclear technology such as small modular reactors (SMRs), microreactors and advanced reactors will necessitate infrastructure upgrading and development, capacity building, and 'safeguards by design' engagement with the industry, while also requiring new safeguards approaches and impacting export controls.
- Transportable reactors and deployment of nuclear reactors in remote locations will amplify jurisdictional challenges and reliance on reliable connectivity to support unattended monitoring.
- Disinformation/mis-information, deep fakes and the dark web are becoming increasingly concerning, challenging the verification community to strengthen its ability to discern truth from fiction and address hidden proliferation risks.
- Many emerging technologies could significantly enhance safeguards effectiveness and efficiency, such as new types of remote sensors, artificial intelligence (AI), robotics and others, and offer new verification solutions in the future. To fully realize their potential, further

development and consultations with States are needed.

- Given the aging safeguards workforce, and with youth representation in the nuclear sector lagging behind other industries, the community needs to engage and develop the next generation and transfer knowledge to future experts and leaders.
- Partnerships, innovative technologies, and organizational performance are some of the ways to address the growing resource constraints.
- To ensure the strength and resilience of the IAEA safeguards system for the future, it is crucial to proactively prepare for the forthcoming challenges and leverage emerging opportunities, taking account of all stakeholders and forming partnerships also beyond the traditional safeguards communities.

Inspire

Based on these and other insights about the past and the future, Symposium participants generated and identified a number of 'ideas for action' for the attention and consideration of the global safeguards community as a whole. This report groups them into six thematic areas:

1. Prepare for more diverse, mobile and remote use of nuclear applications and facilities
2. Build support for enhancing the legal framework and utilizing all authorities
3. Strengthen national capacity for safeguards implementation
4. Enhance the collection, analysis, integration and security of safeguards data and information
5. Modernize, modularize, miniaturize and automate verification technologies and techniques
6. Strengthen organizations through culture, diversity, resilience, partnerships and performance management

For the ideas for action, please see Part II of this report.

Ideas for Action



Prepare for more diverse, mobile and remote use of nuclear applications and facilities



Build support for enhancing the legal framework and utilizing all authorities



Strengthen national capacity for safeguards implementation



Enhance the collection, analysis, integration and security of safeguards data and information



Modernize, modularize, miniaturize and automate verification technologies and techniques



Strengthen organizations through culture, diversity, resilience, partnerships and performance management

Symposium on International Safeguards

Reflecting on the Past and Anticipating the Future

Please check the website for the updates
www.iaea.org/events/sg-2022

MONDAY 31 October

Board Room B

10:30-10:40	Opening Remarks and Launch of 2022 Safeguards Glossary – DDG-SG Massimo Aparo
10:40-10:45	Safeguards Timeline – Movie
10:45-11:30	A Conversation with Director General Rafael Mariano Grossi on Safeguards, with Award-winning Journalist Barbara Serra
11:30-12:15	Reflecting on the Past – Keynote Address with Pulitzer Prize-winning Author and Historian Richard Rhodes

12:15-13:30	LUNCH BREAK
13:30-14:45	Reflecting on the Past – Panel Discussion
14:45-15:30	Anticipating the Future – Keynote Address with World Economic Forum's Saadia Zahidi

15:30-16:30	COFFEE BREAK
16:30-17:45	Anticipating the Future – Panel Discussion
17:45-18:00	The Week Ahead – Scientific Secretary Jenni Rissanen
18:00-18:15	Opening of Special Event by DDG-SG Massimo Aparo
18:15-18:45	Special Event: Celebrating Progress in Strengthening the Legal Framework with Director General Rafael Mariano Grossi
18:45-21:00	Celebrating Progress – Reception (Sponsored by USA) M-building, Ground Floor

TUESDAY 1 November

09:00-10:15	Introduction to Futures Board Room B
	Foresight in Practice – A View from Singapore Board Room B
	Anticipating the Future – Drivers Board Room B

10:15-10:45	BREAK
10:45-12:15	Evolution of Safeguards – Big Picture Perspectives (DDG-SG, DIR-SGCP and SAGSI Chair, Panel of Directors) Board Room B

Side Event	NTI-CENESS Panel: The Future of IAEA Safeguards – Rebuilding the Vienna Spirit through Russia-USA Expert Dialogue 12:20-13:10 Board Room A
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12:15-13:30	LUNCH BREAK + e-POSTER SESSIONS
13:30 – 15:00	Adaptation and Resilience in the Non-Proliferation Regime Board Room B
	Laboratory-Based Sample Analysis Techniques – End User Perspectives M4
	Safeguards by Design for Innovative Reactors: The Big Picture Board Room A
	ESPACE Special Demo: VR, AR and Online Learning (Part 1) ESPACE Stage 3

15:00-15:30	BREAK + E-POSTER SESSIONS
15:30-17:00	COMPASS Board Room B
	Partnerships and Collaboration in Support of Safeguards with DDG-SG Massimo Aparo M2
	The IAEA's Partners in Laboratory-Based Analysis M4
	Safeguards Challenges and Safeguards by Design for Innovative Reactors: Approaches and Experiences Board Room A
18:00-20:30	Anniversary Reception at Vienna City Hall (Sponsored by Nuclear Threat Initiative)

WEDNESDAY 2 November

09:00-09:30	Anticipating the Future – Drivers Board Room B
09:30-11:00	25 Years of the Additional Protocol and Prospects for the Future Board Room A
	Optimized Unattended NM Verification: Lessons from UMS during Covid-19 and Prospects for the Future M2
	Workshop Engaging Industry: Micro and Small Modular Reactors and Safeguards by Design M4

11:00-11:30	BREAK + E-POSTER SESSIONS
11:30-13:00	Strengthening Safeguards Today: Tools and Techniques for the Detection of Undeclared NM and Activities Board Room B
	Diversity and Inclusion in International Safeguards M4
	Verification of Spent Fuel – Challenges and Solutions M2
	Technologies and References to Support Submission and Utilization of Information Provided by States Board Room A

Special Event	Book Signing: Translated Versions of 'Nuclear Law: The Global Debate', with Director General Rafael Mariano Grossi 13:15-14:00 ESPACE Stage 2, 1st floor M building
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13:00-14:00	LUNCH BREAK + E-POSTER SESSIONS
14:00-15:30	Strengthening Confidence in the Absence of Undeclared Activities Board Room B
	Advancements in In-Field Verification M2
	Safeguards for Geologic Repositories and Nuclear Material in Waste Board Room A
	Help Desk – SGIM Applications (PR3, SDP, ITV) M6

15:30-16:00	BREAK + E-POSTER SESSIONS
16:00-17:30	Reflections on Safeguards – Experiences Implementing CSAs, APs and SQPs M2
	Post-Operational Facilities and Decommissioning Board Room A
	Trade and Export Control Board Room B
	Help Desk – SGIM Applications (PR3, SDP, ITV) M6
17:45-20:30	[MNC] Millennial Nuclear Caucus on Safeguards (Early Career Panel, Student Paper Awards and Speed Mentoring) and Reception (Sponsored by the UAE) Board Room B
18:30-19:15	Book Signing: 'Safeguards Glossary', with DDG-SG Massimo Aparo ESPACE Stage 2, 1st floor M building

Plenary Sessions

Theme 1: Safeguards (SG)

Theme 2: Technology (TEC)

Theme 3: Nuclear (NUC)

Special Events/Side Events

THURSDAY 3 November

FRIDAY 4 November

09:00-09:30	Anticipating the Future – Drivers Board Room B
09:30-11:00	Strategic Thinking in the Use of Open Source Information M2 The Latest in Verification Instrumentation Board Room A ESPACE Special Demo: VR, AR and Online Learning (Part 2) ESPACE Stage 3
11:00-11:30	BREAK + E-POSTER SESSIONS RM 3
11:30-13:00	Safeguards for New Frontiers: Nuclear Applications at Sea and in Space Board Room B The Use of Open Source Information in Action M2 The Latest in Verification Instrumentation M4
Side Event	EC Initiatives Supporting Safeguards Education and Training 13:05-14:15 M6
13:00-14:00	LUNCH BREAK + E-POSTER SESSIONS
14:00-15:30	Enhanced Cooperation and State Assistance Board Room B Distributed Ledger Technology and Safeguards M2 Strengthening Safeguards Culture and Performance Board Room A
15:30-16:00	BREAK + E-POSTER SESSIONS
16:00-17:30	Safeguards Vanguard: Methods and Practices for Training Today's and Tomorrow's Workforce Board Room B Challenges to Safeguards from Emerging Technologies Board Room A How Safeguards Benefits from Artificial Intelligence – Opportunities and Challenges M2 Workshop Engaging Industry and Regulators: Decommissioning, Spent Fuel, Waste and Safeguards by Design M4

Board Room B	
09:30-10:00	Recap of Futures and Results of Crowdsourcing
10:00-11:00	Voices of the Future: Panel of Future Leaders with DDG-SG Massimo Aparo
11:00-11:20	Key Takeaways – DDG-SG Massimo Aparo
11:20-11:30	Closing Remarks – Scientific Secretary Jenni Rissanen

Exhibitors

AIRBUS Defence and Space SAS
Algorand Foundation
ANSTO Detection and Imaging
BBC Monitoring
CAEN SpA
Canberra Packard Central Europe GmbH
Elemental Scientific Instruments
GBS Elektronik GmbH
German Member State Support Programme (GER MSSP)
H3D, Inc.
IAEA – Department of Nuclear Safety and Security (NS)
IAEA – Department of Safeguards (SG)
IAEA – Department of Technical Cooperation (TC)
IAEA Office of Legal Affairs (OLA)
Image ONE Co.,Ltd
innorIID GmbH
Institute of Nuclear Materials Management and the European Safeguards R&D Association
Korea Institute of Nuclear Nonproliferation and Control (KINAC)
MAXAR
ORTEC/AMETEK
Raylab s.r.l.
Teledyne FLIR
Thermo Fisher Scientific
United Kingdom Department for Business, Energy and Industrial Strategy
United States National Laboratories
United States Support Program (USSP)
Vienna Center for Disarmament and Non-Proliferation (VCDNP)
Westinghouse Electric Company
Women in Nuclear – IAEA
World Nuclear Transport Institute (WNT)

Cooperating Organizations

Asia Pacific Safeguards Network
European Safeguards R&D Association
Institute of Nuclear Materials Management
World Nuclear Association

REGIONAL MIXER

- RM 1 African Region (M6)
- RM 2 Safeguards Networks (M6)
- RM 3 Island Nations (M6)

E-POSTER SESSIONS
By ESPACE
Stages 1 and 2

Programme Overview



Part I: Reflecting on the Past, Anticipating the Future

Part I: Reflecting on the Past, Anticipating the Future

The Symposium opened with a day dedicated to its main theme of ‘reflecting on the past and anticipating the future’. In opening the Symposium, Deputy Director General and Head of the Department of Safeguards (DDG-SG) Massimo Aparo welcomed “the return of many renowned figures from yesteryear... who will provide their reflective wisdom, ... and a number of new thinkers who can help us better understand what may lie ahead”.

