

## CHAIRPERSONS' ADDRESS

Welcome to the Nuclear Forensics International Technical Working Group (ITWG) newsletter. During the Covid-19 pandemic, the ITWG continues its mission to identify, develop and promote best practices in the field of nuclear forensics. We therefore invite you to join our webinars, typically held once a month, that capture knowledge from ITWG activities like the Galaxy Serpent exercise series or application of analytical techniques during our Collaborative Materials Exercise (CMX). We also are progressing in the preparation of CMX-7 where samples are intended to be distributed to participating labs in September (please note that registration ends on 31 March, so contact the Exercise Task Group co-chairs if you want to participate). CMX-7 will include a new option that provides an opportunity for laboratory experts and investigators to collaborate more closely during the exercise, the so-called 'crime scene in-a-box' element. Finally, while we look forward to meeting again in person, we have postponed our annual meeting to June 2022, still planned to be held in the San Francisco Bay area, United States. In place of this year's annual meeting, we are organizing a series of virtual engagements during the week that we planned to meet, i.e. 15 June 2021. Stay tuned for more details to be posted on the ITWG website. In this edition of the ITWG newsletter you will find an article reporting on International Atomic Energy Agency (IAEA) assistance to strengthen nuclear forensics capabilities globally (p. 1), another describing the IAEA's Nuclear Forensics Methodologies course (p. 4), and a final article discussing a series of exercises to demonstrate nuclear forensics capabilities in Georgia, Ukraine, Azerbaijan, and Moldova (p. 5). This edition also includes a box of notable publications related to nuclear forensics (p. 6).

With best regards,  
Klaus Mayer and Michael Curry

## IAEA ASSISTANCE TO STRENGTHEN NUCLEAR FORENSICS CAPABILITIES GLOBALLY ÉVA KOVÁCS-SZÉLES

In these times of a global pandemic, the International Atomic Energy Agency (IAEA) has continued to provide, on request, nuclear security assistance to its member states. Addressing the challenges posed by the Covid-19 pandemic, the IAEA has launched a series of webinars to raise awareness about its guidance, as published in the Nuclear Security Series. In addition, it will launch an e-learning course later in the year, which will include a case study on nuclear forensics.

Four instruments are used by the IAEA to assist member states in strengthening their nuclear forensics capabilities. First, the development and update of IAEA guidance via the Nuclear Security Series. Second, assistance to strengthen member states' legal and regulatory frameworks and technical infrastructure; on request, the IAEA facilitates expert missions and technical exchange visits. Third,



**Figure 1.** Advanced IAEA training activity in a real nuclear forensics environment

assistance to develop member states' human capital and national capabilities; the IAEA organizes and financially supports training courses, workshops and residential assignments, as well as coordinated

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IAEA Assistance to Strengthen Nuclear Forensics Capabilities... *continued from page 1*

**Figure 2.** David K. Smith, former IAEA expert, transfers knowledge of nuclear forensic science to participants of an IAEA training course

research projects.<sup>1</sup> Fourth, the organization of conferences and meetings to coordinate the efforts of the international community, and to promote good practices and interorganizational cooperation.<sup>2</sup>

### IAEA guidance

IAEA Nuclear Security Series no. 2-G (Rev. 1), ‘Nuclear Forensics in Support of Investigations: Implementing Guide’, is the foundational document on nuclear forensics. First published in 2006, the document was revised in 2015 and a further review of it is planned to start next year. In addition, the IAEA has published five other documents relevant to nuclear forensics in the last eight years, including technical documents, a non-serial publication and a proceedings series.<sup>3</sup>

<sup>1</sup> Smith, D. K., ‘IAEA coordinated research in nuclear forensic science: The essential contribution from the ITWG’, *ITWG Update*, no. 10 (Mar. 2019), pp. 1, 4–5.

<sup>2</sup> Davydov, J., Smith, D. K. and Vorhofer, N., ‘The IAEA Technical Meeting on Nuclear Forensics: Sharing global success in nuclear forensics development and implementation’, *ITWG Update*, no. 11 (June 2019), pp. 2, 4–5.

