

## ESTABLISHING AN IAEA COLLABORATING CENTRE FOR NUCLEAR FORENSICS IN HUNGARY

ÉVA KOVÁCS-SZÉLES

### Hungary's response to nuclear smuggling incidents of the 1990s

At the beginning of the 1990s, smuggling incidents involving nuclear material (e.g. uranium oxide pellets, metallic uranium and uranium ore concentrates) started to occur frequently, especially in Central Europe. Hungary was particularly affected by this illicit trafficking, and Hungarian law enforcement agencies spearheaded several confiscations of smuggled materials.

After the first seizures of nuclear contraband 20 years ago, scientists from the Institute of Isotopes (IKI)—which was reconfigured and renamed the Centre for Energy Research (MTA EK) in 2012—initiated non-destructive research and development activities to develop gamma-spectrometric methods for categorizing and characterizing seized nuclear

materials of unknown origin. These activities were founded on basic scientific research and development as well as a national tradition of excellence in nuclear physics.

By a governmental decree in 1996, the Hungarian Government designated IKI with the task of analysing confiscated nuclear and other radioactive materials and assessing its origin. The decree was updated in 2015. Closer cooperation with the International Atomic Energy Agency (IAEA) in this field also started in the mid-1990s. Both the Hungarian Government and the Hungarian Atomic Energy Authority (as the responsible national nuclear authority) have strongly supported nuclear forensic activities in Hungary.

*Continued page 4*

## DEVELOPING A DECONTAMINATION METHOD FOR TRADITIONAL FORENSIC TRACES

MATTHIJS ZUIDBERG AND ED VAN ZALEN

### Towards an integrated forensic toolbox for CBRN incidents

Chemical, biological, radiological and nuclear (CBRN) terrorism remains a real threat to European countries, and a key element of any CBRN response is to ensure that the forensic investigation results in a successful court prosecution. Funded under the European Commission's Seventh Framework Programme, the Generic Integrated Forensic Toolbox for CBRN incidents (GIFT CBRN) consortium is developing an advanced forensic toolbox for CBRN incidents to help achieve that success.

Traditional forensic analysis of traces that are contaminated with radiological materials is important for investigating a nuclear security event or for linking such an event to suspects and perpetrators. As such the traditional analysis of contaminated materials is of interest to the ITWG community. The decontamination of forensic traces without destroying or damaging any pertinent information has been a

challenge for forensic investigators and is part of the developments in the GIFT CBRN project.

Through the cooperation of Europe-wide CBRN research agencies, first responders, industrialists and subject matter experts, the toolbox will provide enhanced capability in the following three areas of CBRN forensics:

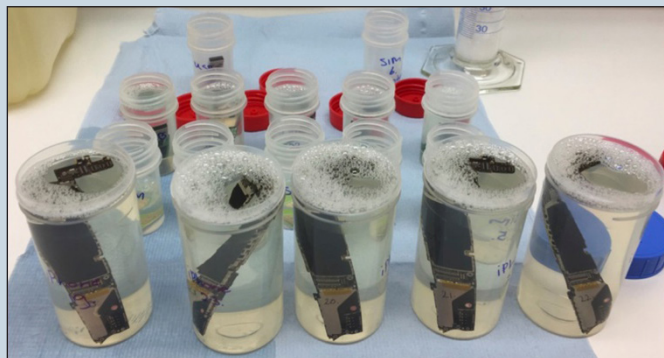
1. Crime-scene based procedures, sampling methods and detection of CBRN agents;
2. Traditional forensics laboratory methods for dealing with contaminated evidence; and
3. Laboratory methods for profiling CBRN agents released at an incident.

The GIFT CBRN consortium intends to further develop the investigative and analytical methods that are currently used in a secure laboratory environment and allow them to be used at the scene of a crime. Thus ensuring not only that delicate equipment can be transported to a remote location, but also that it is able

*Continued page 2*



**Figure 1.** Decontamination of dismantled SIM cards, USB drives and iPhones with DeconGel 1120



**Figure 2.** Decontamination of dismantled SIM cards, USB drives and iPhones with Dekoneutral solution

### Developing a Decontamination Method *continued*

to withstand the problems of a CBRN environment—such as decontamination of forensic traces.

The GIFT CBRN consortium aims to address the challenge of conducting forensic analysis in a contaminated environment by developing novel methodologies and technologies that will enable forensic investigators to perform enhanced analysis at a crime scene. Some key innovations will be: (a) novel sensors for chemical and biological agents; (b) detection of alpha-emitting particles using ultraviolet light; (c) the development of decontamination methods for CBRN-contaminated items that will not impact on forensic traces; (d) micro-analytics on-chip to detect agents of interest; (e) signatures for chemical, biological and radiological agents; and (f) an education and training curriculum.