The opening plenary featured a conversation with IAEA Director General (DG) Rafael Mariano Grossi, speeches by key note speakers, two panel discussions with experts, as well as [a short documentary](#)¹ video on the past and present of IAEA safeguards.

Conversation with IAEA Director General Rafael Mariano Grossi

DG Grossi joined award-winning journalist Barbara Serra in a [conversation about the past, present and future](#)² of IAEA safeguards. DG Grossi expressed optimism about the future

of the nuclear non-proliferation regime and its cornerstone the Nuclear Non-Proliferation Treaty (NPT), despite recent well-known challenges. The safeguards system underpinning the NPT has come a long way in the past decades in response to challenges, and would do so also in the future, the DG said.

In 2022, the IAEA was faced with the new, unprecedented challenge of applying safeguards in a war zone in Ukraine, while also continuing to address long-standing safeguards implementation challenges in Iran. DG Grossi stressed the importance of continued IAEA preparedness to act in a timely, impartial and technical manner so as to serve the international community as an instrument of international peace and security. He stressed that the IAEA is ready to “get to the bottom of things” and conduct its work meticulously until issues can be resolved, noting that “non-proliferation is a never-ending process”. DG Grossi characterized safeguards staff as the “best and the brightest” with a clear legal mandate and great resilience, as demonstrated by continued safeguards implementation throughout the COVID-19 pandemic and uninterrupted



DG Rafael Mariano Grossi in conversation with Journalist and Symposium Moderator Barbara Serra on IAEA safeguards

1 <https://www.iaea.org/newscenter/multimedia/videos/iaea-safeguards-past-and-future>

2 <https://iaea.event.do/#/e/5551/f/35965/s/249885>

provision of non-proliferation assurances to the international community.

Looking into the future, DG Grossi noted the renewed interest in nuclear energy, and emergence of new types of technologies such as small modular reactors (SMRs) and microreactors. He reminded that the IAEA's safeguards mission is an enabler for the expansion of peaceful nuclear applications. Acknowledging that naval nuclear propulsion is a politically sensitive topic and will entail applying safeguards in "uncharted waters", DG Grossi reminded that the authors of the model comprehensive safeguards agreement (INFCIRC/153) had envisaged this possibility already in the early 1970s. With regard to emerging technologies, such as artificial intelligence, DG Grossi noted the technologies potential for carrying out the IAEA's work more efficiently at a time when resources are not expected to increase, noting also the IAEA's active efforts to stay ahead by monitoring technologies with potential for safeguards application or impact.

In concluding his remarks, DG Grossi called the IAEA "a beacon of certainty in a world that poses many challenges", helping to build international trust and confidence. The creators of the IAEA "got it absolutely right" and it was now up to the current and future generations to keep the institution strong.

*"The IAEA is a beacon of certainty in a world that poses many challenges",
DG Rafael Mariano Grossi*

Reflecting on the Past

Historian Richard Rhodes, the author of *The Making of the Atomic Bomb*, delivered a [keynote address](https://iaea.event.do/#/e/5551/f/35965/s/249887)³ entitled 'A Past Full of Promise', reminding Symposium participants of the early days of nuclear energy: the contributions of scientists in advancing the field, the race for nuclear weapons and growing concerns of

nuclear proliferation, as well as policy-makers' efforts to control its dual-use nature through laws and institutions – efforts that eventually led to the establishment of the IAEA and its vital verification mission.

Complimenting the IAEA for its outstanding achievements, Rhodes reminded the audience that "without safeguards, every nation with a nuclear power programme would be a nascent nuclear-weapons State".



Pulitzer-prize-winning author Richard Rhodes delivering his key note address.

In [the panel on "Reflecting on the Past"](#)⁴, former IAEA officials and an academic expert reflected on the origins of the nuclear non-proliferation regime in which the IAEA safeguards system functions, considered the events that have shaped the safeguards system's evolution over the past 60 years, and analysed ways in which the system had responded – identifying lessons relevant to circumstances today and into the future.

Looking back, strengthening the IAEA safeguards system had required good communication and

3 <https://iaea.event.do/#/e/5551/f/35965/s/249887>

4 <https://iaea.event.do/#/e/5551/f/35965/s/249888>

close consultation with Member States and IAEA policy-making organs to establish unity of purpose and ensure their support. Engagement of technical experts had further sensitized stakeholders to the need to evolve the system and resulted in valuable advice and practical solutions for strengthened safeguards.

The discussion also identified the importance of competent and imaginative leadership within the Secretariat as well as relying on the judgement and professionalism of motivated, experienced and qualified inspectors and analysts. The evolution of safeguards had also entailed shifts

“The lesson learned in strengthening safeguards is not only communication and transparency but also proactive engagement with Member States”, Jill Cooley, former Director of Concepts and Planning, IAEA Department of Safeguards

*“Safeguards are as good as the Member States want them to be”,
Laura Rockwood, VCDNP*

in organizational culture required by the move to a more analytical approach needed for the detection of undeclared nuclear material – for which the IAEA always had the mandate but had not fully exercised it prior to 1991.

Panelists stressed the importance of fully exercising the IAEA's legal authorities (e.g. use of special inspections) to ensure they do not erode due to lack of precedent. They encouraged the IAEA Secretariat to be forthright in stating their needs (e.g., funding, legal authorities) and be innovative and proactive to keep the system strong also for the future, working in partnership with not just States but also new, non-traditional partners (e.g. professional associations, NGOs) and the nuclear industry.



Former DDGs-SG, Pierre Goldschmidt and Olli Heinonen, former Director of the Division of Concepts and Planning Jill Cooley, former Section Head at Office of Legal Affairs Laura Rockwood, and Trevor Findlay of University of Melbourne in conversation with Moderator Barbara Serra.

Milestones in IAEA Safeguards

#IAEASG2022



1953

Atoms for Peace

US President Dwight D Eisenhower delivers the 'Atoms for Peace' speech, calling for the creation of an international atomic energy agency

1962

First IAEA verification

The IAEA conducts its first ever in-field verification activity, at a research reactor in Norway

1974

Safeguards Analytical Laboratories

The opening of the first dedicated Safeguards Analytical Laboratory in Seibersdorf, Austria to analyse nuclear material samples

1993

Strengthening of safeguards

Following the revelations about undeclared nuclear material and activities in Iraq and the DPRK in the early 1990s, the IAEA embarks on 'Programme 93+2' to further strengthen the effectiveness of safeguards

2002

Satellite imagery analysis

The IAEA establishes a unit for satellite imagery analysis to enhance its capabilities to detect undeclared nuclear material and activities

2006

IAEA, Iran and the UN Security Council

Following the 2005 finding by the Board of Governors that Iran is in non-compliance with its safeguards obligations, the Director General transmits his report on Iran's nuclear programme to the UN Security Council

1959

First application of safeguards

The IAEA Board of Governors approves the first application of safeguards, to three tons of natural uranium supplied to Japan by Canada

1970

NPT verification mandate

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) enters into force, entrusting the IAEA with key verification responsibilities, under its Article III, to verify the fulfilment of obligations assumed by non-nuclear-weapon States parties

1991

Confirming dismantlement

Following South Africa's accession to the NPT, the IAEA plays a key role in confirming the dismantlement of the country's former nuclear weapons programme; the experience demonstrates the benefits of a high level of cooperation between the State and the IAEA

1997

Additional protocol

The Board of Governors approves the Model Additional Protocol (AP), providing increased IAEA access to information and locations for verification; Australia becomes the first country to bring an AP into force



2005

Modified small quantities protocol

The Board of Governors addresses a weakness in the IAEA's safeguards system by approving a revised text and modified eligibility criteria for the small quantities protocol (SQP); the new SQP reinstates the State's reporting requirement and the IAEA's right to perform inspections

2020

Strengthening SSACs

The Director General launches a capacity building initiative – COMPASS – to help States strengthen the effectiveness of their national authority and of their respective state system of accounting for and control of nuclear material (SSAC)

1957

Establishment of IAEA

The IAEA Statute enters into force, establishing the IAEA as an autonomous international organization, authorized "to establish and administer safeguards"

1968

First safeguards agreement under a NWFZ

Mexico becomes the first country to accept IAEA safeguards on all of the country's nuclear material, in connection with the establishment of the first regional nuclear weapon free zone (NWFZ), in Latin America and the Caribbean

1991

Detection of undeclared nuclear material and activities

The discovery of a clandestine nuclear weapons programme in Iraq highlights the limitations of safeguards implementation that concentrates exclusively on a State's *declared* nuclear material and facilities

1996

First environmental sampling

The IAEA introduces environmental sampling as a safeguards measure to detect indications of undeclared nuclear material or activities

2003

Illicit nuclear supply networks

Libya's disclosure of undeclared nuclear-weapons-related research heightens the IAEA's attention to the possible nuclear proliferation impacts of illicit supply networks and globalization

2005

Nobel Peace Prize

The IAEA and its Director General are awarded the Nobel Peace Prize "for their efforts to prevent nuclear energy from being used for military purposes and to ensure that nuclear energy for peaceful purposes is used in the safest possible way"

2016

Expanded verification scope under JCPOA

The IAEA begins to implement monitoring and verification of Iran's nuclear-related commitments under the Joint Comprehensive Plan of Action (JCPOA), while continuing to verify Iran's NPT-related obligations under its CSA

2020

COVID-19 pandemic and safeguards

Despite unprecedented challenges caused by the COVID-19 pandemic, safeguards implementation continues; the IAEA carries out all necessary in-field activities and draws safeguards conclusions for all States with safeguards agreements in force

1961

Safeguards for research reactors

The IAEA Board of Governors approves the first model agreement (INF/CIRC/26) for applying safeguards to research reactors

1972

First NPT safeguards agreement entry-into-force

The first comprehensive safeguards agreement (CSA), concluded between IAEA and Finland in connection with the NPT, enters into force – paving the way for a significant expansion of the IAEA's safeguards activities in the coming decades



1993

Correctness and completeness of State declarations

After the IAEA's discovery of inconsistencies in the Democratic People's Republic of Korea's (DPRK) nuclear material report, the Board of Governors confirms the importance of IAEA verification of not just the correctness but also the completeness of State declarations under CSAs

2001

First State-level safeguards approach

The IAEA implements the first 'State-level safeguards approach' (SLA), for Australia; the approach optimizes the implementation of safeguards by integrating safeguards measures available to the IAEA under the country's CSA and AP

Anticipating the Future

The World Economic Forum's (WEF) Saadia Zahidi delivered the Symposium's [key note address](#)⁵ focused on the future, identifying trends and drivers likely to shape the world and the environment in which the IAEA will operate in the coming years. Drawing from the knowledge of the WEF's vast network of global experts, Zahidi described the risk outlook as one of continued volatility with multiple surprises, putting to test organizations' resilience.

