ITWG Nuclear Forensics International Technical Working Group

ITWG NUCLEAR FORENSICS UPDATE

No. 13 December 2019

CHAIRPERSONS' ADDRESS

Welcome to the Nuclear Forensics International Technical Working Group (ITWG) newsletter. As the ITWG begins to commemorate the group's 25th anniversary and rededicates itself to the mission of identifying, developing, and making available best practices in the field of nuclear forensics, we want to thank you for participating in ITWG activities. In 2019, we put forward a rich set of exercises and meetings for practitioners to draw from and we look forward to that continuing in 2020 and beyond. Also, as we look towards 2020, the ITWG will be well represented at the IAEA International Conference on Nuclear Security (ICONS2020) with briefings on our work and activities, e.g. the sixth collaborative material exercise (CMX-6), etc., that we hope you will find useful. Please highlight ITWG briefings to colleagues that will attend ICONS2020. In addition, we are planning to hold our annual meeting at Lawrence Livermore National Laboratory where the ITWG began. Details will follow in the First Announcement that will be issued shortly, but to help us prepare for the annual meeting and reflect on the origins of the ITWG, this edition of the newsletter includes an article from one of the first ITWG co-chairs, Dr Sidney Niemeyer (page 1). It also includes other topics of interest such as an article on Germany's 11th joint annual crime scene exercise (page 3) and an article on the nuclear forensics summer school in Ukraine (page 2).

With best regards,
Klaus Mayer and Michael Curry

THE ORIGIN STORY OF THE NUCLEAR FORENSICS INTERNATIONAL TECHNICAL WORK GROUP (ITWG)

SIDNEY NIEMEYER

In the early 1990s I gave numerous briefings to US Government officials about the need to develop a nuclear forensics capability to address nuclear smuggling and terrorism. Around this time, the threat was being highlighted by a significant number of seizures of illicit nuclear materials across Europe. In May 1995, a US Department of Energy (DOE) official attending a G7+1 meeting of non-proliferation experts suggested holding an international conference on the role of nuclear forensics in addressing nuclear smuggling. His offer to sponsor for the conference and to hold it at the Lawrence Livermore National Laboratory (LLNL) received strong support from the group.

The early days

I was asked to chair the conference and worked closely with the US State Department to issue invitations and develop the meeting agenda. The invitation list was expanded beyond the G7. The participation of key people who had been involved in analysing interdicted nuclear material was of crucial importance. It was therefore good to hear that Lothar Koch from the European Commission's Institute for Transuranium Elements (ITU) would be attending, as he had led most of the known analyses of interdicted nuclear material. Milos Beran from the Czech Republic also agreed to present his findings on the large highly enriched uranium (HEU) interdiction in Prague.

Interest mounted as word got out about who would be attending the conference. The agenda grew to the point where three days would be needed. All the participants were encouraged to give presentations and panel discussions were interspersed with talks by technical experts.

The International Conference on Nuclear Smuggling Forensic Analysis met in November of 1995. There were more than 70 participants from 14 countries and organizations. Many people found the blend of scientists, law enforcement officials, intelligence

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THE SUMMER SCHOOL ON NUCLEAR FORENSICS FOR THE GUAM STATES

LIZ DALLAS, KLAUS MAYER AND VOLODYMYR TRYSHYN

A summer school on nuclear forensics for student participants from Georgia, Ukraine, Azerbaijan and Moldova (the GUAM member states) took place in Kyiv, Ukraine on 9–13 September 2019.

The next generation project

The discipline of nuclear forensics draws heavily on the knowledge and expertise available in the broader nuclear field, and in particular on radiochemistry and nuclear physics. An aging 'nuclear workforce' has not been balanced by the emergence of young researchers, however, resulting in a scarcity of young scientists entering the discipline of nuclear forensics. This discontinuity could restrict the transfer of highly specialized experience from seasoned nuclear forensics experts to the next generation. By extension, this could reduce capacity in an area that is pivotal to nuclear security and hamper responses to a nuclear security event. The Next Generation of Nuclear Forensic Scientists Project aims to address precisely this deficit.* A key component of this project was the development and delivery of a summer school on nuclear forensics for students from the GUAM states, an offer that is unique among training and educational initiatives in nuclear forensics.

