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## CHAIRPERSONS' ADDRESS

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Welcome to the Nuclear Forensics International Technical Working Group (ITWG) newsletter. The ITWG recently held its 26th annual meeting in Tbilisi, Georgia, and the co-chairs would like to thank the hosts, sponsors and participants. The Georgian Ministry of Internal Affairs did a great job organizing the event and funding from the European Commission's Joint Research Center (JRC) in Karlsruhe, Germany, and the US Department of Energy's Nuclear Smuggling Detection and Deterrence (DOE NSDD) programme was indispensable. Meeting participants engaged in an active discussion of recent and upcoming ITWG activities that set us on a productive path forward. ITWG-26 was a resounding success and a meeting summary can be found below. This edition of the newsletter also contains other useful resources. There is an article about the International Atomic Energy Agency (IAEA) nuclear forensics and radiological crime scene management webinar series on page 3 and an article about international and regional nuclear forensics cooperation efforts in South Africa on page 5. As co-chairs, we are looking forward to the ITWG's next annual meeting, planned for the United Kingdom in the summer of 2024, and to our continued collaboration with the nuclear forensics community over the coming year. Finally, we would like to acknowledge the extraordinary contributions of the ITWG leadership team—the task group leaders, Executive Committee members and so on—which continues to facilitate meaningful nuclear forensics exercises and activities that allow us to share experiences and learn from each other as we all work to strengthen our collective nuclear security. Thanks everyone!

With best regards,

Michael Curry and Maria Wallenius

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## CO-CHAIRS' SUMMARY OF THE ITWG-26 ANNUAL MEETING

MICHAEL CURRY AND MARIA WALLENIUS

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The 26th annual meeting of the Nuclear Forensics International Technical Working Group was held on 20–23 June 2023 in Tbilisi, Georgia. This was the first meeting in the Caucasus region in the ITWG's history. Countries in the Caucasus region have invested significant effort over the past decade in building up a rigorous nuclear security regime to fight the illicit trafficking of nuclear and other radioactive materials, making Tbilisi an ideal location for ITWG-26. The annual meeting was hosted by Georgia's Ministry of Internal Affairs and sponsored by the US Department of Energy (DOE) and the European Commission, through the Science and Technology Centre in Ukraine (STCU).

The welcoming remarks by the Deputy Minister on Internal Affairs illustrated the host's high regard for the ITWG. Two further presentations on Georgian CBRN capabilities and strategies were then given by Georgian stakeholders. This was followed by the

plenary meeting, which began with updates from key international stakeholders (the IAEA, INTERPOL and the Global Initiative to Combat Nuclear Terrorism) and continued by highlighting the main outcomes from the most recent collaborative materials exercise (CMX-7).

The annual meeting featured extensive technical content in the form of ITWG Nuclear Forensics Laboratories (INFL) sessions organized by Naomi Marks (Lawrence Livermore National Laboratory, LLNL, USA) and Zsolt Varga (JRC-Karlsruhe, European Commission). INFL presentations covered topics ranging from radiochronometry to lanthanide patterns, oxygen isotopic variations, Cm-244 sealed source non-destructive studies and retrospective dosimetry—illustrating the wide variety of areas that the nuclear forensics community is currently working on. The INFL session also included a range of real-world case studies and other updates on nuclear forensics activities in various countries,

*Continued page 2*

Co-Chairs' Summary of the ITWG-26 Annual Meeting *continued from page 1*

such as Moldova, Germany, Czechia and Romania. There was also a professional development session on gamma spectrometry moderated by Jovana Nikolov (University of Novi Sad, Serbia).

