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## CHAIRPERSONS' ADDRESS

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Welcome to the Nuclear Forensics International Technical Working Group's (ITWG) quarterly newsletter, the ITWG Update. At the close of 2023, when people may be taking stock of the past year and charting a course for the future, this newsletter includes some insights that the nuclear forensics community will hopefully find useful. This edition opens with a personal reflection by Klaus Mayer, former ITWG co chair, about his time as part of the nuclear forensics community, highlighting areas in which the ITWG should take pride. Our colleagues at the International Atomic Energy Agency (IAEA) have provided an article on page 3 that identifies workshops and opportunities for hands-on training at their new Nuclear Security Training and Demonstration Centre (NSTDC) in Seibersdorf, Austria. For the first time in the ITWG Update's history, there is also a book review on page 5, where Klaus Mayer and David Smith (another former ITWG co-chair) examine *Atomic Peril*, a novel by ITWG co-founder Sid Niemeyer. The book is a fictionalized account of collaboration among scientists, law enforcement officials and intelligence officers to prevent a terror attack utilizing nuclear forensic science. As usual, the calendar section at the end of the newsletter highlights upcoming activities and training courses. Looking ahead, and in addition to preparations for the ITWG annual meeting this summer, our leadership team is planning several contributions to the IAEA's International Conference on Nuclear Security (ICONS) in May 2024. These include a side event that will highlight the interface between nuclear forensics laboratory analysis and crime scene management, drawing on the recent, seventh collaborative materials exercise (CMX-7). We also anticipate offering technical briefings that include an overview of the ITWG and our CMX series. Finally, the ITWG plans to launch at the conference a new case study publication series that reflects when and how nuclear forensic techniques have been applied during nuclear security events. As governments look to highlight successes at ICONS 2024, we encourage nuclear forensics practitioners to flag for leaders when participation in ITWG exercises and activities has helped strengthen nuclear security and preparedness. We also urge practitioners to review IAEA Information Circular no. 917 (INFCIRC/917) and encourage governments to subscribe to the INFCIRC as an ICONS deliverable where applicable. We hope to see you at the conference!

With best wishes for a safe and healthy new year,

Michael Curry and Maria Wallenius

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## A PERSONAL JOURNEY INTO NUCLEAR FORENSICS AND THE ITWG

### KLAUS MAYER

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I joined the ITWG in 2004 at the annual meeting in Cadarache, hosted by the French Alternative Energies and Atomic Energy Commission (CEA) at their 'chateau'. Yet this was neither my first contact with the ITWG nor with nuclear forensics. The first direct encounter with the ITWG was at an International Atomic Energy Agency (IAEA) consultancy meeting back in 2002, which I had the pleasure to chair. This turned out to be a delicate task, as the meeting aimed at defining the IAEA's attitude towards the new discipline of nuclear forensics, with

largely controversial positions within the IAEA and towards the ITWG. In the margins of this meeting, Sid Niemeyer invited me to join the ITWG. At that point, I did not realize this would mark the start of a long journey.

My broader journey into nuclear forensics, however, had already started 10 years earlier, before the expression 'nuclear forensics' had been coined. After the discovery of Iraqi President Saddam Hussein's clandestine nuclear programme, the 'IAEA Action Team' gathered evidence in Iraq that Saddam Hussein

## A Personal Journey into Nuclear Forensics and the ITWG *continued from page 1*

had violated the Non-Proliferation Treaty (NPT) obligations. Some 20 samples of natural uranium were sent to the Joint Research Centre, where I measured the U-234/U-238 ratio at very high precision using a state-of-the-art mass spectrometer. The sample set could be clustered in three groups, and this grouping was consistent with an impurity analysis performed by quadrupole ICP-MS. My first ‘nuclear forensic analysis’ helped the IAEA to attribute Iraq’s uranium to batches of declared material (legally imported), undeclared material from domestic mining and undeclared material from illegal imports. At that time, I did not realize this investigation would be like an appetizer before embarking fully on the journey into the fascinating world of nuclear forensics.