Among the WEF's top geopolitical risks are the potential collapse of multilateral institutions, the fractured nature of inter-State relations as well as the possible use of weapons of mass destruction. Technological risks include e.g., adverse outcomes of technological advances, failure to govern technology, and cyber threats, as well as the breakdown of critical information structures.

In the ['Anticipating the Future' panel](#)⁶, a group of diverse experts (e.g., energy, non-proliferation, technologies) identified emerging and future trends and developments of direct impact on the IAEA and its verification mission, in particular the energy transition. Nuclear energy has the substantial potential to address climate concerns and enhance economic development but specifics will depend on a multitude of factors, including availability of financing, geographical limitations (e.g., access to water), societal acceptance, and non-proliferation.

"One of the biggest challenges for the IAEA will be just to keep pace with technologies", Cindy Vestergaard, Stimson Center

Nuclear technology is undergoing changes, with increasing interest in SMRs, microreactors and advanced reactors, requiring States to ramp up infrastructure development and capacity building efforts with plenty of lead time as well as active 'safeguards by design' engagement by the IAEA with the industry. The supplier base is widening

with new industry actors. Advancements in nuclear technology will impact not just verification but also export controls. Remote deployment of nuclear reactors will raise jurisdictional issues and increase reliance on connectivity and digitalization – at a time when threats to information veracity are growing (e.g. misinformation, deep fakes). At the same time, on-line platforms are fueling 'tribalism' and deepening divides between people and societies.

Stresses on the nuclear non-proliferation regime are growing, requiring greater diplomatic efforts to prevent its erosion – at a time when the world is undergoing tectonic shifts in international relations and experiencing rising geopolitical tensions.

"We could face multiple withdrawals from the NPT in the next 50 years; we should think what would be the legal implications for safeguards", Anton Khlopkov, CENESS

To restore unity of purpose, some panelists called for the redefinition of 'peaceful uses' and saw a role for IAEA in helping to define it. The panelists noted that many emerging technologies could significantly enhance safeguards efficiency and effectiveness, such as new types of remote sensors, AI, robotics and others, and offer solutions for verifying nuclear disarmament in the future.

"We all have to come to grips with nuclear facilities exposed to military action; the situation highlighted how unprepared the international community was", Togzhan Kassenova, SUNY, Center for Policy Research

5 <https://iaea.event.do/#/e/5551/f/35965/s/249890>

6 <https://iaea.event.do/#/e/5551/f/35965/s/249891>

A View from Singapore

The Symposium also heard about the experiences gained by practitioners in strategic foresight. Janet Kwek of Singapore's Centre for Strategic Futures explained that the country's recognition of the value of foresight comes from a deep understanding that as a small country, it must be aware of what is happening in the world and plan for the future. Scenario planning has helped its leadership to identify and better understand the large, sweeping forces impacting the future. Foresight planning is not about anticipating discontinuous shocks - the black swans and wildcards, the low-probability, high-impact game-changers, by their very definition, are hard to anticipate, but resilient organizations can better withstand such shocks when they occur.

Kwek underscored the importance of setting the right expectations. Scenarios are ultimately a tool to support good strategy, and good strategy is not about the future; it is about taking action in the present to prepare for the future. The goal is to help to understand the external environment while also re-examining the internal environment, to take stock of one's own assets and liabilities against future landscapes. In that regard, scenarios are useful in surfacing

“Scenarios, to my mind, are ultimately a tool to support good strategy. Good strategy is not about the future, it's about the present. It's about making good decisions in the present to prepare us for the future”, Janet Kwek, Centre for Strategic Futures, Singapore

otherwise hidden assumptions and mental models about how the world works. They build a shared vocabulary across the public service for talking about the future, and bring together experts and practitioners from all domains to focus on what developments in their fields mean for other fields and ultimately, the future of Singapore.

Drivers, Scenarios, Futures Rooms

In the lead-up to the Symposium, the Symposium team with support from N Square and in collaboration with Altimeter, conducted a participatory futures exercise, led by futurists John Sweeney and Marcela Capaja from the School of International Futures (SOIF), to consider the forces shaping the operating environment



Janet Kwek sharing Singapore's foresight experiences.



Greenolution



The Great Game



Information Storm

Futures rooms.

for safeguards to the year 2057, the 100 year anniversary of the IAEA. The aim was to create opportunities to collaborate with event participants to develop a shared understanding of global trends and possible futures, analyze their implications to international safeguards and to crowdsource ideas for action.

More than 30 individuals across 17 organizations⁷ from geographically and professionally diverse backgrounds participated in the initiative, including experts in the field of safeguards as well as next generation foresight practitioners. The group collaboratively created a [‘Drivers 2057’ deck](#)⁸, several futures scenarios and associated artefacts; three scenarios and associated artefacts were then crafted into immersive ‘futures’ exhibition rooms (Greenolution, Information Storm and The Great Game). To contrast just how much has changed, a ‘Past’ room was also featured.

All rooms were designed with artefacts and engagements to stimulate all the senses and provoke participants to think about “what if?” and to address “what then?” questions. Each future room featured questions specific to that future, so that participants could provide input on possible impacts to IAEA safeguards and share ideas on

what might be done today to better prepare for such a future.

During the Symposium, several experts who were involved in the initiative shared their reflections during daily panel sessions, in which Sweeney and Capaja introduced the Drivers 2057 and invited Symposium attendees to contribute to crowdsourcing. This resulted in a listing of the most impactful drivers.

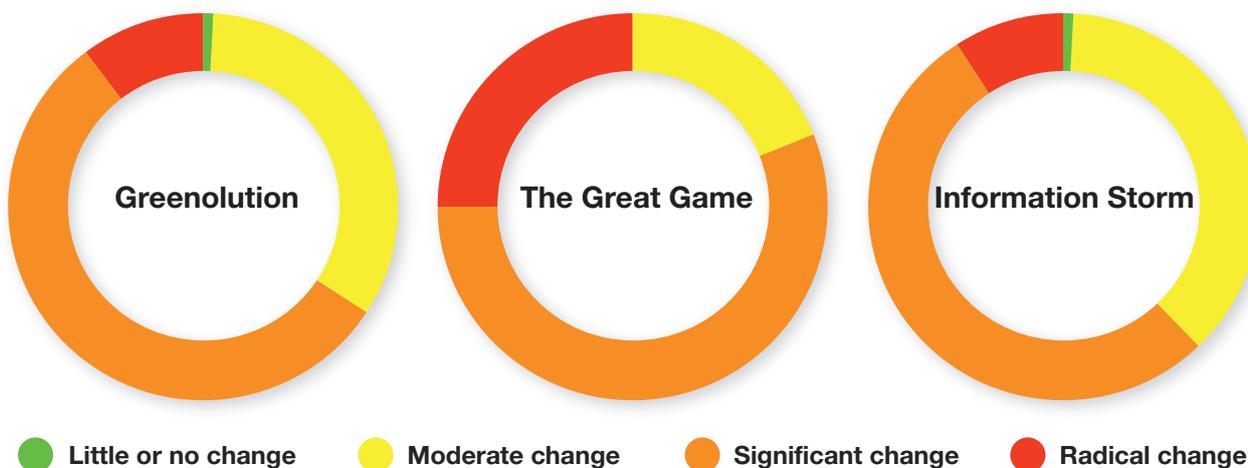
Seventy eight percent of those polled agreed that the Drivers 2057 deck, the scenarios, and experiential futures rooms showed the value of taking a foresight approach to anticipating the future of safeguards and considering actions to take today to position organizations for success into the future.

A significant majority of attendees agreed that the scale of change facing the IAEA under each of the three futures scenarios would be significant, as shown in the following graphic:

⁷ Belfer Center, Harvard University; Breakthrough Institute; European Safeguards Research and Development Association (ESARDA); Institute of Nuclear Materials Management (INMM); Nuclear Threat Initiative (NTI); One Earth Future; Open Nuclear Network (ONN); Replanet; Stimson Center; Swiss Center for Positive Futures; Third Way; Verification Research, Training and Information Centre (VERTIC); Vienna Center for Disarmament and Non-Proliferation (VCDNP); Voices of Nuclear; and the World Nuclear Association (WNA).

⁸ https://media.superevent.com/documents/20230330/752bb95d23a564987081664a7d0a6468/final_driversdeck.pdf

Imagining a future where these drivers are dominant, what scale of change, specifically in terms of safeguards mission, might the IAEA face?



Futurists John Sweeney and Marcela Capaja interviewing contributors to the Drivers 2057: Eric Brewer of the Nuclear Threat Initiative (NTI), Noah Mayhew of Vienna Center for Disarmament and Non-Proliferation (VCDNP) and Alberto Muti of Verification Research and Training Centre (VERTIC).

Engaging the Next Generation

The IAEA had a number of initiatives to engage the next generation in order to increase age diversity at the event, generate ideas from younger safeguards experts and future leaders, and to connect younger generations with experts of today. Twenty percent of the submitted papers were submitted by students and early career professionals.

Student Paper Competition

To attract paper submissions from the next generation, the Symposium featured its first ever student essay competition. Nearly 40 students submitted their abstracts. The Selection Committee chose three winners and invited them to present their research at the Symposium.