<sup>3</sup> IAEA, *Application of Nuclear Forensics in Combating Illicit Trafficking of Nuclear and Other Radioactive Material*, Technical document, IAEA TECDOC no. 1730 (IAEA: Vienna, 2013); IAEA, *Identification of High Confidence Nuclear Forensics Signatures*, Technical document, IAEA TECDOC no. 1820 (IAEA: Vienna, 2017); IAEA, *Nuclear Forensics: Beyond the Science*, Technical document, IAEA TECDOC no. 1896 (IAEA: Vienna, 2019); IAEA, *Development of a National Nuclear Forensics Library: A System for the Identification of Nuclear or Other*

### Scientific and operational capacity building

The IAEA’s Integrated Nuclear Security Support Plan (INSSP) is the principal mechanism for the member states to request assistance in strengthening their national capabilities in nuclear forensics and in other areas of nuclear security. Through the systematic and comprehensive framework of an INSSP, the requesting state and the IAEA consolidate nuclear security needs and priorities, as well as the means to address them.

Based on the country-specific INSSP, the IAEA provides three types of courses to increase nuclear forensics capabilities. These courses vary in duration and hands-on opportunities, from the shorter introductory course, ‘Basic Introduction to Nuclear Forensics’, to the longer laboratory-based courses, ‘Practical Introduction to Nuclear Forensics’ and ‘Nuclear Forensic Methodologies’.<sup>4</sup> Additionally, the IAEA supports residential assignments, whereby experts are embedded in a real, advanced nuclear forensics laboratory for a period of up to three months. In the last 6–8 years, the IAEA has conducted

*Radioactive Material out of Regulatory Control*, Report (IAEA: Vienna, 2018); and IAEA, *Advances in Nuclear Forensics: Countering the Evolving Threat of Nuclear and Other Radioactive Material out of Regulatory Control*, Proceedings series, (IAEA: Vienna, 2015).

<sup>4</sup> Davydov, J., Smith, D. K. and Tsvetkov, T., ‘IAEA nuclear forensic science training programme: Focus on the implementation’, *ITWG Update*, no. 7 (June 2018), pp. 4–5.





**Figure 3.** IAEA demonstration of hand-held radiation detection equipment used at a mock crime scene

more than 60 training courses (with close to 800 participants) and 3 coordinated research projects, as well as expert missions, conferences and different meetings to help member states meet their priorities in nuclear forensics.

Advisory services and expert missions, such as the International Nuclear Security Advisory Service (INSServ), also help states identify nuclear security infrastructure requirements related to nuclear and other radioactive material out of regulatory control, as well as to develop measures to prevent, detect and respond to criminal and intentional unauthorized acts involving such material. INSServ missions are carried out by IAEA-led teams of international experts. In close collaboration with the requesting state, the INSServ team assesses the situation, develops a confidential report that recommends areas for improvement and identifies good practices.

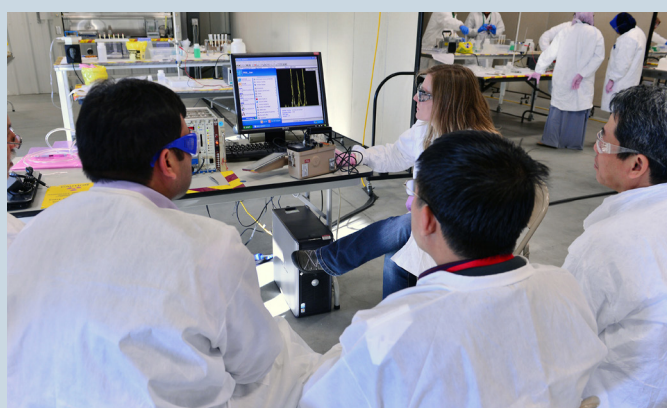
### Regional approach to nuclear forensics support

In order to address the high demand for support and ensure the long-term sustainability of the assistance provided, the IAEA implements, where appropriate, a regional approach to nuclear forensics capacity building. For instance, the training courses mentioned above are often conducted as a joint event with multiple regional participants, such as courses for French-speaking African member states, Russian-speaking member states or member states from the Association of Southeast Asian Nations (ASEAN) region.