The ITWG task groups were active as usual throughout the annual meeting. The Evidence and Testimony Task Group (ETTG)—co-led by Jim Blankenship (FBI, USA) and Jens-Tarik Eisheh (Bundesamt für Strahlenschutz, BfS, Germany)—addresses the needs and priorities of law enforcement and technical experts related to the collection, preservation and handling of evidence from a radiological crime scene. A tabletop exercise (TTX) was conducted on radiological crime scene management during the ETTG session. The TTX has multiple parts that can be used to exercise prioritization of evidence collection, review of national regulations and the route from crime scene to laboratory. There are currently three different TTX scenarios. The material can be tailored to the specifics of each country and translated to ease play. Initial comments were collected on the TTX and the material will be sent to all ETTG members for further review and possible future use as an ITWG engagement activity.

The Libraries Task Group (LTG)—co-led by Steve LaMont (Los Alamos National Laboratory, USA) and Chris Cochrane (Canadian Nuclear Safety

Commission, Canada)—addresses technical questions related to establishing, populating and using national nuclear forensics libraries (NNFLs) in support of nuclear forensics data interpretation. The draft strategic plan, which includes a new mission statement for the task group and updated goals, was presented during the LTG session. A possible name change was discussed to better reflect the NNFL interpretation element in the mission of the task group. The LTG session also reviewed the status of version 5 of the Galaxy Serpent exercise (GSv5), in which about 180 participants in 30 teams are taking part. On average, the teams are two-thirds of the way through the exercise. Old GS exercises can be obtained on request for use as training modules or as a teaching tool.

The main objective of the Exercises Task Group (ETG)—co-led by Jon Schwantes (Penn State University, USA) and Olivia Marsden (Atomic Weapons Establishment, UK)—is to organize collaborative material exercises (CMXs). The objectives of the draft strategic plan for the next five years were reviewed during the ETG session. Among these were exploring whether the CMXs can be made more inclusive of laboratories with fewer capabilities. Efforts will also be made to reduce the time between the end of the exercise and release of the results to the participating laboratories (i.e. the After Action



**Figure 1.** Participants of the 26th annual meeting of the Nuclear Forensics International Technical Working Group (ITWG), Tbilisi, Georgia, 20–23 June 2023. Photo: ITWG.

Report). This is particularly important to allow adequate time for laboratories to implement the lessons learned from the previous exercise before the next one commences. There was also a brainstorming session on new features to be included in future CMXs. Among the proposals were real contamination of the crime-scene-in-a-box (CSIAB) evidence; the use of certified reference materials as samples; a wider variety of radionuclides as samples, including low vs high activity; a mentoring/reach-back capability; and individualized feedback. CMX-8 is scheduled to begin in the autumn of 2024. It will have four components: nuclear/other radioactive samples, traditional forensics evidence, a CSIAB and an NNFL query. All those interested in participating in CMX-8 should contact the ETG co-leads.

The Guidelines Task Group (GTG)—co-chaired by Mike Kristo (LLNL, USA) and Jovana Nikolov—develops guidelines on all aspects of a nuclear forensics investigation. Two new guidelines were presented during the GTG session: one on ‘in-beam active neutron interrogation techniques’ and the other on ‘characterization of particle morphology via microscopy’, both prepared by Canadian Nuclear Laboratories. In addition, three guidelines on gamma spectrometry are in the process of being updated to reflect the current state of play, and the Graded Decision Framework guideline is ready for final approval. Volunteers were identified to draft new guidelines, and we will hopefully hear about ‘confidence in conclusions’ (UK), ‘national nuclear forensics libraries’ (Italy) and ‘fission track analysis’ (Israel/Czechia) at the next annual meeting. Towards the end, there was a discussion on how to accelerate

the process from drafting a guideline to its approval. Because webinars reach a larger audience and can be organized between the annual meetings, they were mentioned as a potential option.

