ITWG Nuclear Forensics International Technical Working Group

ITWG NUCLEAR FORENSICS UPDATE

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CHAIRPERSONS' ADDRESS

Welcome to the 35th edition of the ITWG Update. As this is the summer edition of the newsletter, you may be reading this just before you travel to the annual meeting, ITWG-28. We want to thank most sincerely the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) for hosting this year's meeting and, in particular, Giuseppe Ottaviano and Antonietta Rizzo for their work on organizing the event. Although the consecutive numbering of the meeting does not reveal the fact, we are celebrating 30 years of the ITWG this year, thanks to the two years 'lost' to Covid-19. A full preview of the upcoming annual meeting can be found below.

This edition also introduces the new initiatives on nuclear forensics by the International Atomic Energy Agency (IAEA). The article reviews, among other things, a newly developed workshop on Radiological Crime Scene Management held at the Nuclear Security Training and Demonstration Centre (NSTDC) in Seibersdorf, Austria; a long-term fellowship programme hosted by international partner laboratories; and the IAEA Expert Mission on 'Adapting Laboratories for Nuclear Forensics'. Read more about these and other excellent activities to enhance capacity building in nuclear forensics below.

Another interesting article, on the United Nations Interregional Crime and Justice Research Institute's (UNICRI) newly launched training programme 'Strengthening CBRN Investigation, Prosecution and Adjudication Capabilities', addresses an often overlooked aspect of CBRN forensics—the admissibility of forensics evidence in court. The training is extremely comprehensive and involves five modules. It has been piloted in two national courses before implementation at the regional level later this year. This is a highly appreciated initiative that complements the nuclear forensics process 'From Crime Scene to Court Room'.

With best regards,

James Blankenship and Maria Wallenius

PREVIEW OF THE 28TH ITWG ANNUAL MEETING

JAMES BLANKENSHIP AND MARIA WALLENIUS

The 28th annual meeting of the Nuclear Forensics International Technical Working Group will take place in Bologna, Italy, on 1–3 July 2025. Hosted by the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), the upcoming annual meeting will be a great opportunity to look back on recent ITWG developments and help shape its future activities. Thirty years have passed since ITWG-0 in Livermore, USA, in 1995. It is therefore time to review how the ITWG can best fulfil its main objective 'to identify, develop and socialize best practices in nuclear forensics'.

There are already some reforms on this year's agenda. It is planned to stage two sessions on 'Emerging Topics in Nuclear Forensics', which will replace, at least temporarily, the previously staged professional development seminars. The proposed topics are: 'Advanced and Small Modular Reactors (SMR)', what they are, their fuel types and the nuclear forensics challenges and opportunities these pose; and 'Artificial intelligence', a description of some AI/machine learning applications and how they can be leveraged for nuclear forensics.

Besides shaping the sessions on SMR and AI, the ITWG Nuclear Forensics Laboratories (INFL) will organize the dedicated sessions for the technical part of the meeting. These presentations will highlight recent scientific developments by the international community on the measurement and interpretation of nuclear forensics signatures.

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Preview of the 28th ITWG annual meeting... *continued from page 1*

The time allocated to the task groups (TGs) has been slightly reduced due to a special session dedicated to '30 Years of the ITWG'. The content of the latter session will not be disclosed here but the themes for the various TGs are set out below.

The Exercise TG will discuss progress with the eighth collaborative material exercise (CMX-8). Alongside the nuclear material component of past exercises, CMX-8 also includes the interactive crime scene in a box (CSIAB) element, which has become an integral part of these exercises. As a new feature, the CMX-8 will include a National Nuclear Forensics Library (NNFL) component, which is being planned together with the Libraries and Assessments TG.

The Libraries and Assessments TG, in addition to refining the CMX-8 NNFL element, will report detailed outcomes from the fifth iteration of the Galaxy Serpent exercise (GSv5), during which increased emphasis was placed on data interpretation. The discussion will include examples of how forensics data translates to conclusions that answer investigative questions, and how best to present findings for the investigative team.

The Evidence and Testimony TG, in addition to the CSIAB element, plans to review various documents, such as the guidelines on the chain of custody and on documenting casework. It will also discuss the possibility of creating a new table-top activity that will focus on how to interpret and present nuclear forensics results in a way that is tailored to law enforcement, public messaging and decision makers.