Audience polling - Drivers 2057

Looking at all of the drivers, which three have the potential to ‘most shape’ the operating environment for safeguards? What’s your top three?



In his paper entitled “Solving the Trade-off between Security and Auditability on an Encrypted Nuclear Safeguards Blockchain 160”, Marcus Borszcz (Australia) explored distributed ledger technologies’ potential for safeguards application. Claudia Olaru’s (Romania) paper entitled “Nuclear and Radioactive Material Information System – A Tool for Digitalizing National Safeguards Accountancy and Nuclear Forensics Library Databases in Romania” described a nuclear information system with the potential for increasing efficiency in safeguards implementation, by sharing the approach and lessons learned with others and applying them in more States. The paper by Conny Egozi (United States) on “Characterization of Pu-239 with PGAA for materials accountability” proposed a novel method for measuring Pu-239 using prompt

gamma ray activation and Compton suppression as a new NDA technique.

Another two authors, Andre Vidal Soares and Kwangseo Kim, were awarded an honourable mention. All the five papers demonstrated sound analysis of the chosen topics as well as an impressive level of understanding of safeguards implementation processes.

Millennial Nuclear Caucus on Safeguards

The Millennial Caucus event recognized that the world’s population is young, with more than 60% of people under the age of 40. Yet, youth representation in the nuclear sector continues to lag behind other industries. By organizing

this event, the IAEA sought to recognize the contributions that youth facilitate at the international, regional, and national levels and encourage the consistent inclusion of their voices in decision-making processes.

DDG-SG Aparo, Ambassador Laura Holgate (USA) and Ambassador Hamad Ali Mohammed Subaih Alkaabi (United Arab Emirates) delivered remarks focused on the renewed perspective that youth bring to traditional concepts. Youth's ideas are integral to building partnerships within industry and regulatory bodies, and to inspiring and supporting the next generation as they become leaders in global efforts to prevent the spread of nuclear weapons, promote cooperation in the peaceful uses of nuclear energy and to further the goal of nuclear disarmament. The speakers emphasized the need to engage youth early and often through the provision of scholarships, employment and mentorship opportunities, and platforms like the Symposium, which are critical to not just elevating their voices but also transferring knowledge to the next generation of leaders.

The event heard from three members of the youth community working in their countries in a regulatory authority, the public health sector, and the nuclear industry, respectively. They shared their perspectives on the future of nuclear power generation and nuclear applications, engaging the

industry and the nuclear workforce. The panelists encouraged providing safeguards training to the broader nuclear workforce, e.g., those involved in nuclear medicine, nuclear applications, R&D, etc., and in particular from countries with small quantity protocols (SQPs), to enable more people to engage in safeguards related matters. They saw mentorship of young professionals, both informal and formal, as essential to intergenerational knowledge transfer. They also encouraged making use of virtual platforms and work from home as a means to build inclusive and equity-driven working environments that enable us to connect faster and further, from all parts of the world. The panelists also considered industry engagement and university focused training programs as essential to reducing knowledge gaps between the Agency, governments, academia, operators and designers.

The Caucus concluded with a 'speed mentoring' exercise which enabled younger participants to connect with today's safeguards professionals from both within and outside of the IAEA.

Voices of the Future

The closing day featured a panel of early-career experts and future leaders in conversation with DDG-SG Aparo, reflecting a diversity of



Cebisile Dlamini (Eswatini), Huda Al Tamimi (UAE) and Rafael Villamayor (Argentina) shared their perspectives with Moderator Kristine Madden (IAEA) on the inclusion of youth in the nuclear sector

different ideas, cultures, genders, backgrounds, and years of experience. Drawn to safeguards in order to prevent the use of WMD, to promote the use of nuclear energy, or to contribute to non-proliferation in a “beautiful combination of technology and politics”, the panelists encouraged the safeguards community to collaborate actively with multidisciplinary stakeholders and strive for a unity of purpose to strengthen safeguards, especially as the nuclear sector innovates and evolves.

Panelists identified several opportunities to strengthen safeguards, including leveraging NGOs to conduct timely research; digitizing, monitoring and automating safeguards information; proactively communicating with vendors and designers about safeguards by design; and engaging the entire safeguards community in building unity and clarity of purpose toward taking such steps. Given the dynamic future, building resilience in safeguards remains critical and panelists suggested focusing on transferring knowledge of retiring experts to the next generation; including to younger staff in key projects and initiatives; and embracing flexibility and being willing to take risks, make decisions, and adjust as needed.

*“Even in a pessimistic vision of the future, youth are the ones that give us hope”,
DDG-SG Massimo Aparo*

In calling the safeguards community to action in the near-term, panelists recommended making full use of technological advancements to strengthen detection capabilities and streamline the work of inspectors, and requested that ‘strengthening the non-proliferation regime, first and foremost,’ and the persistent budget constraints in the Safeguards Department, be top of mind. Panelists also noted that safeguards is perhaps now more than ever, high in the public consciousness, presenting an opportunity to spur action – to include safeguards in university programmes, inspire students to pursue a career in the nuclear field, or motivate mid-career individuals to apply to work at the IAEA.



Moderator Mitchell Hewes (IAEA) in discussion with DDG-SG Aparo and Farnaz Alimehri (IAEA and President of UN-NYG); Noah Mayhew (VCDNP); Lara Rendl (IAEA Marie Skłodowska Curie Fellow); Marcus Borszcz (University of New South Wales, and a winner of the 2022 Safeguards Symposium’s Student Paper Competition); Huda Altamimi (UAE Federal Authority for Nuclear Regulation); and Amina Agbab Uthman (IAEA).



IAEA

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Part II: Insights and Ideas for Action

Part II: Insights and Ideas for Action

Over the course of the week, Symposium participants could attend 70 technical sessions, organized into three different tracks – nuclear, safeguards implementation, and technology. Session owners had identified objectives for their sessions and rapporteurs captured the key points arising in the presentations, discussions and audience replies to polling questions. This section draws from careful reviews of the session reports and consultations with session owners and rapporteurs.

The findings, insights and ideas for action have been grouped into six thematic areas, which are oriented toward anticipating and preparing for a dynamic future. The ideas for action listed under these six themes come from the thoughts and proposals made by the Symposium participants in the technical sessions in particular. These are ideas that merit further attention and consideration – not just by the IAEA Secretariat but the safeguards community as a whole.

Theme 1: Prepare for more diverse, mobile and remote nuclear applications and facilities

With the twin pressures of climate change and energy security, interest in nuclear power is surging, in particular small and modular reactors (SMRs), including in countries new to nuclear power. Nuclear is also ‘on the move’ with floating or transportable nuclear reactors planned to be deployed in the seas and remote locations. Nuclear naval propulsion in States with

“How to meet these challenges of innovative designs and SMRs: unattended monitoring systems, remote data transmission, digital connectivity, safeguards seals, design verification, satellite imagery, new SG approaches, State-level considerations, and training for safeguards authorities and IAEA staff”, Jeremy Whitlock, Senior Technical Advisor, IAEA

comprehensive safeguards agreements is in the near horizon.

More facilities are being built to handle nuclear waste and many other types of facilities are being decommissioned – these facilities as well as the few that have suffered an accident, pose challenges in terms of preparing for new safeguards activities and dealing with difficult-to-measure forms of nuclear material

In the longer run, the nuclear landscape may be considerably transformed by applications of nuclear power in the commercial maritime sector (e.g. shipping, cruise lines) as the world transitions into fossil-free transportation modes. It may also see the use of fission reactors in outer space.

“Private industry is interested in space travel and may use nuclear technologies. Most of the challenges in space are similar to challenges in remote locations”, Jay Disser, Safeguards Information Analyst, IAEA

Challenges and Opportunities

- Deployment of small modular reactor (SMRs) and advanced reactors (ARs) further underscore the important role of ‘safeguards by design’ (SBD) – the integration of safeguards considerations into the design process.
- With many new designs being planned, implementing SBD needs to become more than best practice and needs resources and robust mechanisms for active, efficient and targeted engagement.
- The number of countries that are taking initial steps toward acquiring SMRs is increasing considerably, and many are nuclear newcomers. Establishing the needed regulatory and technical capacity to operate these plants will take several years, so outreach and infrastructure development efforts may need to accelerate in the near term.

Audience polling - Changing Nuclear Landscape

What support do you consider useful in responding to the challenges of the changing nuclear landscape?



- For the first time in its history, the IAEA will be preparing safeguards arrangements, as envisioned in paragraph 14 of INFCIRC/153, for nuclear naval propulsion. The high level of Member States' interest associated with the development of such arrangements for the non-application of safeguards suggests the importance of communication and engagement to preserve confidence in the safeguards system.
- Floating or transportable nuclear power plants, including in the commercial maritime sector (e.g. shipping, cruise-liners), and nuclear propelled space exploration will pose new type of verification challenges, bring new actors into the mix, and raise new complexities around ownership and jurisdiction. Early engagement will be critical to deal with the political, technical and legal challenges of 'nuclear on the move'.
- New reactor designs and deployments will require some new verification technologies to be developed, and remotely-located nuclear facilities will need reliable power and connectivity to support unattended monitoring.

- Facilities that have suffered an accident and those entering decommissioning or processing waste, pose challenges in terms of planning for new safeguards activities which require early consultations to ensure verification objectives can be achieved.

Ideas for Action

- Continue to engage with existing industry groups and reach out early to new and emerging actors and sectors (e.g. start-ups, designers) unfamiliar with safeguards in order to raise awareness of the mutual benefits of safeguards by design.
- Normalize SBD engagement early in the nuclear facility design process, for both non-nuclear weapon States and nuclear weapon States exporting facilities, for example through creating requirements for such dialogue in regulations or licensing processes.
- Issue specific guidance (including templates, models, etc.) on waste and termination and for States and facility operators that are preparing for safeguards for facilities undergoing

decommissioning (essential equipment, DIQ updates in particular).

- Prepare for technical and legal issues arising from safeguarding NM in facilities in remote or changing locations (“territory/under jurisdiction/under its control”).
- Engage in early consultations, R&D as well as proactive communication on safeguards arrangements for novel nuclear applications.

Theme 2: Build support for enhancing the legal framework and using all authorities

Safeguards have always evolved to remain effective. Today’s operating environment is changing faster than ever and in less predictable ways. Reflecting on past actions to strengthen safeguards in response to disruptive events, lessons emerge with regard to pro-active enhancements to ensure the safeguards system remains robust also in the future.