As it relates to item (c), at the end of the GIFT project, the toolbox should contain recommended operating procedures to clean items contaminated with C, B and RN while preserving any forensic traces (e.g. DNA, fingerprints and data on electronic devices). While the scope of GIFT covers chemical, biological and radioactive particle contamination, only the latter is pertinent to nuclear forensic analysis and therefore discussed here.

#### Decontaminating exhibits for traditional forensic investigation

The presence of CBRN agents obstructs regular forensic science practices at a crime scene and prohibits items from being sent to forensics laboratories for further analysis. In order to overcome this problem, decontamination of the items is required. Over the past few decades, decontamination methods have been developed to neutralize, kill and/or remove CBRN contamination. However, if decontamination is to be used on forensically relevant items, an additional

requirement is that forensic traces are not affected in any way. Therefore, the focus within the GIFT CBRN project is to develop or adapt decontamination methods that allow cleaning without (substantially) damaging the forensic traces. This would allow clean exhibits to be sent to, and investigated at, a forensics laboratory in a regular manner.

Decontamination of radioactive particles is often achieved using physical removal methods (so-called high-impact removal methods). Since it is already well established that such high-impact methods are destructive to both DNA in biological body fluids and fingerprints, the toolbox will simply not advise applying any such methods when a forensic investigator is interested in either DNA or fingerprints on an item contaminated with radioactive particles.

Instead, the investigator is advised to process the traces at the crime scene or in a dedicated-containment facility (also part of the developments in GIFT). However, the effect of high-impact removal methods on the data retained in contaminated electronic devices was largely unknown.

#### Investigating high-impact decontamination methods on electronic devices

In an effort to answer this question and further develop the toolbox, researchers with the GIFT CBRN project investigated the effect of high-impact decontamination on the forensic trace material of electronic devices and their data and evaluated the decontamination efficiency. To do this, two decontamination agents were selected for study: DeconGel 1120 and Dekoneutral solution. Phones (iPhone 4), SIM cards (mini) and USB drives (4 GB) were used. To maximize the potential impact of the decontamination agent, their outer casings were

*Continued page 3*

## UPCOMING TRAININGS AND MEETINGS

- ITWG CMX Data Review Meeting, Magurele, Romania, April 2017
- GICNT Plenary, Tokyo, Japan, June 2017
- Nuclear Forensics Experts Meeting hosted by the European Commission Joint Research Centre, Karlsruhe, Germany, June 2017
- ITWG-22 Annual Meeting, European Commission Joint Research Centre, Karlsruhe, Germany, June 2017
- IAEA RTC on Practical Introduction to Nuclear Forensics, Budapest, Hungary, 2–6 October 2017
- IAEA Residential Assignment Program for Nuclear Forensics for 3 participants, Hungary, Oct–Dec, 2017
- IAEA Regional Nuclear Forensics Workshop, Mexico City, Mexico, Q3 2017 (TBC)
- IAEA NTC Introduction to Nuclear Forensics, United Arab Emirates, Q3 2017 (TBC)
- 9th International Conference on Isotopes and Expo (9ICI), Doha, Qatar, November 2017
- IAEA Nuclear Forensics Seminar, Russian Federation, Q4 2017 (TBC)

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

## Developing a Decontamination Method *continued*

removed. The devices were covered in gel or placed in solution (see figures 1 and 2). During the entire process, hash values (or checksums) were determined to check the data quality.

On the impact on forensic traces, it was found that the DeconGel 1120 restricted the direct extraction of the data as residual gel shielded off some of the connectors. However, the data on the memory chip is likely not to be affected by the presence of the gel. Further research is needed to confirm this. It was found that the Dekoneutral solution allowed direct data extraction after exposure and did not interfere with the data (indicated by similar hash values prior to and after decontamination).

With regard to the efficiency of decontamination, it was found that both DeconGel 1120 and Dekoneutral solution could remove over 90 per cent of the radioactive particles attached to smooth surfaces (e.g. SIM cards). In cases of uneven surfaces, such as electronic boards tested with USB drives, the experiments showed a large variation in results. This was probably due to the rough surfaces of the devices, which hampered full contact and the detachment of particles by the decontamination agent.