The Guidelines TG is continuing to develop consensus guidelines on a range of nuclear forensics topics that reflect best practices as identified by the collaborative efforts of the community of nuclear forensics experts. At ITWG-28, it will provide an update on the status of the draft guideline documents, with special attention to the revised versions of the alpha spectrometry and gamma spectrometry guidelines, as well as the new, revised draft of the NNFL guidelines. Ideas for the development of new guidelines will be gathered from among TG members.

The Outreach and Training TG will focus on opportunities for enhanced outreach through a digital presence, technical meetings and international conferences, and the content of future editions of the ITWG Update. It will also begin a survey of training on nuclear forensics to identify opportunities for collaboration and gaps.

Finally, but importantly, the annual meeting will again feature updates from other key international nuclear forensics contributors. For instance, the IAEA and UNICRI will provide an update on their nuclear forensics-related activities. In addition, national representatives from the Global Forum to Prevent Radiological/Nuclear Terrorism (GFTPRNT) will report on the activities of this newly established forum. •

IAEA: NEW INITIATIVES ON STRENGTHENING NUCLEAR FORENSICS GLOBALLY

ANDREI APOSTOL

The IAEA is implementing a number of initiatives to strengthen states' abilities to respond to criminal or other intentional unauthorized acts involving nuclear or other radioactive material out of regulatory control (MORC). These efforts, which range from laboratory enhancements to training activities, aim to enhance nuclear forensics readiness in a cost-effective and sustainable manner.

Supporting countries to enhance their national laboratories infrastructure for nuclear forensic analysis

At a country's request, the IAEA can through its expert missions support national efforts to enhance existing laboratory infrastructure for nuclear forensics examinations. An expert mission involves a team of international experts assessing existing capacities, identifying specific areas for enhancement and making recommendations. By building on existing assets, such as x-ray fluorescence and alpha or gamma spectrometry, the initiative helps to ensure that national laboratories are ready to contribute to the investigation of criminal or other intentional unauthorized acts involving MORC, thereby fostering sustainable nuclear forensics capacity development.

Long term on-the-job training programme

In April 2025, the IAEA launched a long term on-the-job training programme in nuclear forensics, which began at the European Commission's Joint Research

Centre in Karlsruhe, Germany. Designed to last for up to one year, this programme provides comprehensive, hands-on experience across the entire nuclear forensics process, from secure evidence handling to applying advanced analytical techniques.

Trainees engage directly in research activities, such as gamma spectrometry, ion beam analysis or the application of artificial intelligence to radionuclide identification and characterization. The programme is structured to build national expertise in nuclear forensics and generate publishable research results that support the development of international good practices.

Plans are under way to expand the initiative with additional host institutions in Hungary, Romania and the United States, and more IAEA member states are expected to participate. By combining capacity building with scientific research output, this initiative offers an efficient approach to strengthening nuclear forensics capabilities globally.

Enhancing radiological crime scene management

The IAEA has created the new National Workshop on Radiological Crime Scene Management (RCSM) for practitioners, building on its existing RCSM activities to improve national preparedness (see figure 1).

The workshop has been developed with expert input from INTERPOL and specialists from member states, and is tailored to practitioners. It focuses on the secure handling, collection and preliminary analysis of evidence at radiological crime scenes. The first iteration is scheduled for late 2025, marking an important milestone in strengthening national nuclear security capabilities.

By integrating conventional crime scene management techniques with radiation protection-specific procedures, the workshop aims to equip participants with the knowledge and practical skills required to ensure that evidence associated with MORC is preserved, documented and properly prepared for laboratory analysis, and that the chain of custody is maintained effectively from the radiological crime scene to the courtroom.

Advancing analytical capabilities: Gamma-ray spectrometry

The first training course covering foundational and advanced applications of medium- and high-resolution gamma-ray spectrometry will be delivered at the IAEA's Nuclear Security Training and Demonstration Centre and the European Commission's Joint Research Centre in 2026. Other laboratories will be invited to co-host future iterations of this activity.

Participants will gain technical proficiency in the use of state-of-the-art detection systems, such as high-purity germanium and lanthanum bromide detectors, for non-destructive analysis of radioactive samples. The course will focus on practical skills in spectral data acquisition, radionuclide identification, activity quantification, isotopic composition analysis, age dating and the interpretation of results in a nuclear security context.

By enhancing analytical capabilities at both field and laboratory level, member states' participants will be able to more effectively characterize and assess radioactive samples in support of nuclear security operations and investigations.