Communication and consultation have been crucial to building understanding and support for change. Safeguards operates within the broader nuclear non-proliferation regime, and the current geopolitical climate warrants consideration of ways to fortify the regime against future disruptions such as the discovery of undeclared activities and maybe even further withdrawals from the NPT.

The safeguards system is only as strong as the legal framework underpinning it, and efforts continue toward universal conclusion of safeguards agreements and additional protocols and the modification or rescission of original text SQPs. Moreover, the Annexes of the Model Additional Protocol have not kept pace with technological advancements, and not all existing authorities within the legal framework have been exercised fully.

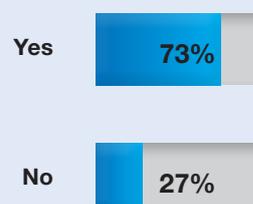
“WAES should not be seen as an indictment of a State’s nuclear program, but for [building] confidence in the safeguards regime”, Eric Brewer, NTI

Challenges and Opportunities

- Significant progress has been made in strengthening the legal framework over the past few years, but five States party to the NPT have yet to conclude a CSA and many more have yet to bring into force an AP and modify or rescind the original text SQPs.
- The monitoring of nuclear trade, and sharing experiences among practitioners in this domain, could enhance regulatory efficiency and improve the uses of this key global data set.
- The analysis of nuclear trade data for safeguards could be further strengthened, e.g. by optimizing the use of link analyses and working toward further harmonization of codes and other aspects of export control regimes.
- An objective of safeguards is to deter the diversion of nuclear material through the risk of early detection. Deterrence can be strengthened through clear communication regarding the effectiveness of safeguards.
- Communication and consultation, particularly with Member States may be sacrificed in lieu of ‘mission critical’ tasks when resources are tight. Yet these are crucial for introducing further strengthening measures such as new instruments and methods, securing needed funding, and to prevent degradation of safeguards effectiveness.
- In an era of abundant information and short attention spans, modern dynamic visual and

Audience polling - Items under AP

Do you think that the AP should include more nuclear-relevant items than it currently does (e.g. items not especially designed or prepared for nuclear use but that still hold a relevance for the NFC)?



interactive data presentations are becoming the norm and expected by current and future audiences.

- Technological developments may have advanced the readiness of wide area environmental sampling (WAES) for deployment; the technology could be promoted as a confidence building measure to be implemented under APs.
- In the event of any future NPT withdrawals, the continuity of safeguards implementation could be called into question given that the requirement to apply safeguards derives from the NPT.
- Response to non-compliance involves escalation, such as through consultations with the State and reporting in the SIR, but other methods could be considered, such as the UN arbitration process or the establishment of a generic UNSC resolution that would strengthen tools and authorities available to the IAEA during its efforts to resolve the situation.

Ideas for Action

- Continue to promote and support States in taking steps to advance toward universality of the legal framework.
- Better communicate the deterrence value of safeguards and present information and findings on safeguards implementation using modern methods that align with stakeholders' expectations, to strengthen their understanding and support.
- Assess and communicate the value of information provided under AP Annexes for safeguards implementation, and update them to incorporate technological advancements over the past two decades.
- Establish mechanisms for stakeholders to share experiences and approaches in monitoring and using nuclear trade information.
- Conduct a contemporary review of the technical readiness and utility of WAES and present the results to Member States.

Theme 3: Strengthen national capacity for safeguards implementation

Targeted assistance, peer-to-peer support, online learning and self-assessment have proven effective methods to build safeguards capabilities within States, particularly through the COMPASS project. Resource constraints have increased the priority of further streamlining, standardizing and simplifying processes and methods for preparing and reporting State declarations to the IAEA. Capacity building requires resources and dedication, both in the Department of Safeguards and in the States requesting assistance and those providing peer support. Efficiencies can be gained through the use of online learning, and many web-based methods and resources developed during the COVID-19 pandemic are now used routinely for capacity building as well as trouble-shooting safeguards implementation issues such as equipment malfunction.

“During the past 40 years, 175 trainees from 70 developing countries completed the traineeship programme and 46% were recruited by the Agency. This is an absolutely unique programme, the only programme of its kind at the IAEA”, Kseniya Pojasek, Training Assistant, IAEA

Challenges and Opportunities

- Self-assessment tools assist States in identifying their specific capacity building priorities, but adequate resources (funds and expertise) are key to addressing those priorities.
- Targeted assistance has proved an effective and efficient mode of capacity building and holistic training projects are providing more effective results than one-off courses.
- The web-based platforms used for online training and engagement have advanced significantly over the past two years and have been used in novel ways, for example to remotely trouble-shoot equipment malfunction, demonstrate a complex task, or hold large events.

Ideas for Action

- Continue to provide States with targeted assistance through the use of self-assessment tools and holistic capacity-building projects, and follow up on results of assistance provided.
- Simplify and streamline processes for submitting reports and declarations and for facilitating verification, particularly for States with SQPs.
- Make further use of the significant advancements in online collaboration and engagement platforms to achieve capacity building objectives, resolve implementation challenges, and to engage a broader range of States.
- Assist operators to comply with International Target Values for measurements of bulk material to reduce measurement uncertainty.

Theme 4: Enhance the collection, analysis, integration and security of safeguards data and information

The field of data science and IT is advancing rapidly, bringing promising tools and methods to enhance the exploitation of information and data for safeguards purposes. The scope of information and data available for collection, processing and analysis, is expanding. The use of AI and machine learning is helping to automate routine tasks and sort the signal from the noise. For example, analysis involves richer data sets from measurement instruments and data integration (such as from different instruments coupled with geospatial and temporal data) is leading to more meaningful results.

Platforms and tools for the efficient exchange and capture of information, including web portals and distributed ledger technology, are playing greater roles in safeguards. Satellite imagery analysis, geospatial data exploitation and link analysis techniques are powerful tools in the safeguards toolbox.

At the same time, disinformation/mis-information, the dark web and deep fakes are becoming increasingly concerning, and the safeguards community recognizes the need to strengthen its ability to discern truth from fiction.

“The key elements to counter information overload are a structured and disciplined approach to data collection, validation and analysis. Analysts must not allow the volume of data to drive processes, but design processes to drive the management of data”, Stephen Francis, Senior Safeguards Analyst, IAEA

Challenges and Opportunities

- The amount of safeguards-relevant data and information is exponentially increasing. Investment is vital in advanced safeguards data analysis and visualization tools (AI, visualization, network analysis, computer vision models, distributed ledger technologies (DLT), satellite imagery, etc.) and in the associated processes to enhance reporting and evaluation efficiency.
- As digitization expands, detecting disinformation will be critical, as well as automating data-related processes wherever practicable and using AI where it makes sense; supporting analysis through visualization; and protecting against evolving cyber threats.
- Data mining, network analysis and machine learning help to find useful information faster, sort through more ‘hay’ to improve chances to find the ‘needle’; tools to support such evaluation need to be further developed.
- Many applications of AI are under discussion or being tested or applied. However, safeguards organizations, including the IAEA, are resource limited (in terms of expertise as well as funding). Assistance from partners may be required. Feedback from users on AI performance (truthfulness, reliability) and good user-AI interfaces are also needed. Finally,

“Trade data provides a fingerprint, and analysis of export/import data helps analysts to focus their efforts where relevant industries and capabilities exist”, Elena Marinova, Safeguards Information Analyst, IAEA

robust governance processes, developed in consultation with IT experts and SMEs, will be needed to protect against bias and unforeseen consequences.

- Computer vision models are growing and capabilities for their use in recognizing safeguards-relevant objects in open-source imagery are increasing.
- Collaboration between analysts and inspectors strengthens information integration and analysis.

Ideas for Action

- Apply AI/machine learning, advanced data analytics, data mining, and network analysis for data management and information collection and analysis
- Collaborate with AI experts in the development of sound governance and feedback processes, effective user-AI interfaces, and techniques to protect against bias and unforeseen consequences
- Expand use of IAEA tools and platforms to geospatially and temporally integrate and visualize the results of safeguards activities in the field and at HQ in order to create a more holistic view of a State's nuclear activities
- Further explore the utility of using open-source information from commercially available non-optical remote sensors (i.e., radars, infrared, and thermal) for safeguards application
- Exchange experience gained by entities applying DLT for safeguards purposes (e.g., nuclear material accountancy, tracking movements of items with nuclear materials)
- Continue to strengthen analytical culture through collaborative, multidisciplinary analysis; apply robust techniques to identify mis/dis-information and deep fakes; and mitigate of cognitive bias
- Maintain robust information security systems to prevent data/information loss, manipulation, theft and data dump
- Strengthen awareness of nuclear proliferation and cyber security risks arising from the dark web

“Use of inaccurate open source information could lead to the Agency losing trust and credibility, which are the cornerstones of the Agency’s safeguards mission. There are approaches that are being used to ensure accuracy, bias and credibility of information, like evaluating sources and data, detection, origin tracing and accuracy evaluation that can be used to debunk inaccurate information”, Sarah Laderman, ONN

Theme 5: Modernize, modularize, miniaturize and automate verification technologies and techniques

Significant advancements have been realized in destructive assay (DA) and non-destructive assay (NDA) analysis methods, and some historical laboratory-based methods are being transitioned to in-field techniques. Modularity and miniaturization, and in the case of the Robotized Cherenkov Viewing Device (RCVD) – robotization – are increasing the usability and portability of instruments.

Unattended monitoring systems played a key role in ensuring verification continuity during the pandemic, may do so also for SMRs and advanced reactors in the future, in addition to enhancing efficiency more broadly.

Environmental sample analysis is a powerful verification method applicable to all facility types and lifecycle stages. New measurement methods are likely necessary for advanced reactors; facility acceptance will require early planning and coordination. New methods may also involve new reference materials and expertise, and cooperation with a broadening set of partners.