Figure 1. Nuclear forensics summer school students ask questions during a tour of Kiev Institute for Nuclear Research (KINR) facilities

The objectives of the summer school were to:

- Raise awareness of the field of nuclear forensics among students of physics, chemistry and other scientific disciplines;
- Communicate the principles of conducting a nuclear forensic science investigation;
- Teach the scientific fundamentals relevant to nuclear forensics, including elements of radiochemistry, nuclear physics and instrumental analysis; and
- Provide examples of real seizures of material out of regulatory control and its examination.

Figure 2. Subject-matter experts work with students during a hands-on exercise focused on gamma spectroscopy

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THE 11TH JOINT ANNUAL CRIME SCENE EXERCISE, GERMANY

EMILY ALICE KROEGER

Over three days in May 2019, around 100 participants from Germany's Federal Police (BPOL), Federal Criminal Police Office (Bundeskriminalamt, BKA) and Federal Office for Radiation Protection (Bundesamt für Strahlenschutz, BfS) took part in the 11th joint annual crime scene exercise. The exercise took place at the Berlin offices of the BfS and was attended by 45 national and international observers. The exercise had been publicized on the BfS website.

Testing capabilities

The annual exercise is an opportunity to test the capabilities of the institutions involved, their joint procedures and the deployment of communications. The aim of the exercise is to simulate a situation in which crime scene work is required in the presence of nuclear or radioactive materials. The capacity to carry out crime scene work in a crime scene contaminated with nuclear or radioactive material is extremely important because the criminal misuse of nuclear or radioactive material can never be ruled out. (There have previously been cases in Germany, such as the 'WAK plutonium theft' in 2001, in which contaminated material was stolen from a reprocessing facility in Karlsruhe.) Such a capability must be exercised regularly in advance of a genuine deployment to ensure an effective joint response. Crime scene work is a precursor to nuclear forensics and should be considered equally important.

Task force roles

All the institutions involved in the exercise had precise roles: the BKA led the police investigation and carried out the crime scene work, the BfS was responsible for radiation protection of all the deployed forces and determined which radiation safety measures were required and the BPOL was responsible for the decontamination of the deployed forces and for medical and logistical support. The three institutions built a crime scene task force capable of supporting a police investigation during a serious nuclear or radioactive incident. Together, they form the Central Federal Support Group in response to serious nuclear threats (ZUB).

'Dirty bomb'

This year, the exercise focused on time-critical forensics work in the presence of open (unsealed) alpha contamination. The fictional scenario was that an internationally organized criminal group dealing in weapons, explosives and chemical, biological, radiological and nuclear materials over the so-called darknet was suspected of having built a radiological dispersal device (RDD) or 'dirty bomb', possibly

Figure 1. Mobile decontamination facilities deployed during the training

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Summer School on Nuclear Forensics... *continued from page 2*

The agenda

The summer school agenda and training materials were developed by the Kyiv Institute for Nuclear Research (KINR) with support from experts from Moldova, Georgia and Azerbaijan, as well as experts from the European Commission Joint Research Centre (EC-JRC) and the US Department of Energy (DOE) Office of Nuclear Smuggling Detection and Deterrence (NSDD). The one-week course benefited from the training infrastructure available at the KINR and offered a mix of types of instruction, from theoretical course elements (lectures) to demonstrations, hands-on exercises and interactive classroom exercises. Students had to apply to participate in the programme, and five or six were selected from each country. Applicants were typically studying at masters (MSc) level in a variety of scientific disciplines.

Networking and feedback

The course also demonstrated the viability of regional approaches to building nuclear forensics capacity. Students made substantive contacts with nuclear forensics experts from their own and other countries, and in this way met expert members of an international community of practice. In addition, they used the opportunity to form a regional network of young researchers with an awakening interest in nuclear forensics. These contacts will serve as invaluable support with establishing pathways for the next generation of nuclear forensic scientists in GUAM member states.

Student feedback indicated that the course generated significant interest in, and knowledge of, a variety of aspects of nuclear forensics. All the participants had a shared fascination for this scientific area and appreciated the opportunity to gain insights into the many avenues for professional and scientific endeavour that this discipline offers.