Today, some 30 years later, I look back on an exciting time spent in nuclear safeguards and nuclear forensics. In the early 2000s nuclear forensics was still described as an ‘emerging discipline’, inviting researchers to develop novel analytical and interpretational methodologies and to generate new insights. Soon after joining the ITWG, I discovered that it was a community of practice which is eager to learn, passionate to advance the discipline and determined to make the world a safer place. Let me summarize my experience with the ITWG in three words: miracle, friends and competence.

First, the ITWG is a *miracle*. It was established as an informal group of individuals, of experts in their respective fields, originating from different countries and with different areas of expertise. Being of an informal character, without a clear legal status and without a budget, the group’s mandate—and indeed its very existence—was challenged. Nevertheless, the momentum within the group, its achievements and its tangible output have helped to establish the ITWG as the international reference when it comes to nuclear forensics. We can all be proud of this!

Second, within the informal setting of the ITWG, *friends* and colleagues can openly exchange information, share their latest research results, discuss new approaches, formulate best practices and develop joint projects. Whether in task groups or during coffee breaks, there are opportunities to foster direct contacts and network across disciplines and countries. The cooperative and collegial atmosphere at the annual meetings also strengthens the coherence of



Klaus Mayer, head of nuclear forensics at the Institute for Transuranium Elements (ITU), examines a sample of nuclear material in Karlsruhe, Germany, 09 February 2011.  
*Photo: Uli Deck/Alamy.*

the group and these meetings are a cornerstone of the ITWG’s sustained success. This is something we can all be happy about!

Third, *competence* is the key ingredient in the accomplishments of the ITWG. The concept of ‘a cop and a scientist’—the idea of bringing together experts from completely different fields—has significantly helped in advancing the discipline of nuclear forensics. Fuel cycle knowledge, radio-analytical skills, radiation protection, crime scene management and evidence handling are just some examples of the areas of competence which constructively interact at the ITWG and contribute to its impressive and unique knowledge base. We have good reason to be pleased about this!

In conclusion, as part of the ITWG I have had the privilege to work with so many great experts from all around the world. I have learned so much from other members of the group in discussions, presentations and seminars. Working with my co-chairs, Sid Niemeyer, David Smith, Ben Garrett and Michael Curry, was an extraordinary experience. They had different characters, different leadership styles and yet were all wonderful to work with in different ways—and determined to jointly steer the ITWG forward. It was great to see the group evolving, the annual meetings growing in size, the number of nuclear forensic laboratories increasing, the science becoming increasingly sophisticated and, overall, the discipline of nuclear forensics maturing. I feel privileged and thankful to have been a part of it.

Nuclear forensics is inseparable from the ITWG and I am sure both will continue to flourish. •

## OPPORTUNITIES FOR TRAINING IN NUCLEAR FORENSICS AT THE IAEA'S NUCLEAR SECURITY TRAINING AND DEMONSTRATION CENTRE

GARY R. EPPICH CHELSEA WILLETT AND ÉVA SZÉLES

On 3 October 2023 the IAEA inaugurated the Nuclear Security Training and Demonstration Centre (NSTDC), a unique nuclear security training centre that is located at the IAEA Laboratories in Seibersdorf, Austria, 30 kilometres south of Vienna. The NSTDC is equipped with state-of-the-art technical equipment that will provide advanced training to approximately 1000 participants each year.

The establishment of the NSTDC addresses existing gaps in nuclear security training by using specialized up-to-date equipment, computer-based simulation tools and advanced training methods. The key objective is to expand training opportunities in two areas: the physical protection of nuclear and other radioactive material and facilities; and the detection of and response to criminal or intentional unauthorized acts, involving or directed at nuclear or other radioactive material, associated facilities or associated activities.

In nuclear forensics and radiological crime scene management, in particular, the unique capabilities of

the NSTDC will allow new capacity-building activities and enable trainees to obtain hands-on experience, as well as to observe demonstrations to further enhance nuclear security processes and measures.