Challenges and Opportunities

- The evolving nuclear landscape will likely require new methods for DA and NDA, R&D, potentially new reference materials, and associated testing/acceptance activities involving State/operator support.
- Environmental sampling is a powerful detection tool in the IAEA's toolbox, and is applied at all stages of the NFC. In addition to exploring the potential feasibility of using wide-area environmental sampling, there may be opportunities to more fully utilize location-specific sampling in new ways.
- Significant advancements in analytical techniques and performance have been realized within the Network of Analytical Laboratories (NWAL), such as in the development of certified reference materials, age dating of Pu samples, and expedited sample processing methods. It may be necessary to expand NWAL to handle surges of environmental samples, as has been the case in the past few years. In addition, reliable analytical performance requires a steady supply of reference materials and expertise/workforce. Automation and machine learning may be able to further improve the timeliness of the evaluation of analytical results.
- Some measurement techniques are maturing to the point where UF₆ enrichment measurements may be performed in the field without sample preparation (e.g., laser induced spectrochemical assay for uranium enrichment, or LISA-UE).
- Fusion of measurement results from different types of instruments together with location information (LIDAR, camera, etc.) look promising for attaining increased effectiveness and confidence as well as efficiencies for verification.
- Unattended Monitoring Systems proved an efficient use of safeguards resources, particularly during the pandemic. This momentum affected safeguards approaches, new instrumentation design and was even reflected in facility operators' logistics and systems. These systems will play important roles in the 'nuclear on the move' and remotely deployed facilities, as well as complex advanced reactor designs.
- Significant enhancements to performance and resilience as well as inspector safety were

attained in the new robotized and enhanced Cerenkov Viewing Devices deployed in the past few years.

Ideas for Action

- Sensitize stakeholders to the significance of technologies in enhancing safeguards effectiveness and efficiency, and consult with States to ensure their buy-in and assistance in providing test-beds for new techniques.
- Facilitate information exchange and coordination among the IAEA, designers and members of the R&D community that are working on DA, NDA and monitoring methods and instrumentation for use in SMRs and advanced reactors, in order to leverage potential harmonization and efficiencies.
- Taking into account experiences during the pandemic, further optimize the role of unattended monitoring systems in existing facilities and consider their use to address challenges of 'nuclear on the move' and static but remotely deployed facilities.
- Expand the Network of Analytical Laboratories (NWAL) to ensure fluctuations in environmental sample throughput can be effectively managed.
- Consider the application of machine learning and automation to increase the timeliness of evaluation of the results of sample analysis, where practicable.
- Ensure a steady supply of reference materials and expertise is available to serve the needs of the NWAL, including to address the evolving fuels associated with advanced reactors.

"The picture we see today is genuinely alarming: the gap between essential activities that are funded and those that are unfunded will widen. My message to partners, both traditional and non-traditional, today is sharper than in the past. Our future success depends on you. In addition to resources, we need your creativity, your advocacy, and your talents", DDG-SG Massimo Aparo

Theme 6: Strengthen organizations through culture, diversity, resilience, partnerships and performance management

Organizations are now redefining themselves as they emerge from the COVID-19 pandemic, working to sustain the resilience gained while acknowledging the changing expectations of the workforce, new ways of communicating, and impacts to organizational culture and performance.

The global economic downturn is impacting budgets worldwide, including at the IAEA. As a result, the contributions of partners in terms of financial, where appropriate, and in-kind support as well as new types of expertise will become increasingly important to address priority needs and enhance organizational performance.

Geographic, gender, age and disciplinary diversity are seen as contributing significantly to the effectiveness of an organization, and a variety of methods exist to increase diversity.

Resource constraints also affect the broader safeguards community, and the lessons from COVID in terms of resilience and safeguards

implementation continuity will serve institutions as they strive to operate in more uncertain times and 'do more with less'.

Mechanisms to engage with key stakeholders and decision makers are important tools to enable consultation and policy-making in turbulent times.

Challenges and Opportunities

- Diversity and inclusion can be enhanced by expanding proven methods such as the IAEA traineeship programme and Marie Skłodowska Curie Fellowship, and by emphasizing the value of diversity in the leadership and organizational culture.
- Facilitating the peaceful use of nuclear energy through effective verification as a mission provides a strong basis for a robust organizational culture.
- Although progress has been made in recent years, there are further opportunities to realize efficiencies in safeguards implementation, through e.g., reducing menial tasks for inspectors and streamlining the work of State authorities in preparing and submitting reports.

Audience polling - Safeguards culture

Which one of the following constitutes the greatest challenge in changing the safeguards culture?



- The safeguards workforce must keep pace with demand and evolve to address new verification challenges and approaches. The candidate pool can be expanded and diversified through engagement with universities e.g., to encourage the inclusion of safeguards in relevant programmes, or to collaborate on R&D tasks.
- Knowledge management techniques can build resilience through robust documentation, the avoidance of single-point failures and preservation of institutional memory.
- To reach and motivate the next generation of safeguards leaders, safeguards communications will need to speak to young audiences within their platforms and using language they can relate to.
- Strained regular budgets will necessitate increased reliance on extrabudgetary support and the contributions of partners. At the same time, the IAEA's vital nuclear verification mission helps attract new potential partners and donors willing to provide support. Experience gained and lessons learned during COVID-19 times offer opportunities for deploying smarter and more efficient ways of working.

Ideas for Action

- Assess existing organizational culture (e.g., assumptions, beliefs, habits) underpinning safeguards implementation and performance.
- Expand the safeguards workforce candidate pool and advance diversity and inclusion goals (age, gender, geography) through leveraging networks, offering mentorship and coaching, broadening communication approaches & channels, and better supporting and engaging university programmes.
- Expand the support base for addressing the IAEA's priority needs and leverage experts outside of the traditional safeguards community to find innovative solutions to persistent challenges.
- Identify or establish communication and coordination mechanisms that can be exercised during disruptions, to support State authorities, facilities, R&D organizations and others (leveraging experience gained during the pandemic) and share good practices across the safeguards community.



Part III: Special Events

Part III: Special Events

Celebrating Progress in Strengthening the Legal Framework with DG Grossi

A special event during the first day of the Symposium celebrated progress made with the DG's initiative to strengthen the safeguards legal framework with a signing ceremony followed by a networking reception. DG Grossi acknowledged the States that had in 2022 – the historic anniversary year – brought into force their safeguards agreements and/or APs, and/or amended or rescinded their SQPs: Cabo Verde, Guinea-Bissau, Lao People's Democratic Republic, Namibia and the State of Palestine.

The event also saw further progress, with the signing of the AP to Sierra Leone's safeguards agreement and the amendment of its SQP. Sierra Leone's Ambassador noted in his remarks, "This signing demonstrates Sierra Leone's strong commitment to nonproliferation and to peaceful uses of nuclear energy for science and technology, to meet the sustainable development goals." The DG also announced the amendment – on the same day – of Suriname's SQP. The event was followed by a reception for all Symposium participants, which was sponsored by the United States of America.



The Permanent Representative of Sierra Leone to the UN and other international organizations in Geneva, HE Mr Lansana Gberie, together with DG Grossi showing a letter amending Sierra Leone's SQP

Anniversary Event

To celebrate the historic safeguards anniversaries, the IAEA held a special anniversary event at the Vienna City Hall. The event featured a [high-level panel discussion](#)⁹ for the diplomatic community on the 'historic firsts' exploring how the leadership of individual countries – Norway in 1962, Mexico in 1968, Finland in 1972, and Australia in 1997 – had helped pave the way in advancing the implementation of the safeguards legal framework.¹⁰ The four countries were trailblazers in opening up their countries for the IAEA verification activities. Panelists considered what historic lessons learned this offered for today and the future.



DG Grossi and DDG-SG Aparo cutting the 50th and 25th anniversary cakes with NTI's President and Chief Operating Officer Joan Rohlfing looking on.

The Finnish Foreign Minister noted that "what drove us to be a 'fast mover' was that Finland really wanted to have international safeguards for our peaceful nuclear programme, instead of bilateral safeguards arrangements with nuclear supplier countries".

⁹ <https://iaea.event.do/#/e/5551/f/35965/s/249913>

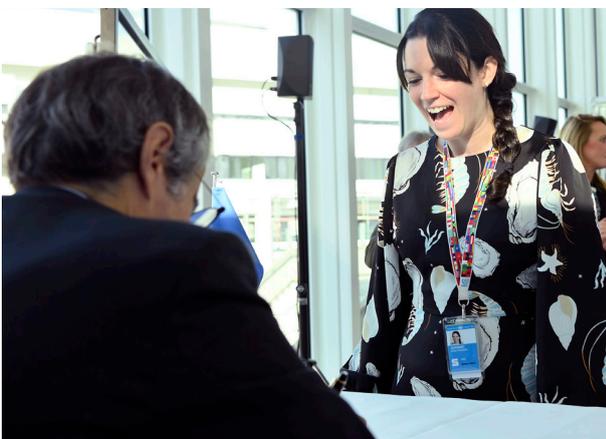
¹⁰ Norway was the first country receive an IAEA inspection, at research reactor in 1962. Mexico was the first country to accept safeguards on all of the country's nuclear activities in 1968, in connection with the Tlatelolco Treaty establishing a nuclear weapon free zone in the Latin America and the Caribbean. Finland was the first country to bring into force a CSA in connection with the Treaty on the Nonproliferation of Nuclear Weapons (NPT), in 1972. Australia was the first country to bring into force an AP, in 1997.



DG Grossi was joined on the panel by Pekka Haavisto, Finland’s Minister for Foreign Affairs; Ambassador Luis Javier Campuzano Piña, Resident Representative to the IAEA, Permanent Mission of the United Mexican States; Ambassador Susan Eckey, Resident Representative to the IAEA, Permanent Mission of the Kingdom of Norway; and Geoffrey Shaw, Director General of the Australian Safeguards and Non-Proliferation Office. The panel was moderated by Director (Legal Advisor), IAEA Office of Legal Affairs, Peri Lynne Johnson.

Book Signing of Translated ‘Nuclear Law: The Global Debate’ with DG Grossi

The IAEA released translated versions of *Nuclear Law: The Global Debate* at the Symposium, the IAEA’s first ever book by global thought leaders



DG Grossi signs copies of the *Nuclear Law: The Global Debate*.

on nuclear law. With the support of Member States, it was translated from English to the other five UN official languages. DG Grossi participated in the signing ceremony; the book is available on the [IAEA website](#)¹¹.