The illicit trafficking of material out of regulatory control is reported across international borders and an effective response to such occurrences necessitates the strongest possible collaboration between regional partners. As stated in IAEA Nuclear Security Series no. 20, Nuclear Security Fundamentals, 'States also recognize that nuclear security in one State might depend on the effectiveness of the nuclear



**Figure 4.** IAEA demonstration of an advanced analytical technique for nuclear forensics



**Figure 5.** IAEA demonstration of hand-held radiation detection equipment

security regimes in other States'.<sup>5</sup> Regional capacity building promotes international cooperation among the neighbouring states in the region. Joint training and exercises allow participants to gain a collective understanding of the conduct of a nuclear forensic examination, with the possibility for sharing experiences, best practices, information and resources. Finally, the joint regional tabletop and field exercises help states advance their nuclear forensics capabilities by testing their nuclear forensics planning and infrastructure, improving communication with neighbouring states and integrating nuclear forensics capabilities into their nuclear security national response plans.<sup>6</sup> •

<sup>5</sup> IAEA, *Objective and Essential Elements of a State's Nuclear Security Regime: Nuclear Security Fundamentals*, IAEA Nuclear Security Series no. 20 (IAEA: Vienna, 2013), p. 5.

<sup>6</sup> Kroeger, E., '11th joint annual crime scene exercise, Germany', ITWG Nuclear Forensics Update, no. 13 (Dec. 2019), pp. 3, 5; and Eishah J.-T. and Kroeger, E., 'Joint German-Swiss customs and radiation protection emergency exercise: Results and lessons learned', ITWG Update, no. 5 (Dec. 2017), pp. 5–6.

## THE INTERNATIONAL TRAINING COURSE ON NUCLEAR FORENSIC METHODOLOGIES

JON SCHWANTES, MARIA WALLENIUS AND DAVID KENNETH SMITH



**Figure 1.** The IAEA's two-week, intensive International Training Course on Nuclear Forensic Methodologies provides participants with experiential training of forensic techniques used to support a nuclear forensic examination

The International Atomic Energy Agency (IAEA), in cooperation with the United States Department of Energy (DOE) and the European Commission's Joint Research Centre (JRC), has developed an applied training course on nuclear forensic methodologies for practitioners. Known as the International Training Course on Nuclear Forensic Methodologies, the IAEA has offered it six times since 2012, hosted at Pacific Northwest National Laboratory (PNNL) in Richland, Washington, USA in 2012, 2013, 2015 and 2018, and at the JRC in Karlsruhe, Germany in 2016 and 2019. In total, over 150 representatives from 52 partner states have participated in this two-week, intensive training course.

The field of nuclear forensics exploits a variety of basic and advanced analytical techniques to support 'the examination of nuclear or other radioactive material, or of evidence that is contaminated with radionuclides, in the context of legal proceedings under international or national laws related to nuclear security'.<sup>1</sup> While access to advanced nuclear forensic analysis is available globally through technical collaborations facilitated by communities such as the Nuclear Forensics International Technical Working

Group (ITWG), every state has the responsibility to prevent and respond to nuclear and other radioactive materials encountered out of regulatory control. This includes supporting law enforcement or nuclear security investigations with the capabilities to categorize and characterize samples. The IAEA's course was developed with this responsibility in mind, providing practitioners from member states with an introduction to nuclear forensic methodologies. Like all IAEA training, the curriculum follows published guidance from the IAEA and the ITWG, augmented by the shared experience of leading nuclear forensic examiners.

The learning objectives of the training course are to provide those with responsibility for carrying out examinations with a comprehensive summary of key scientific methodologies used to support nuclear forensic science. Using a mix of traditional classroom instruction and experiential learning, via a series of demonstrations and hands-on modules utilizing equipment and procedures found in a nuclear forensics laboratory, participants are guided through the stages of an examination. Scenario-based exercises are also used periodically to reinforce learning objectives. In order to demonstrate lessons learned, participants assume the role of border guards, forensic examiners or nuclear science experts and participate in a mock nuclear forensic examination

<sup>1</sup> IAEA, *Nuclear Forensics in Support of Investigations: Implementing Guide*, IAEA Nuclear Security Series no. 2-G (Rev. 1) (IAEA: Vienna, 2015), p. 1.



supporting a nuclear security investigation. While the course primarily focuses on laboratory techniques and evaluation of nuclear forensic results, modules demonstrating the use of radiation portal monitors and handheld instruments at border crossings to detect material out of regulatory control (MORC) and subsequently manage a radiological crime scene are included for context. In this way, the participants are introduced to the full chain of events related to a nuclear security incident. Moreover, it reflects the increased attention given to the proper execution of the steps taken before the nuclear forensic analyses are conducted.