Fostering regional cooperation

The IAEA continues to advance regional cooperation through its peer-to-peer (P2P) workshops on nuclear forensics, which bring together technical experts from neighbouring member states to exchange good practices and lessons learned.

These workshops offer a platform for participants to share national experiences and learn from case studies. Following a successful workshop in Southeast Asia in 2024, the next session will be at the IAEA Collaborating Centre in Tajikistan in 2025, leveraging its infrastructure to foster cost-effective and sustainable regional capabilities. •

Figure 1. The International Integrated Workshop on Radiological Crime Scene Management and Nuclear Forensics was held at the NSTDC in the IAEA Laboratories in Seibersdorf. Photo credit: Zhong YUAN/IAEA

FROM CRIME SCENE TO COURTROOM: ADVANCING CBRN KNOWLEDGE FOR INVESTIGATORS, PROSECUTORS AND JUSTICE AUTHORITIES

TALGAT TOLEUBAYEV

In 2024, a groundbreaking initiative, 'From Crime Scene to Courtroom', marked a significant step forward in strengthening the global response to Chemical, Biological, Radiological and Nuclear (CBRN) threats. Fully funded by the European Commission's Foreign Policy Instruments (FPI) and developed within the framework of the European Union CBRN Risk Mitigation Centres of Excellence (EU CBRN CoE) Initiative, this pilot project is helping to shape best practices in CBRN forensics while also strengthening legal and judicial capacities in affected regions.

Among the most innovative aspects of the training is its strong emphasis on the admissibility of forensics evidence in court—an aspect often overlooked in traditional CBRN capacity-building efforts. The programme comprehensively addresses key legal and procedural elements, such as expert witness preparation, evidentiary reporting, the qualifications and credibility of forensics experts and maintaining an unbroken chain of custody. These elements are critical to ensuring that the technical findings of CBRN investigations can withstand judicial scrutiny.

The full training package is structured to be completed within a six-month period. It comprises five integrated courses designed to simulate and build on real-world scenarios: (*a*) a table-top exercise provides foundational knowledge on CBRN needs, gaps and priorities, and promotes inter-agency coordination; (*b*) a CBRN Criminalization Workshop (see figure 2) focuses on international legal frameworks for defining and prosecuting CBRN-related crimes; (*c*) 'Building a Case for Prosecution' (see figures 3,4 and 5) equips participants with the tools to translate forensics findings into legally sound prosecution strategies; (*d*) a mock trial / moot court allows participants to test their knowledge in a realistic courtroom setting, using adapted national legislation (see figure 6); and (*e*) Train-the-Trainer ensures the programme's scalability and sustainability by empowering national trainers.

All five modules have been successfully delivered and tested in national formats in Moldova and Ukraine, demonstrating both the feasibility and the effectiveness of this targeted capacity-building model. The mock trial component has already proved highly effective in Moldova and Ukraine, where the training was tailored to reflect the respective legal systems, national regulations and Standard Operating Procedures (SOPs). This localized approach ensured that the training was not only educational, but also directly applicable to national contexts.

Following its successful roll-out, the project has attracted interest from numerous states. As of early 2025, 14 countries are on a waiting list to implement the full training package, officially titled 'Strengthening CBRN Investigation, Prosecution and

Figure 2. Participants in the CBRN Criminalization Workshop, Slovakia, February 2025. Photo credit: UNICR

Figure 3. Dr Éva Széles conducts a practical exercise during the Building a Case for Prosecution training event, Moldova, April 2025. Photo credit: UNICRI

Adjudication Capabilities'. Beginning in September 2025, the programme will shift to a regional delivery model, targeting areas such as the Balkans and the Gulf states to maximize reach and impact.

The programme has greatly benefited from the involvement of distinguished international experts and institutions. Renowned prosecutors, judges, law enforcement personnel and CBRN forensics specialists have all played a vital role in content delivery, enriching the programme with their unique perspectives and field experience.

The European Commission's JRC in Karlsruhe, through its experts Dr Maria Wallenius and Dr Klaus Mayer, provided in-depth nuclear forensics content, which included real-world case studies from various jurisdictions. This component was essential to illustrate the complexities of nuclear material analysis

Figure 4. Participants of the training 'Building a case for prosecution'. Moldova, April 2025. Photo credit: UNICRI

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From crime scene to courtroom... *continued from page 5*

Figure 5. Practical exercise on evidence collection and sampling. Moldova, April 2025. Photo credit: UNICRI

Figure 6. Mock trial. Moldova, April 2025. Photo credit: UNICRI

and the importance of cross-border investigative cooperation.