The Outreach and Training Task Group (OTTG)—co-chaired by Liz Dallas (Oak Ridge National Laboratory, USA) and Liz Keegan (Australian Nuclear Science and Technology Organisation, Australia)—strives to foster active association with practitioners in nuclear forensics. The OTTG presented ideas on updating the ITWG restricted website, which is currently under construction and being implemented by Weconext with the support of Commissariat à l’énergie atomique et aux énergies alternatives (CEA), France. The updated website will be more user friendly and allow ITWG members to be more interactive, such as in the work of the task groups and between annual meetings. The OTTG continues to update ITWG members through its quarterly newsletter and plans to restart the discussion on training needs in the ITWG community. A presentation by the Office of Nuclear Smuggling Detection and Deterrence (NSDD) illustrated its approach to the pipeline initiative for nuclear forensics expertise.

In addition to the strong technical content and task group sessions, the last day of ITWG-26 included presentations from some new ITWG members (such as Jordan and Latvia) and on national capability building activities in Kazakhstan and South Africa. Recordings of the presentations in the ITWG and INFL plenary sessions will be made available on the restricted website of the ITWG. •

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## WEBINAR SERIES ON NUCLEAR FORENSICS IN GLOBAL NUCLEAR SECURITY

CHELSEA WILLET

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The IAEA is pleased to announce a new Webinar Series on Nuclear Forensics in Global Nuclear Security. Nuclear forensics is a growing and dynamic discipline; thus, opportunities to bring together specialists and stakeholders are crucial to furthering development of the science and to engaging with newcomers while developing and retaining existing expertise.

The webinar format is globally accessible and the topics aim to be relevant to all levels of nuclear forensic capacities found in IAEA member states. The series will allow interested parties to keep abreast of developments in the field and to interface virtually with the IAEA.

The webinar series will cover two primary topics over a span of four sessions. The first topic, covered in the first session on 18 July 2023, introduced the recently published IAEA Technical Document, *Establishing a Nuclear Forensic Capability: Application of Analytical Techniques*. The session outlined the information contained in the publication and guided participants on ways to enhance nuclear forensics practice.

The second topic will span three sessions and cover the important time intervals commonly associated with nuclear forensics examinations: the first 24 hours, the first week and the first two months after receiving the sample.

*Continued page 4*

Webinar Series on Nuclear Forensics *continued from page 3*

**Figure 2.** The IAEA webinars aim to allow interested member states to remain abreast of latest developments. Photo: Dean Calma/IAEA.

During the webinars, the presenter will engage with the participants on the many activities conducted during time-bound nuclear forensics examinations. This will be done by abbreviating the time intervals required to ship a package, dissolve a sample or calibrate a sophisticated instrument. Each of the webinars will be led by a different nuclear forensics practitioner from an IAEA member state. Each of the three webinar sessions will address the important questions around and outcomes from the three crucial time intervals pertinent to nuclear forensics examinations.

- In the first session, on the first 24 hours after sample receipt, the presenter will demonstrate tasks such as initial sample unpacking, material handling, optical microscopy, photography and initial gamma spectrometry.
- The second session will cover analyses that can be completed within one week of sample receipt. These might include scanning electron microscopy, X-ray diffraction, structural determinations and certain mass spectrometry techniques.

- The final session will address the analyses that can be completed within two months of sample receipt. These might include high-resolution mass spectrometry and gamma spectrometry, transmission electron microscopy and radiochronometry. This session will also discuss approaches to data interpretation.

The webinar series is designed to take an interactive and dynamic approach that encourages the audience to participate and respond in real time. For example, there will be group voting on the next steps in a 'choose-your-own-adventure' style while the presenter performs demonstrations in the laboratory space. Each webinar session will also allow participants to engage with experts in a Q&A session.