This course is taught by the world's leading nuclear forensics experts from the Australian Nuclear Science and Technology Organisation, the JRC, the Swedish Defence Research Agency, Moldova's Technical-Forensic and Legal Expertise Centre, Romania's Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, the United Kingdom's Atomic Weapons Establishment, the US Department of State

with the assistance of local (Washington State Crime Lab) and federal law enforcement (Federal Bureau of Investigation) agencies, as well as numerous experts from the US Department of Energy's National Laboratories (including Lawrence Livermore, Los Alamos and PNNL), and the IAEA Division of Nuclear Security.

Nuclear forensics is a valuable tool for combatting nuclear smuggling and ensuring that nuclear material is only used for peaceful purposes. Illicit nuclear trafficking is not a hypothetical threat, and experts can use nuclear forensics to help identify the point where the control was lost, the origin and history of MORC, and eventually work with the responsible authorities to ensure the event is not repeated. By design, this training course emphasizes practical learning and is a centrepiece of the IAEA's training in nuclear security and nuclear forensics. Future offerings will reflect the growing importance of nuclear forensics as a capability to assist states in fulfilling their nuclear security responsibilities. •

## NUCLEAR FORENSICS FIELD TRAINING AND TABLETOP EXERCISES IN THE BLACK SEA REGION

**LIZ DALLAS, KLAUS MAYER, VOLODYMYR TRYSHYN, ION APOSTOL, GRIGOL BASILE AND JALAL NAGHIYEV**

The United States Department of Energy's National Nuclear Security Administration and the European Commission's Joint Research Centre jointly oversee a set of three projects that are co-funded by the US Department of Energy and the European Union. The projects are focused on nuclear forensics capacity building and sustainment in Georgia, Ukraine, Azerbaijan and Moldova (the GUAM states), in support of the investigation of interdicted radiological and/or nuclear (R/N) materials. Ukraine serves as the technical lead within the GUAM states for the projects and the Science and Technology Center of Ukraine (STCU) is in charge of project management. Each state is represented by one or two expert agencies or laboratories involved in combating the illicit trafficking of R/N materials.

The projects were funded in 2017 and commenced in 2018. Project activities are ongoing today, and will serve as the foundation for a second set of projects scheduled to commence in June 2021 and run through 2024.



**Figure 1.** A field training exercise in Moldova involving the initial characterization of interdicted material at the exit of a safety perimeter (Oct. 2020)

Nuclear forensics capacity building is addressed systemically over three project areas:

1. Development, implementation and maintenance of national nuclear forensics libraries.
2. Sustaining nuclear forensics capabilities.
3. Knowledge transfer in nuclear forensics.

Substantial advances have been made over the past 18 months across all the project areas. In project

**Nuclear Forensics Field Training and Tabletop Exercises...** *continued from page 5*

area 1, database platforms have been developed, adapted to the specific needs of the individual partner state. Additionally, a 'Regional Nuclear Forensics Information System' has been developed, which uses public domain information and serves essentially as a resource for subject matter experts.