## Conclusions

With regard to electronic devices contaminated with radioactive particles, the results of the experiments undertaken in the GIFT CBRN project indicate that such devices and the data can sustain high-impact decontamination using DeconGel 1120 and Dekoneutral solution. However, the decontamination processes investigated did not fully remove the radioactivity. Therefore, electronic devices ‘decontaminated’ with DeconGel 1120 and Dekoneutral solution should still be considered as contaminated given that residual radioactivity was found. Further discussion among partners is required in order to reach a consensus on the implication of the residual contamination levels for forensic practitioners. Radiation exposure limits might be a good starting point.

All the protocols and associated limitations will be stored in the toolbox in order to make them accessible during a crime scene investigation. Ultimately, GIFT CBRN should aid decision-making processes and enable a more efficient forensic response to CBRN incidents in the future. •





**Figure 1.** Live demonstration of MEST during GICNT workshop, October 2014



**Figure 2.** Montage of nuclear forensics capabilities at MTA EK

### Establishing an IAEA Collaborating Centre for Nuclear Forensics in Hungary *continued*

#### Development of nuclear forensic capabilities

Based on these precedents, and to strengthen international cooperation, the role of the IKI in nuclear forensics increased due to its participation in the Nuclear Forensics International Technical Working Group (ITWG) and in programmes at the IAEA. The IKI participated in specific IAEA-coordinated research programmes (CRPs) between 2008 and 2011, and in almost all the collaborative material exercises (CMXs) organized by the ITWG from its beginning. The CMXs provide excellent experience and an essential basis for learning and understanding nuclear forensics in detail and how to use it practically. Following the first exercise (2013–14) within the ‘Galaxy Serpent’ series on how to establish and use a national nuclear forensics library (NNFL), the first prototype of an NNFL was established in Hungary in 2015.

Since 2010, nuclear forensic activities have expanded programmatically at IKI/MTA EK. The technical infrastructure, in particular, has been strengthened over the past three to four years. In 2014 a new centralized nuclear forensics laboratory was established to include state-of-the-art instrumentation and analytical methods. A new mobile laboratory was also equipped with handheld radioisotope detection devices and large sensitive radiation-detector systems.

Remote-control techniques (e.g. exploring robots and drones) are presently under development; and a mobile expert support team is available for radiological crime scene investigation. National field exercises that model confiscations have also been organized in Hungary.

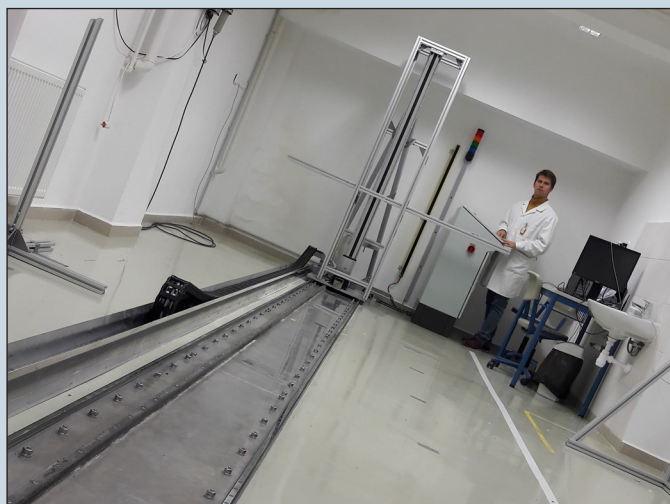
#### Cooperation with the IAEA

In 2012, practical arrangements were signed between the IAEA and MTA EK that focus on scientific collaboration in nuclear forensics, scientist-to-scientist exchanges, the involvement of MTA EK staff in the development of IAEA guidance documents and training, and utilization of MTA EK expertise in non-destructive (e.g. gamma) and destructive (e.g. mass spectrometry) analysis for the purpose of nuclear forensic categorization and characterization. Working together, the IAEA and MTA EK have also expanded training and education in nuclear forensics with a focus on sustainability for scientists in the region. Notably, the IAEA and MTA EK piloted the one-week training course ‘Practical Introduction to Nuclear Forensics’ in August 2014. The practical part of the training course was on gamma spectrometry, mass spectrometry and scanning electron microscopy.

In 2015, the IAEA and MTA EK piloted a complex residential assignment in nuclear forensics, which included a practical introduction to the different techniques common in the nuclear forensics laboratory, consistent with the conduct of a full nuclear forensic examination at MTA EK. The techniques covered included crime scene response, categorization, full characterization at laboratories using all the analytical techniques available, and nuclear forensic interpretation of results using the existing NNFL programme in Hungary.