The webinar series is scheduled to take place in alternate months. The IAEA also plans to vary the time of day at which each session is held to present live-viewing opportunities for participants in different time zones. Recordings of all the webinar sessions will be made available on the IAEA NUSEC webpage. •

## THE NUCLEAR FORENSICS LABORATORY AT NECSA: SUSTAINABILITY AND INTERNATIONAL COOPERATION IN SOUTH AFRICA

AUBREY NELWAMONDO, JEANETH KABINI, BANYANA KOKWANE AND RACHEL LINDVALL

South Africa announced its commitment to establish a national nuclear forensics capability at the 2010 Nuclear Security Summit in Washington, DC. In 2011 the South African government chose the Nuclear Energy Corporation of South Africa (Necsa) to implement this task, and Necsa began to develop its nuclear forensics capabilities. As of June 2023, assisted by the United States, Necsa has established an advanced Nuclear Forensics Laboratory, developed and implemented analytical methods for the forensic fingerprinting of uranium ore concentrates and other radioactive materials, and set up a prototype National Nuclear Forensics Library. The story of this collaboration is described in the June 2023 issue of this newsletter.<sup>1</sup>

In cooperation with multiple international partners, such as the US government, the IAEA, the Nuclear Forensics ITWG and Japan's Atomic Energy Agency (JAEA), among others, Necsa is working to develop international cooperation on nuclear forensics to ensure the long-term sustainability of its recently developed nuclear forensics capabilities. Necsa is also

committed to strengthening regional nuclear security by fostering nuclear forensics cooperation with neighbouring countries.

### **Necsa's international cooperation on nuclear forensics capacity building**

#### *Cooperation with the IAEA*

In its ongoing efforts to establish a robust national nuclear forensics capability, Necsa has utilized the IAEA guidance document on Nuclear Forensics in Support of Criminal Investigations (IAEA Nuclear Security Series no. 2-G (Rev. 1)) to identify existing capabilities and gaps. South Africa also continues to participate in the IAEA's Incident and Trafficking Database (ITDB).

The IAEA and the US DOE NSDD have played a critical role in supporting South Africa's efforts to establish its national nuclear forensics capability. South African representatives have participated in numerous training courses, workshops, meetings and conferences funded and organized by these organizations, including participation in IAEA



**Figure 3.** Delegates at the IAEA regional nuclear forensics training held in Pretoria, South Africa, on 6–9 November 2017.

**The Nuclear Forensics Laboratory at Necsa** *continued from page 5*

Technical Meetings on nuclear forensics. The IAEA funded a Coordinated Research Project (CRP) on ‘Applying Nuclear Forensic Science to Respond to a Nuclear Security Event: The Application of Inductively Coupled Plasma Mass Spectrometry and High gamma-Ray as Complementary and Alternative Techniques in Nuclear Forensics Analysis’, under the leadership of Dr Aubrey Nelwamondo as Chief Investigator. In 2017, the IAEA, supported by experts from the ITWG, organized and funded a Southern African regional nuclear forensics workshop to enhance integrated regional nuclear forensics capabilities in Southern Africa.

**Cooperation with the ITWG**

South Africa’s nuclear forensics laboratory has participated in all the Galaxy Serpent tabletop exercises to date and plans to participate in all future exercises. The laboratory has also participated in CMX-3 to CMX-7 to improve its proficiency. South Africa has participated in and contributed to ongoing international engagements such as the ITWG annual meetings, where it has presented papers on completed activities typical of the outcomes from involvement in the Galaxy Serpent and CMX joint activities. South African scientists have contributed articles and/or sections of articles to numerous peer-reviewed journals alongside internal collaborating laboratories in nuclear forensics.

**Cooperation with other organizations**

Necsa has participated in several Nuclear Security Partnership (PNS) events alongside Witwatersrand University and North-West University, among others. Many fruitful workshops have been held in South Africa and abroad to plan and carry out collaborative activities in support of global nuclear security initiatives, especially those aligned with nuclear forensics and nuclear safeguards regimes. Necsa scientists have participated in many Institute of Nuclear Materials Management (INMM) workshops and presented topical papers on South Africa’s experience of the Galaxy Serpent virtual exercise. The South Africa chapter of the INMM, funded by the PNS, was launched in Orlando, Florida, in 2014.