In sum, the students and participating experts agreed that the summer school was a valuable undertaking that would have a lasting impact on all participants. It will certainly serve as a model to be transferred to other regions. •

* This project is part of a larger set of initiatives that address the development of sustainable nuclear forensics expertise in the GUAM states. These initiatives are funded by the United States and the European Union and implemented by the Science and Technology Centre in Ukraine (STCU) with support from the US DOE's Office of Global Material Security and the EC-JRC.

Figure 3. Participants of the Summer School on Nuclear Forensics for the GUAM member states, Kyiv, Ukraine, 9–13 September 2019

The 11th Joint Annual Crime Scene Exercise... *continued from page 3*

leading to the death of one of the group members. The location of the fictional suspect activity was investigated during the exercise. In fact, the fictional crime scene was one of the many cellars on the BfS site, which had been specially prepared for the exercise by the BKA and the BfS.

All-hazard approach

The first task was to assess the hazards present at the crime scene using an all-hazard approach. An initial mixed team (police and radiation protection) received a radiation protection briefing, put on appropriate Personal Protection Equipment (PPE) and entered the crime scene to assess the chemical, biological and radiological dangers, while also checking for the presence of explosives or other kinds of dangers, such as to the structural integrity of the building. Localized open (unsealed) alpha contamination was confirmed and an air sampler was set up in order to monitor airborne activity.

After an initial evaluation of the scene, a briefing was held to discuss the next steps. A mobile airlock was installed over the designated entrance to/exit from the crime scene together with a filtered air pumping system that kept the air pressure inside the scene lower than outside in order to suppress any further spread of open nuclear or radioactive material. A heat-sealing system for plastic sacks containing pieces of evidence and a mobile glovebox were deployed. Having updated the decontamination facilities and medical support staff, crime scene work began in full PPE with BfS experts advising BKA experts on radiation protection measures at the scene.

Open alpha contamination

The use of open alpha contamination during the exercise was made possible by the application of radon daughter products in solution, which provides a mix of alpha and beta radiation. This method has been developed using a radon calibration source at BfS in Berlin that is licensed and overseen by the regulatory authority. It is one method of arranging contamination by nuclear or radioactive material that can be measured during an exercise, which allows all the deployed forces to use their radiation detection equipment—in this case contamination monitors—in a realistic way. Other methods have been used in Germany for this kind of exercise, such as the use of iodine-131 and fluorine-18. However, these radionuclides do not provide a measureable alpha signal, which is something that the deployed forces must be prepared for during a genuine response.

Figure 2. Participants investigate contaminated evidence in a mobile glovebox during the training exercise

Success through communication

All the deployed forces carried out their tasks successfully throughout the exercise and all the participants were satisfied with the outcome. This year, the communication between the institutions, which is often a sticking point, was much improved by the installation of a joint command tent. This allowed face-to-face communication between the leaders of the police and radiation protection teams in real time, which made the response much more effective. The radiation protection team used digital radio to communicate during the exercise and found that the method has many advantages over the use of mobile phones, not least in terms of security and timeliness. Nonetheless, it was agreed that briefings and debriefings should be improved as information was not always passed on fully from one team to the next.

The evaluation of such a large exercise is just as important as the preparation. The evaluation process is ongoing, both within and between the institutions involved. Learning from past mistakes allows constant improvement of joint procedures and of training inside the individual institutions. The annual crime scene exercises contribute to enhancing the response to and prevention of nuclear security events in Germany. •

The Origin Story of the ITWG... *continued from page 1*

experts and policy personnel a distinctive feature of the conference. Bringing together such a collection of people on a technical topic was almost unheard of at the time. Conference sessions discussed real-life experiences of analysing seized material, on-site crime scene issues, techniques for analysing samples, research issues and the feasibility of forensic science interpretations of technical analyses.

The culmination of the conference got to the heart of its purpose. The final session was on 'mechanisms for international cooperation and next steps'. After the session, my US State Department point of contact (POC) asked me to 'gather all the technical people and decide on what would be the best way for us to continue this type of international cooperation, while we non-technical people take an extended break to await your proposal'.