Special practical, instrumental training courses for nuclear forensic purposes have also been organized

*Continued page 5*



**Figure 3.** An MTA EK testing laboratory for detection systems



**Figure 4.** Using gamma spectrometry—a key technique for nuclear forensics—at MTA EK

### Establishing an IAEA Collaborating Centre for Nuclear Forensics in Hungary *continued*

for MTA EK by the Joint Research Centre in Karlsruhe since 2012.

The results of these efforts were recently recognized by the IAEA through its designation of MTA EK as a Collaborating Centre in Nuclear Forensics from 2016–20. Goals include further strengthening national, regional (especially in the Central–East European region) and interregional/international cooperation and actively sharing technical experiences and knowledge with other countries. One aim is to increase the technical and scientific capabilities related to nuclear forensics worldwide. Another is to strengthen

the nuclear security community by enhancing nuclear forensic activity in other countries. As a recognized Collaborating Centre, MTA EK will also benefit by gaining wider recognition in the nuclear security field through IAEA-supported technical and scientific achievements and methods.

Future plans for the Collaborating Centre include different kinds of applied training courses and residential assignment programmes, scientific support for other countries and new directions in research areas connected to, for example, IAEA CRPs and using the ITWG platform. •

### THE IAEA ‘INTERNATIONAL TRAINING COURSE ON NUCLEAR FORENSICS METHODOLOGIES’, OCTOBER 2016

DAVID SMITH

The International Atomic Energy Agency (IAEA) recently partnered with the European Commission's Joint Research Centre (JRC) in Karlsruhe (Germany) and the US National Nuclear Security Administration to implement the ‘International Training Course on Nuclear Forensics Methodologies’ at the JRC's laboratories in Karlsruhe. Twenty-two experts selected from Germany, Indonesia, Malaysia, the Philippines, Romania, Serbia, South Africa, Switzerland and Ukraine participated in the two-week training course that was held on 17–28 October 2016.

The purpose of the course is to provide scientists and forensic examiners with an in-depth, realistic and applied learning environment oriented to the analysis of nuclear and other radioactive material, consistent with published IAEA Nuclear Security Series

technical guidance ‘Nuclear Forensics in Support of Investigations’.

It is the fourth time that the IAEA has offered this training course and it represents the highlight of the IAEA's annual training calendar in nuclear forensics. Previous instruction in nuclear forensics methodologies was held at the Pacific Northwest National Laboratory, USA, in 2012, 2013 and 2015. The course utilizes a well-equipped nuclear forensics laboratory setting to increase the skills, knowledge and abilities of nuclear forensic practitioners to optimize non-destructive and destructive nuclear forensic measurements, supporting law-enforcement investigations of nuclear and other radioactive

*Continued page 6*





**Figures 1 and 2.** The participants of the IAEA's 'International Training Course on Nuclear Forensics Methodologies' engage in laboratory demonstrations and practical exercises within the setting of a nuclear forensics laboratory at the JRC in Karlsruhe following a fictitious case scenario

### IAEA Course on Nuclear Forensics Methodologies *continued*

material encountered out of regulatory control. The training materials are augmented by published Nuclear Forensics International Technical Working Group (ITWG) guidelines to include evidence collection, thermal ionization mass spectrometry (TIMS), high-resolution gamma spectroscopy, age dating and alpha spectrometry.

The course emphasizes the latest techniques and procedures used to receive nuclear forensic samples, develop appropriate analytical plans, conduct high-confidence measurements, ensure confidence in the analytical results, interpret data and report findings from the nuclear forensics laboratory. The course was taught by international experts drawn from the IAEA, the JRC in Karlsruhe, the US National Nuclear Security Administration, the US Department of State, the US Federal Bureau of Investigation, Pacific Northwest National Laboratory, Los Alamos National Laboratory, Lawrence Livermore National Laboratory (USA), the UK Atomic Weapons Establishment (AEW) and the Swedish Defence Research Institute.

Under controlled conditions and the supervision of qualified personnel, the participants measure nuclear and other radioactive materials within the setting of a nuclear forensics laboratory, following a fictitious case scenario. Training includes classroom instruction, tabletop exercises, laboratory demonstrations and practical exercises. Through a comprehensive two-week curriculum that specifically focuses on the processing of evidence, participants improve their technical prowess in gamma spectroscopy, mass spectrometry, estimations of analytical uncertainty, and nuclear forensic interpretation using a database or a library. The course also provides a review of case studies as well as resources for further international assistance to include the ITWG.