A 2017 Necsa collaboration with the Integrated Support Centre for Nuclear Non-proliferation and Nuclear Security-Japan Atomic Energy Agency (ISCN-JAEA) centred on methods and library database development. It was supported by the National Research Foundation and Japan Society for the Promotion of Science (NRF/JSPS) fund for promoting inter-laboratory analysis and scientific visits.

**Ensuring long-term sustainability: Southern African Regional Nuclear Forensics Centre of Excellence**

Nuclear forensics cooperation has clear potential to strengthen the nuclear security community in

**NOTABLE PUBLICATIONS ON THE WORK OF THE ITWG, NUCLEAR FORENSICS AND RELATED DISCIPLINES**

- Tóbi, C., Homonnay, Z., and Süvegh, K., ‘A possible novel method in nuclear forensics: Positron annihilation spectroscopy’, *Journal of Radioanalytical and Nuclear Chemistry*, vol. 332, no. 7 (July 2023), pp. 2741–2747.
- Inglis, J. D. et al., ‘An introduction to the significance of sample size in particle analyses for nuclear forensics and radiological investigations’, *Journal of Radioanalytical and Nuclear Chemistry*, vol. 332, no. 8 (Aug. 2023), pp. 3371–3381.
- Kumar, S. et al., ‘In view of “on-site” Nuclear forensics and assay of fissile materials in sealed packages by high-resolution-ray spectrometry’, *Analytical Chemistry*, vol. 95, no. 6 (14 Feb. 2023), pp. 3247–3254.
- Cassata, W.S. et al., ‘Noble gas constraints on spent fuel irradiation histories’, *Journal of Radioanalytical and Nuclear Chemistry*, vol. 332, no. 8 (Aug. 2023), pp. 3151–3159.
- Reilly, S.D. et al., ‘Trace actinide signatures of a bulk neptunium sample’, *Analytical Chemistry*, vol. 95, no. 23 (1 June 2023), pp. 9123–9129.

the Southern Africa region. To institutionalize this idea, South Africa has developed the concept of a Southern African Regional Nuclear Forensics Centre of Excellence (NUFORCE), to be hosted by Necsa, and secured support for it from the governments of Namibia, Mozambique, Malawi and Angola. NUFORCE has received strong support from the international community, including the US DOE and the IAEA.

NUFORCE will provide Southern African Development Community (SADC) member states with the facilities and expertise to develop human capital in nuclear forensics through a number of training courses. The inductively coupled plasma mass spectrometry (ICP-MS) and high-resolution gamma spectrometry (HRGS) installed at the Necsa Nuclear Forensics Laboratory allow NUFORCE to serve as a hub laboratory in the regional network. For this project, a regional forum for nuclear forensics experts was established to share best practices and provide specific technical training on radiological crime scene and chain of custody management.

The SADC regional centre of excellence will:

(a) provide support to neighbouring countries with

setting up nuclear forensics capabilities in their own areas; (b) train law enforcement actors on all aspects of the national response plan in relation to radioactive materials; (c) benchmark specific developments, such as methods of fingerprinting nuclear material found out of regulatory control; (d) assist with inter-laboratory comparison analysis (joint analysis) in support of national nuclear forensics libraries projects; and (e) provide work–industry integrated learning opportunities for postgraduate students and interns.

SADC regional members will send professionals to the nuclear forensics hub housed at Necsa for training in all aspects of nuclear forensics. The centre will advance the SADC region nuclear security agenda by highlighting the importance of strengthening nuclear security worldwide and working to address the need for capacity building, technology development and the coordination of assistance on nuclear security matters that exists among participating states. The IAEA is seen as having a major role in coordinating the activities of and providing the additional training required by its member states in the region. •

<sup>1</sup> This is the second of two articles on the development of South African nuclear forensics capabilities. See the June 2023 edition of this newsletter for the first article.