Moreover, global institutions such as the IAEA, the Organisation for the Prohibition of Chemical Weapons (OPCW), the Biological Weapons Convention Implementation Support Unit (BWC ISU), the United Nations Office for Disarmament Affairs (UNODA), the United Nations Office on Drugs and Crime (UNODC), the United Nations Interregional Crime and Justice Research Institute (UNICRI) and the Verification Research, Training and Information Centre (VERTIC) all contributed to implementation and the refinement of the training modules.

Sustainability is a cornerstone of the capacity building and training programme. More than 50 training modules are envisaged as part of the

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

- Cicchetti, N. et al., 'Speciation mapping of the oxidation layer on aged Uranium Dioxide using scanning transmission X-Ray spectromicroscopy', *Journal of Nuclear Materials*, no. 612 (June 2025), 155792.
- Herman, S. et al., 'Separation of divalent transition metal activation products', *Journal of Radioanalytical and Nuclear Chemistry*, 17 May 2025.
- Krachler, M., Martinez Ferri, A. I. and Bulgheroni, A., 'Assessing uranium enrichment levels using digital autoradiography', *Analytica Chimica Acta*, vol. 1361 (Aug. 2025).
- Mathew, K. J. et al., 'Utilization of traceable standards to validate plutonium isotopic purification and separation of plutonium progeny using AG MP-1M resin for nuclear forensic investigations', *Radiochimica Acta*, May 2025.
- O'Neal, P. J. and Chirayath, S. S., 'Adapting a machine learning method for the source discrimination of plutonium samples mixed from multiple reactor types', *Annals of Nuclear Energy*, no. 218 (Aug. 2025), 111271.

full rollout. These are planned to be permanently embedded within national institutions in Moldova and Ukraine, such as the National Institute of Justice, the Police Academy, CBRN forensics units and training centres for prosecutors and the security services. This integration will ensure that the expertise gained is not lost over time but institutionalized, creating a self-sustaining ecosystem of knowledge and operational readiness.

The programme offers exceptional value for donor investment by establishing a lasting foundation for CBRN investigation and prosecution capacity. Its design not only builds technical expertise, but also fortifies legal and judicial frameworks, creating a comprehensive defence against CBRN threats.

As the global security environment continues to evolve, the need for well-coordinated, interdisciplinary responses to CBRN incidents becomes increasingly urgent. The 'From Crime Scene to Courtroom' initiative is a timely and forward-thinking collaboration that brings together science, law and international contributions. Its success in Moldova and Ukraine serves as a model for other countries preparing to enhance their national resilience to CBRN risks. •

UPCOMING TRAINING COURSES AND MEETINGS*

- IAEA Regional Workshop on Radiological Crime Scene Management, Manila, the Philippines, 16–20 June 2025
- ITWG Annual Meeting, Bologna, Italy, 1–3 July 2025
- IAEA International Integrated Workshop on Radiological Crime Scene Management and Nuclear Forensics, Seibersdorf, Austria, 7–11 July 2025
- IAEA International Train the Trainers Course on Radiological Crime Scene Management, Seibersdorf, 7 July–1 August 2025
- IAEA Regional Training Course on Basic Introduction to Nuclear Forensics, Lima, Peru, 11–15 August 2025
- IAEA Interregional Workshop on Radiological Crime Scene Management, Tunis, Tunisia, 25–29 August 2025
- IAEA Regional Peer-to-Peer Workshop on Nuclear Forensics, Dushanbe, Tajikistan, 1–5 September 2025
- IAEA Regional Training Course on Practical Introduction to Nuclear Forensics, Budapest, Hungary, 29 September to 3 October 2025
- IAEA National Workshop on Radiological Crime Scene Management, Hanoi, Viet Nam, 6–10 October 2025
- IAEA International Integrated Workshop on Radiological Crime Scene Management and Nuclear Forensics, Seibersdorf, 3–7 November 2025
- IAEA Regional Workshop on Radiological Crime Scene Management, Novi Sad, Serbia, 24–28 November 2025
- IAEA Regional Workshop on Radiological Crime Scene Management, Dakar, Senegal, 8–12 December 2025

*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.

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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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