The 'International Training Course on Nuclear Forensics Methodologies' is unique for the applied instruction offered in a state-of-practice nuclear forensics laboratory and taught by leading international experts. The IAEA has received very positive reviews from current and past participants of the course and plans to offer it to member states again in the future. •

## THE IAEA ‘INTERNATIONAL CONFERENCE ON NUCLEAR SECURITY: COMMITMENTS AND ACTIONS’, DECEMBER 2016

DAVID SMITH

The International Atomic Energy Agency (IAEA) hosted the ‘International Conference on Nuclear Security: Commitments and Actions’ at its Vienna headquarters on 5–9 December 2016. This conference, held at the ministerial level, is convened every three years, and the 2016 conference was essential for the development of the IAEA Nuclear Security Plan 2018–21.

More than 2000 participants attended, representing 139 member states and 29 organizations; 47 member states were represented by their ministers. The conference covered all aspects of nuclear security, with nuclear forensics featuring prominently relative to aspects involving the prevention and response to nuclear and other radioactive material out of regulatory control. The Nuclear Forensics International Technical Working Group (ITWG) was a cooperating organization for the conference and served on the programme organizing committee.

ITWG outreach was a priority at the conference. The ITWG Outreach and Training Task Group staffed an information booth that provided expert information on the work of the ITWG. It also disseminated print copies of published ITWG guidelines on evidence collection in a radiological or nuclear contaminated crime scene; thermal ionization mass spectrometry (TIMS); high-resolution gamma spectrometry; age dating (production date determination); and alpha spectrometry. In addition, the ITWG prepared outreach material to introduce Galaxy Serpent, the ITWG national nuclear forensics library web-based tabletop exercise. Copies of the inaugural edition of *ITWG Update*, the nuclear forensics newsletter, were also distributed.

The IAEA conference provided a forum for more than 50 scientific papers featured in oral sessions, interactive content presentations (flat-screen based) and poster presentations. Three nuclear forensics sessions were included in the conference programme:

1. ‘Nuclear forensics: building confidence in conclusions’, co-chaired by Dr Ruth Kips, Lawrence Livermore National Laboratory (USA), and Dr Hudson

Kalambuka, University of Nairobi. Dr Allan Pidduck, UK Atomic Weapons Establishment, served as rapporteur.

2. ‘Nuclear forensics: the science and interpretation of nuclear forensics signatures’, co-chaired by Gleb Kochev, Russian Laboratory for Microparticle Analysis, and Vitaly Fedchenko, Stockholm International Peace Research Institute (SIPRI). Dr James Borgardt, Juniata College (USA), served as the rapporteur.

3. ‘Nuclear forensics: serving a nuclear security infrastructure’, co-chaired by Dr Maria Wallenius, Joint Research Centre in Karlsruhe, and Mohamed Zaryah, Centre National de l’Energie des Sciences et Techniques Nucléaires (CNESTEN). Dr Jon Schwantes, Pacific Northwest National Laboratory (USA), served as the rapporteur.

The ITWG contribution at the conference consisted of three papers:

1. ‘Advancing the state of practice and art of nuclear forensic sciences: past and present Nuclear Forensics International Technical Working Group collaborative material exercises’, by Dr Jon Schwantes, Pacific Northwest National Laboratory, and co-authors.

2. ‘Results from Galaxy Serpent version 2: web-based tabletop exercises for national nuclear forensics libraries’, by Dr James Borgardt (USA), Juniata College, and co-authors.

3. ‘The Nuclear Forensics International Technical Working Group (ITWG): being different and making a difference’, by Dr Klaus Mayer, Joint Research Centre in Karlsruhe, and Michael Curry, US Department of State.

The Ministerial Declaration drafted during the conference recognized ‘the further development of IAEA’s assistance in areas of importance to Member States such as nuclear forensics’. The conference demonstrated the close partnership between the IAEA and the ITWG as the world’s leading association of nuclear forensic practitioners as well as its key role as a leading platform for nuclear forensic innovation. •

---

## CONTENTS

---

Establishing an IAEA Collaborating Centre for Nuclear Forensics in Hungary	1
Developing a Decontamination Method for Traditional Forensic Traces	1
The IAEA 'International Training Course on Nuclear Forensics Methodologies', October 2016	5
The IAEA 'International Conference on Nuclear Security: Commitments and Actions', December 2016	7
Upcoming Trainings and Meetings	3

---

### 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/>