Significantly, progress within project area 2 has included a series of mixed field training exercises and tabletop exercises (FTX/TTX). The first of these was held in Georgia in November 2019 and, building

on that success, mixed FTX/TTX events were also designed and delivered by Moldova (October 2020) and Ukraine (November 2020). Each of these events covered the entire process from detection to response and nuclear forensic investigation. Through the variety of inputs, including internal interdiction, green border and border crossing scenarios, these exercises involved a wide spectrum of agencies and authorities involved in the various steps related to the response to a nuclear security event. The Ukraine



**Figure 2.** Interdicted sample handling in a glovebox at the Kyiv Institute for Nuclear Research (Nov. 2020)

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

- Jovanovic, S. V. et.al., 'Uncovering uranium isotopic heterogeneity of fuel pellets from the fifth collaborative materials exercise of The Nuclear Forensics International Technical Working Group', *Journal of Radioanalytical and Nuclear Chemistry*, vol. 326, no. 3, 2020, pp. 1853–66.
- Taylor, F. et. al., 'State of Practice and Emerging Application of Analytical Techniques of Nuclear Forensic Analysis: Highlights from the 5th Collaborative Materials Exercise of the Nuclear Forensics International Technical Working Group (ITWG)', *Journal of Radioanalytical and Nuclear Chemistry*, vol. 326, no. 1, 2020, pp. 415–30.
- Glennon, K.J. et.al., 'Isolating trace fission product elements in separated plutonium for applications in nuclear forensics', *Journal of Radioanalytical and Nuclear Chemistry*, vol. 327, no. 1, 2021, pp. 143–51.
- Pastoor, K. J. et.al., 'Progress in Uranium Chemistry: Driving Advances in Front-End Nuclear Fuel Cycle Forensics', *Inorganic Chemistry*, published online 23 Feb. 2021.
- Suzuki, D., 'Age determination analysis of a single uranium particle for safeguards', *Journal of Radioanalytical and Nuclear Chemistry*, published online 25 Feb. 2021.

FTX/TTX also featured a live remote demonstration of the handling and analysis of interdicted material in a nuclear forensics laboratory, in line with investigative procedures.

Each TTX/FTX was observed by experts from the other three GUAM states, as well as representatives of the project sponsors. The exercises triggered discussions among the GUAM experts that proved to be extremely valuable for exchanging scientific expertise, and for gaining a mutual understanding of each state's organizational processes related to the nuclear forensic investigation of interdicted material. Moreover, they served as an excellent example of cooperation to support regional capacity building by sharing information, benefitting from each other's experience and combining the national perspective with an objective outside viewpoint.

Recommendations that resulted from each FTX/TTX were collaboratively developed with the host state and project sponsors, and will serve as inputs to the follow-up project commencing in June 2021. In particular, they will support the development or

updating of official practice documents specifying the interface between different agencies' standard operating procedures.

In project area 3, a summer school was successfully held in 2019 at the Kiev Institute for Nuclear Research (KINR) and a follow-on impact assessment was conducted with participating students in autumn 2020. In addition, trainees and postdoctoral students have been hosted at KINR and the Kharkov Institute of Physics and Technology (KIPT).

Despite the global Covid-19 pandemic, dedicated partners in the GUAM states have continued to organize and conduct STCU project activities—including scientific work, exercises, educational work and library development—according to the project plans. Further exercises to advance best practices and to improve inter-agency cooperation are scheduled to be held in Georgia (April 2021) and Azerbaijan (date to be decided). In the new project set, GUAM partners will build on the achievements of the ongoing activities and further improve their nuclear forensics capabilities. •

#### UPCOMING TRAINING COURSES AND MEETINGS\*

- ITWG Webinar on Galaxy Serpent 4, Virtual, 13 April 2021
- IAEA Webinar Investigative Perspectives of Nuclear Forensics in Responding to a Nuclear Security Event, Virtual, 5 May 2021
- ITWG Webinar on Chain of Custody, Virtual, 11 May 2021
- IAEA Regional Exercise on Forensics Examination of Evidence and Trace Amounts of Nuclear Material from Radiological Crime Scenes, Moscow, Russia, 24–28 May 2021
- ITWG Virtual Meeting, 15–18 June 2021
- IAEA International Training Course on Introduction to Nuclear Forensics, Bangkok, Thailand, 27–30 September 2021
- IAEA International Training Course on Practical Introduction to Nuclear Forensics, Sydney, Australia, 27 September–1 October 2021
- United Kingdom NuFor 2021 (Nuclear Forensics Conference), London, England, 13–14 October 2021
- IAEA Regional Training Course on Nuclear Forensics for Association of Southeast Asian Nations Members, Daejeon, Republic of Korea, 18–22 October 2021

\*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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