Book Signing of ‘Safeguards Glossary’ with DDG-SG Aparo

DDG-SG Aparo announced the launch of the updated (2022) edition of the [IAEA Safeguards Glossary](#)¹² at the opening of the Symposium. The implementation of IAEA safeguards has continued to evolve, including with greater emphasis on ‘State as a whole’ considerations in the implementation of safeguards, and to reflect numerous technological advancements. The *2022 IAEA Safeguards Glossary* reflects these developments, as well



11 <https://www.iaea.org/newscenter/news/iaea-publishes-free-e-book-on-nuclear-law>

12 <https://www.iaea.org/publications/15176/iaea-safeguards-glossary>



DDG-SG Aparo signs copies of the 2022 edition of the *IAEA Safeguards Glossary*.

as the natural evolution and elaboration of terminology with twenty additional years' experience in safeguards implementation. In launching the updated Glossary, first published in 1980, DDG-SG Aparo said "The continuing evolution of safeguards to address new challenges and technologies in an ever-expanding nuclear field requires us to keep our terminology up to date".

ESPACE Presentations

For contributions favouring a more visual presentation and/or practical demonstration, the Symposium featured [three 'ESPACE' stages](https://media.superevent.com/documents/20230516/116b959cc63dae3c31abce92bda8c89c/espace-programme.pdf)¹³. Over the course of the week, Member-States, cooperating organizations, exhibitors and IAEA staff delivered 49 such presentations on a variety of topics, including safeguards during the COVID-19 pandemic, technologies such as satellite imagery, virtual reality, on-line learning and training, distributed ledgers, seal readers, next generation unattended measurement tools, and techniques such as environmental sampling, among other.

Regional Mixers

To facilitate networking and experience sharing, three regional mixers were held. One invited participants from the African region to talk with one another and with IAEA inspectors working in the region, as well as the regional body AFCONE, responsible for administering the Pelindaba Treaty establishing the nuclear weapon free zone on the continent. The second mixer invited regional networks to share their experiences, including EURATOM, ABACC, the Asia Pacific Safeguards Network, and others. The third mixer focused on island nations and the safeguards implementation experiences specific to this community.

Side Events

Two side events took place on the sidelines of the Symposium. The European Commission organized a side-event titled 'Supporting Safeguards Education and Training' to celebrate the first class of graduates from its new Safeguards Master's programme and familiarize participants on the scope and content of this educational offering. Participants heard

¹³ <https://media.superevent.com/documents/20230516/116b959cc63dae3c31abce92bda8c89c/espace-programme.pdf>

an overview of the Master's programme and testimonials from inaugural graduates.

The Nuclear Threat Initiative (NTI) and the Centre for Energy and Security Studies (CENESS), both partner organizations of the IAEA, organized a panel entitled the 'Future of IAEA Safeguards – Rebuilding the Vienna Spirit through Russia-USA Expert Dialogue' where the partners shared findings from their research papers with recommendations for strengthening four key areas: safeguards efficiency, safeguards culture, safeguards sustainability, and safeguards effectiveness.

Exhibits

The Symposium offered an opportunity to organizations with an interest in safeguards to

present their products, services and activities to Symposium participants. Twenty-four external exhibitors (e.g., companies, associations, Member State Support Programmes and research institutions, and NGOs), three IAEA Departments and the IAEA Office of Legal Affairs used the opportunity to connect with the international safeguards community.

The exhibitors came from a wide range of sectors and professions and displayed solutions covering an extensive array of technical solutions: providers of satellite imagery, nuclear appliances, small modular reactors, measuring devices, radiation resistant cameras, packaging of radioactive materials, open-source media monitoring and blockchain solutions. During the week DDG-SG Massimo Aparo visited many of the booths and spoke with exhibitors.



DDG-SG Aparo visiting the exhibition booths.



**Part IV: Looking Back on 2018 Ideas
for Action – Progress Made**

Part IV: Looking Back on 2018 Ideas for Action – Progress Made

[The report of the 2018 Symposium¹⁴](#), themed ‘Building Future Safeguards Capabilities’, identified ‘ideas for action’ under seven themes for consideration for the safeguards community at large. Based on insights of the 2018 Symposium, these ideas were seen as resonating with participants and deserving of further consideration and action. The section below recalls the ideas and summarizes the progress made by the IAEA Secretariat, between 2018 and 2022, in advancing them.

1. Rethink spent fuel verification for optimizing safeguards

The IAEA has been exploring innovative approaches to safeguarding spent fuel, including at [the 2020 Emerging Technologies Workshop¹⁵](#), particularly to explore solutions to challenges such as designing effective statistical sampling plans, improving non-destructive assay (NDA) measurements and developing safeguards approaches involving unattended systems to monitor the handling and movements of spent fuel.

The IAEA has introduced new tools for spent fuel verification, particularly the Passive Gamma Emission Tomography (PGET), and the Next Generation Cerenkov Viewing Device (XCVD). PGET and its unattended version (UGET) are capable of detecting any removal or replacement of irradiated fuel rods, thus enabling verification of the absence of any defect on spent fuel assemblies transitioning to dry storage. The XCVD considerably enhances inspection efficiency and is now capable of detecting large defects affecting assemblies stored under water. The robotized version (RCVD) of the XCVD, which has already been successfully used for verification purposes in one Members State, provides further dramatic efficiency gains, reduces inspector radiation dose intake, and, overall, improves safety. The combination of the Cerenkov viewing devices and tomographic devices, has enabled the IAEA to design both effective and productive verification schemes.

In addition, the laser curtain technology is being integrated into the safeguards instrumentation infrastructure at multiple facilities to provide efficient containment around spent fuel dry storage.

Good progress has been made by the IAEA in 2022 in the development of safeguards approaches for encapsulation plant and geological repositories (EPGR) by finalizing, as a joint effort with Euratom and the operator, the equipment infrastructure requirements for such a facility in Finland.

2. Reinforce implementation of multisource data visualization for better integration, analysis and use of safeguards information

The IAEA has further enhanced its capabilities to use and analyse data and safeguards relevant information, benefitting from advances in data science for open source information and making more use of data from measurements, in particular. This topic also featured prominently at the 2020 Emerging Technologies Workshop. The IAEA has developed new methodologies and associated internal tools to support data collection, processing, validation, evaluation and visualization such as Open Source Information System (OSIS 2.0), Geographic Exploitation System (GES), TARS (Technical Assistance Review System), STEPS (to support statistical analysis of data) and the use of Sankey diagrams (to visualize the flows of nuclear material in a State). The use of machine learning algorithms to process data generated from NDA measurement instruments has enriched the quality of the results in support of more effective verification.

The IAEA has encouraged all States to use the State Declarations Portal (SDP), a web based secure system for exchange of information between the IAEA and States. Using SDP helps to ensure information received is easily integrated into IAEA databases and applications, thereby supporting analysis and visualization. States

14 <https://www.iaea.org/sites/default/files/19/07/cn-267-symposium-report.pdf>

15 <https://www.iaea.org/topics/safeguards-implementation/emerging-technologies-workshop>

can submit a wide variety of information via the SDP, including nuclear material accountancy reports, AP declarations, and design information questionnaires (DIQs), and receive timely feedback. A complete [learning module on SDP](#)¹⁶ is available for States in the IAEA's learning portal on Nucleus.

3. Build national safeguards capacity by supporting the improvement of SSAC performance

In 2020, the IAEA launched the Comprehensive Capacity-Building Initiative for SSACs and SRAs (COMPASS) a new initiative to partner with States to strengthen State authorities responsible for safeguards implementation (SRAs) and State systems of accounting for and control of nuclear material (SSACs). The IAEA completed the pilot phase of COMPASS in 2022, working with seven States to provide tailored support to address specific needs, through training, peer-to-peer assistance, outreach and procurement in the areas of legislation, SSAC information systems, material accounting and control, implementation of the additional protocol, IAEA inspections, resources and training.

“COMPASS initiative is a golden opportunity, don't miss it”, Abdelbaset Alzyoud, Energy and Minerals Regulatory Commission, Jordan.

The IAEA also updated its guidance on the International Safeguards and SSAC Advisory Service (ISSAS) missions (Services Series 13), incorporating a self-assessment guide, and assisted States to strengthen their legal frameworks, particularly those having modified their SQP or concluded a CSA or an AP.

The IAEA also launched a series of interactive webinars aimed at enhancing practitioners' understanding of IAEA safeguards, reaching over 103 States and 1800 registrations in 2022. It also issued guidance on preparing DIQs. The

IAEA pivoted to online learning during COVID to ensure staff and States could continue to develop the necessary skills and abilities, and has greatly expanded the e-learning resources available, to include self-study, course references, learning videos, over 20 new eLearning sites, and is developing a tool to perform the self-assessment provided in the Services Series 13 document.

4. Bolster safeguards education to build the next generation of safeguards experts

The IAEA has intensified its efforts to build a diverse new generation of safeguards experts. It now organizes the Safeguards Traineeship Programme to develop young professionals yearly, and has increased the number of participants to nine participants in each cadre. The number of trainees has tripled since 2021. The IAEA also has supported aspiring young safeguards professionals through internships and junior professional officer posts.

To better serve the global education system in teaching students about safeguards, the IAEA has increased the availability of a broad set of safeguards training material online on demand, addressing topics such as nuclear trade, design information, nuclear material accountancy and other relevant topics. These are [all available](#)¹⁷ and have reached over 1500 registrants as of April 2023.

The IAEA also contributed to the development and implementation of the European Nuclear Education Network's (ENEN) (a non-traditional partner of the IAEA) Master's Program on Nuclear Safeguards.

5. Proactively engage industry to ensure the early incorporation of safeguards requirements into nuclear projects

The IAEA has pursued a number of avenues to engage industry on safeguards by design (SBD). Partnerships were formalized with industry groups World Nuclear Association, and Nuclear Energy Institute, and activities have included IAEA SBD

¹⁶ <https://elearning.iaea.org/m2/course/view.php?id=846>

¹⁷ <https://elearning.iaea.org/m2/course/index.php?categoryid=15>

talks in events and working groups involving designers.

The IAEA in 2018 established a MSSP umbrella project on “SBD for SMRs”, to engage bilaterally with designers and customers on planning for safeguards at SMRs, advanced reactors and associated fuel-cycle facilities (e.g., pyroprocessing facilities, molten salt reactors, floating reactors, integral pressurized water reactors, micro modular reactors, and pebble bed modular reactors).

The IAEA also intensified the one-house approach by engaging industry collaboratively with IAEA Departments of Nuclear Safety and Security of Nuclear Energy, through: 3S (safety, security, safeguards) workshops; interdepartmental working groups on both SBD in general and SMRs specifically; an online SMR Platform for Member State engagement of the IAEA’s SMR-related services (with several specialized task forces); the industry-led SMR Regulators’ Forum; and by organizing side events at the IAEA General Conference and presentations at other forums, such as conferences and symposia.