#### UPCOMING TRAINING COURSES AND MEETINGS\*

- IAEA International Training Course on Introduction to Nuclear Forensics, Bangkok, Thailand, 4–8 September 2023
- NSDD GUAM Regional Workshop on Signatures, Azerbaijan, 11–12 September 2023
- IAEA Practical Introduction to Nuclear Forensics Course, Budapest, Hungary, 2–6 October 2023
- Institute of Physics NuFor 5th Nuclear Forensics Conference, London, UK, 10–12 October 2023
- IAEA International Training Course on Introduction to Nuclear Forensics, Nairobi, Kenya, 16–20 October 2023
- International Conference on Nuclear Security (ICONS), Vienna, Austria, May 2024

\*Please check directly with the event organizer on the status and dates for implementation of the individual events listed above.

Dates and locations of IAEA training courses and meetings will be officially confirmed with host member states; participation in IAEA training courses and meetings is by nomination and in accordance with established IAEA procedures.

## CONTENTS

Chairpersons' Address	1
Co-chairs Summary of the ITWG-26 Annual Meeting	1
Webinar Series on Nuclear Forensics in Global Nuclear Security	3
The Nuclear Forensics Laboratory at Necsa: Sustainability and International Cooperation in South Africa	5
Notable Publications about the Work of the ITWG, Nuclear Forensics and Related Disciplines	6
Upcoming Training Courses and Meetings	7

### NUCLEAR FORENSICS

Nuclear forensics is an essential component of national and international nuclear security response plans to events involving radioactive materials diverted outside of regulatory control. The ability to collect and preserve radiological and associated evidence as material is interdicted and to conduct nuclear forensics analysis provides insights to the history and origin of nuclear material, the point of diversion, and the identity of the perpetrators.

### THE NUCLEAR FORENSICS INTERNATIONAL TECHNICAL WORKING GROUP

Since its inception in 1995, the Nuclear Forensics International Technical Working Group (ITWG) has been focused on nuclear forensic best practice through the development of techniques and methods for forensic analysis of nuclear, other radioactive, and radiologically contaminated materials. The objective of the ITWG is to advance the scientific discipline of nuclear forensics and to provide a common approach and effective technical solutions to competent national or international authorities that request assistance.

### ITWG PRIORITIES AND ACTIVITIES

As a technical working group, the priorities for the ITWG include identifying requirements for nuclear forensic applications, evaluating present nuclear forensic capabilities, and recommending cooperative measures that ensure all states can respond to acts involving illicit trafficking and unauthorized possession of nuclear or other radioactive materials. An objective of the working group is to encourage technical peer-review of the nuclear forensic discipline. These goals are met through annual meetings, exercises, and informal and formal publications.

Outreach is a primary goal of the ITWG. The working group disseminates recent progress in nuclear forensic analysis and interpretation with the broader community of technical and security professionals who can benefit from these advancements. Affiliated international partner organizations include the International Atomic Energy Agency (IAEA), the European Commission, the European Police Office (EUROPOL), the International Criminal Police Organization (INTERPOL), the Global Initiative to Combat Nuclear Terrorism (GICNT) and the United Nations Interregional Crime and Justice Research Institute (UNICRI).

### ITWG MEMBERSHIP

Nuclear forensics is both a technical capability as well as an investigatory process. For this reason the ITWG is a working group of experts including scientists, law enforcement officers, first responders, and nuclear regulators assigned by competent national authorities, affiliated contractors, and international organizations. The ITWG is open to all states interested in nuclear forensics.

ITWG participating states and organizations recognize that radiological crimes deserve thorough investigation and, when warranted, criminal prosecution. The ITWG encourages all states to possess the basic capability to categorize nuclear or other radioactive materials to assess their threat. As an international group, the ITWG shares its expertise through its membership to advance the science of nuclear forensics as well as its application to nuclear security objectives.

<http://www.nf-itwg.org/>

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