The genesis of the ITWG

Our proposal was to establish an ongoing forum for international technical cooperation on the topic of the conference. In particular, our aim was to form a Nuclear Smuggling International Technical Working Group, which subsequently became known simply as the ITWG. We were directed to hold the first ITWG meeting in time to draw up a 'status report' documenting progress with technical cooperation on nuclear smuggling forensics analysis so that it could be considered by the Moscow Safety and Security Summit in April of 1996. Lothar Koch was selected to chair this first meeting and I was asked to facilitate communications.

After the conference, my State Department POC spoke highly of the organizational structure of the meeting, which allowed it to focus productively on important topics. She also cautioned me that the ITWG 'should not at every step ask for permission'. She encouraged us as scientists to be proactive, keep the ITWG technical and informal, and simply keep the political specialists informed. She emphasized not allowing it to become an official government activity, as that might well lead to no progress at all.

The premier meeting

The first ITWG meeting was held at the Institute for Transuranium Elements from 30 January until 1 February 1996. All the G7 states and Russia took part, as well as most of the other countries that had participated in the international conference. Draft terms of reference and a draft status report developed by Lothar Koch and myself were sent to the participants before the meeting.

At the start of the meeting, Lothar asked me to co-chair it with him. This was a gracious gesture, which perhaps stemmed from the way the two of us had worked together to prepare for this crucial first

Figure 1. Participants of the International Conference on Nuclear Smuggling Forensic Analysis, Lawrence Livermore National Laboratory, CA, United States, November 1995

meeting. For the first six years of the ITWG, Lothar and I co-chaired every meeting. The terms of reference identified three primary focal areas: (*a*) prioritizing techniques and methods for nuclear forensics analysis; (*b*) formulating and executing inter-laboratory exercises; and (*c*) identifying means for supplementing and improving technical capabilities. Before the meeting concluded, we began to make plans for the first international exercise, in which a sample of plutonium would be used. This may well be the first and only ITWG exercise to use a plutonium sample!

Technical credibility

The fact that the ITWG involved most of the significant nuclear forensic capabilities available in the world at that time gave it technical credibility. Of equal importance was the strong participation of law enforcement and various security personnel. The group explicitly articulated that nuclear forensics has the potential to serve various constituencies—law enforcement, non-proliferation, public health/safety and environmental—and that the primary goal of the ITWG should be to advance international nuclear forensics capabilities in order to meet the needs of all these constituencies.

By the time of the ninth meeting in 2004, I had served as the sole chair for several years, following Lothar's retirement, and become the de facto institutional memory of the ITWG. I recognized that this was not a sustainable situation and therefore proposed the formation of a five-member executive committee. I invited Klaus Mayer to be co-chair and Paul Thompson agreed to act as secretary. We also formalized the group that had been planning the international exercises as a task group, and identified the need to establish other task groups that would carry on the work of the ITWG between the annual meetings. Several new task groups were therefore initiated.

Throughout these early years, the ITWG worked to develop a Model Action Plan for carrying out nuclear forensics investigations. The day after the 2004 ITWG meeting ended, a special one-day meeting was convened by the International Atomic Energy Agency (IAEA) to receive comments on a draft technical document on the Model Action Plan. Its subsequent publication as part of the IAEA Nuclear Security Series document no. 2 was a welcome milestone that provided a wider international audience for this particular accomplishment of the ITWG.

Reflecting on the origins of the ITWG, it is heartening that the ITWG is still going strong 25 years later. I am deeply grateful to all the participants throughout all these years for the progress that has been made—and my congratulations to the leaders who have built well on its early foundations. •

UPCOMING TRAININGS AND MEETINGS

- IAEA 3rd International Seminar on Introduction to Nuclear Forensics (Russian Speaking),Almaty, Kazakhstan, 9–13 December 2019
- Galaxy Serpent 4 Exercise, December 2019–March 2020
- 10th International Conference on Isotopes, Kuala Lumpur, Malaysia, February 3–7, 2020
- IAEA International Conference on Nuclear Security: Sustaining and Strengthening Efforts (ICONS2020), Vienna, Austria, 10–14 February 2020
- GICNT Rogue Tango RMWG – NFWG Exercise, Buenos Aires, Argentina, March 2020

Dates and locations of IAEA training and meetings will be officially confirmed with host member states; participation in IAEA training 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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