6. Develop tailored communication on the role and importance of safeguards

The IAEA has further raised safeguards awareness among the stakeholders and the general public. Efforts have focused on encouraging and facilitating wider adherence to safeguards agreements and APs, as well as amendment and rescission of SQPs. Numerous national and regional events and consultations were held, as well as a series of dedicated technical meetings and seminars for IAEA Missions in Vienna to increase understanding of the safeguards processes and build confidence and support.

The IAEA issued an updated [IAEA Safeguards Glossary](https://www.iaea.org/publications/15176/iaea-safeguards-glossary)¹⁸ in October 2022 during the Symposium, to reflect the evolution of terms and concepts over the more than 20 years since the previous version was published. It has also been issued as an e-book and will be translated into all UN official languages in 2023.

Tailored communication products have proved effective during both in-office and remote working situations, in reaching target audiences and conveying key pieces of information. The lessons learned during the COVID-19 pandemic have led to the extended use of online and hybrid formats, significantly increasing States’ interest and participation in safeguards-relevant events. Enhancements to the IAEA’s website and social media channels have significantly increased the IAEA’s ability to tell a wider audience about the importance of safeguards. The IAEA in 2022 also issued an [IAEA Bulletin](https://www.iaea.org/bulletin)¹⁹ dedicated to safeguards.

7. Expand and leverage non-traditional partnerships to broaden political, financial and technical support to the safeguards mission

In 2021, the IAEA concluded its first formal partnerships with non-traditional partners (i.e., entities such as NGOs in the area of safeguards, through conclusion of practical arrangements. By April 2023, the IAEA Department of Safeguards had initiated formal partnerships with eight organizations working in various aspects of nuclear non-proliferation and international safeguards.

These partnerships complement the support provided by Member States through their support programmes, and provide a framework for cooperation in e.g., safeguards capacity building, inspector training, monitoring emerging technologies, conducting research studies, and organizing outreach events. Some partnerships offer a unique opportunity to explore advancements in verification and monitoring techniques, research contemporary topics and work toward gender parity in the field of nuclear verification. Non-traditional partners were active contributors to the 2022 Symposium.

To communicate its priorities for support from both traditional and non-traditional partners, the IAEA published a document entitled [Enhancing Safeguards Capabilities – Resource Mobilization Priorities](https://www.iaea.org/publications/15176/iaea-safeguards-capabilities-resource-mobilization-priorities)²⁰ in 2022, which identifies a prioritized set of capabilities and associated support needs ranging from R&D to expertise and funding.

18 <https://www.iaea.org/publications/15176/iaea-safeguards-glossary>

19 <https://www.iaea.org/bulletin/63-3>

20 <https://www.iaea.org/sites/default/files/22/02/rmp-2022.pdf>

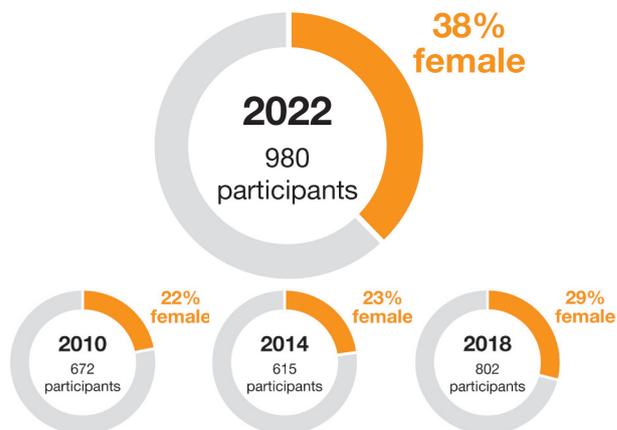
Annex

Annex

The Symposium in Numbers

Participants

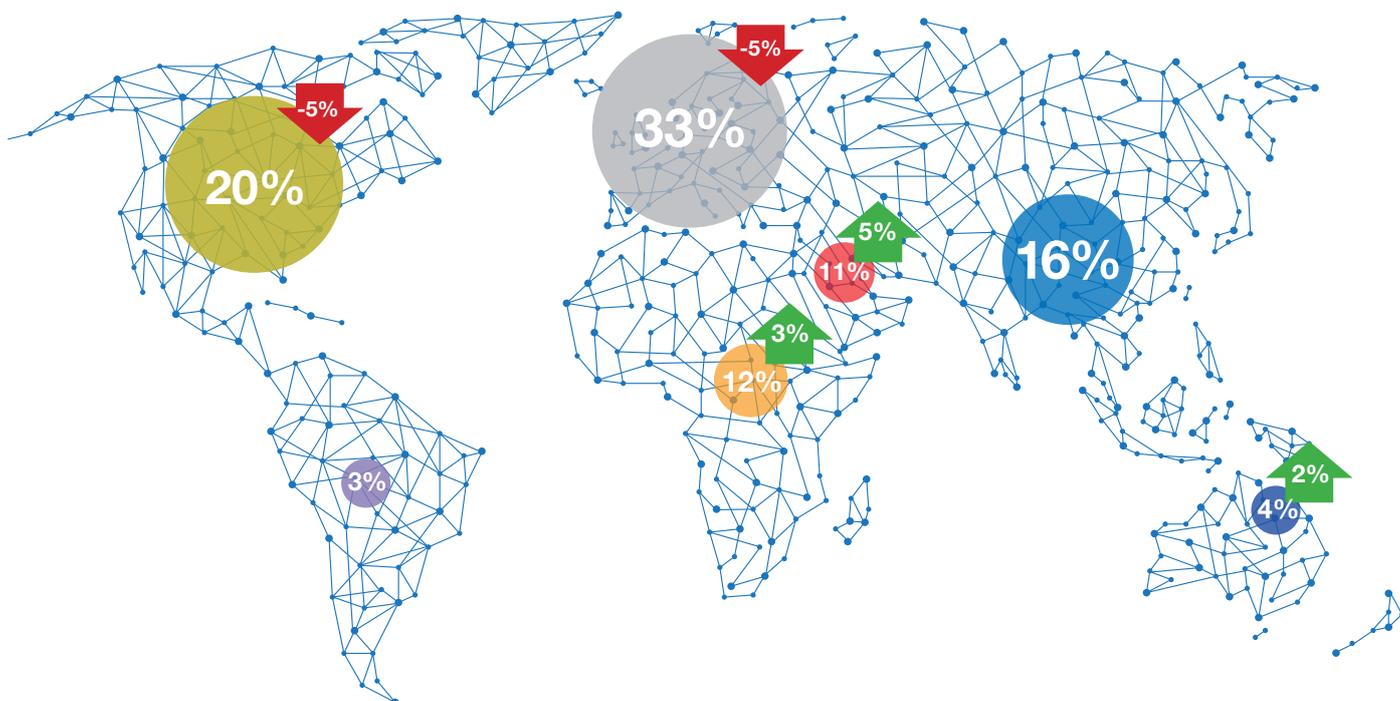
The 14th Symposium on International Safeguards gathered the largest number of participants and observers to date. In total, 973 participants and observers²¹ joined from around the world, representing a 21% increase from the 802 participants and observers in 2018.



Geographic diversity and gender balance

The 2022 Symposium reached a new level of geographical diversity, with participants and observers from 124 countries joining the event, resulting in a substantial 38% increase compared to the 90 countries in 2018. The Symposium provided travel grants to 79 individuals from developing countries which bolstered participation from these regions. The geographical distribution was as follows:

The 2022 Safeguards Symposium had the highest percentage of women participants to date: 38% of all participants and observers were women. In addition, women fulfilled roles of session chairs/moderators, panelists, oral presenters, ePoster presenters, session owners and rapporteurs. Of 446 assigned roles during the Symposium 165 (37%) were performed by women. Notably, 32 out of 53 session chairs/moderators were women (60%).



21 Of the total number of participants and observers, 596 were officially designated by Member States, one came from a Non-Member State, 67 came from IGOs/NGOs, 27 were invited by the IAEA and 282 attended as observers.

Participant feedback

The Symposium sessions were all connected to the three key stated objectives of 1) reflecting on the past, 2) anticipating the future, and 3) inspiring action.

With regards to technical content out of those that participated in the feedback survey, 89%

felt their knowledge of the topics covered had improved and 91% felt that they had learned new information. Of those that participated in the survey, 93% replied that what they have learned in the Symposium would be applicable to their work.

Did the event meet its stated objectives?

YES

96%

NO



Acknowledgements

The Symposium was the result of the hard work of many internal and external contributors. The organization of the Symposium was led by the Section for Strategic Planning and External Coordination, Division of Concepts and Planning (SGCP). Many staff from the other Divisions and Offices within the Department of Safeguards contributed to shaping its content and organizing the sessions.

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External contributors

Partners

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The work on the futures track was funded by the UK Support Programme and made possible by in-kind support from N Square and VCDNP, and the expertise provided by many collaborating organizations. The IAEA would also like to extend its appreciation to the Nuclear Threat Initiative and the City of Vienna that together made possible the memorable anniversary evening event at the Vienna Rathaus.

Cooperating organizations

Asia Pacific Safeguards Network
European Safeguards R&D Association
Institute of Nuclear Materials Management
World Nuclear Association

Member State Support Programmes

Canada
France
Germany
Hungary
Republic of Korea
Russian Federation
Sweden

Switzerland
United Kingdom
United States of America

Exhibitors

AIRBUS Defence and Space SAS
Algorand Foundation
ANSTO Detection and Imaging
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Nuclear Energy Institute (NEI)
Nuclear Threat Initiative (NTI)
N Square
Open Nuclear Network (ONN)
Thirdway
Stimson Center
United Arab Emirates
State Department, United States of America
Verification Research, Training and Information Centre
(VERTIC)
Vienna Center for Disarmament and Non-Proliferation
(VCDNP)
World Nuclear Association (WNA)
World Nuclear Transport Institute (WNTI)

Conference proceedings

The proceedings of the Symposium are stored digitally on the Conference website as well as in the IAEA's Conferences and Meetings application; all papers, posters and video recordings can be found there.

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**Symposium on International Safeguards:
Reflecting on the Past and Anticipating the
Future**

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