The NSTDC has a Nuclear Forensics Laboratory and a Radiation Detection and Monitoring Laboratory for Radiological Crime Scene Management. The Nuclear Forensics Laboratory is equipped with microscopes, balances, a glove box and other relevant equipment. This equipment will be used to demonstrate good practices in nuclear forensics in the context of investigations. Video links between the demonstration laboratory and classrooms will enable participants to observe and guide key techniques that take place in a nuclear forensics laboratory setting, including those that would take place during a nuclear forensic examination.

Gamma spectrometry capabilities, including low-resolution handheld detectors and high-resolution laboratory-based instrumentation, will be utilized in several training courses and workshops, and can



Chelsea Willett, Elena Buglova, Éva Széles, Yuan Zhong, and Gary Eppich in the multipurpose building for the Nuclear Security Training and Demonstration Centre (NSTDC) at the IAEA Laboratories in Seibersdorf, Austria. 3 October 2023  
*Photo: Dean Calma/IAEA.*

Opportunities for Training in Nuclear Forensics *continued from page 3*

Éva Széles, Unit Head, (Crime Scene Management and Nuclear Forensics), presented a demonstration of activities done with Nuclear Forensics to Rafael Mariano Grossi, IAEA Director-General at the Multipurpose Building for the Nuclear Security Training and Demonstration Centre (NSTDC) at the IAEA Laboratories in Seibersdorf (2023).

*Photo: Dean Calma/IAEA.*

be found in both the Nuclear Forensics Laboratory and the Radiation Detection and Monitoring Laboratory. The centre will provide an opportunity for participants to learn about the entire process, with the aim of bridging the gap between the crime scene and the forensics laboratory. However, the NSTDC's nuclear forensics laboratory capabilities are for demonstration and training purposes only and will not be used for the examination of nuclear or other radioactive material out of regulatory control.

A 'Train-the-Trainers Course on Radiological Crime Scene Management for Subject-Matter Experts' will be offered for the first time at the NSTDC on 11–15 December 2023. In addition, an 'Integrated Workshop on Radiological Crime Scene Management and Nuclear Forensics', developed in cooperation with Interpol and the European Union, will be held twice in 2024. The latter will provide participants

with the opportunity to gain awareness of the connection and collaboration between radiological crime scene management and nuclear forensics and it will highlight the necessity of scientific support in the collection of evidence at a radiological crime scene. The workshop also aims to demonstrate how nuclear forensics can support prosecution and will provide information about the laboratory established at the NSTDC for this area of specialization. The target audience includes crime scene investigators and managers, commanders, prosecutors, radiation protection experts, radiation detection experts, radiological assessors, nuclear forensic experts, scientists and representatives from national regulatory bodies.

In total, the NSTDC offers 23 unique training courses and workshops. More details about the full catalogue are available [here](#). •

**BOOK REVIEW: 'ATOMIC PERIL'****DAVID K. SMITH AND KLAUS MAYER**

In a news cycle that each day warns us of the very real threat from the proliferation of dangerous materials and the potential for the unimaginable use of nuclear weapons, comes Dr Sidney Niemeyer's new nuclear forensics thriller, *Atomic Peril*.<sup>1</sup> With this review, we introduce you to a book that emphasizes the potent link between science and security and highlights the value of international collaboration, including the key role played by the ITWG. We first provide an outline of the story, intended as an appetizer, and then we zoom in on the author and his close ties with the discipline of nuclear forensics and the working group.

The story shines a light on a small group of technical experts that have contributed for more than two decades to making the world more secure. As in all good fictional tales, this book is rooted in real events, where actual threats, genuine materials, existing laboratories and the definitive work of scientists, law enforcement officials and intelligence officers combine to portray an investigation very recognizable to the nuclear forensics community. Relevant to today's headlines, the plot revolves around the seizure of highly enriched uranium in the Black Sea region and its implication in a broader terrorist plot to attack the United States with an improvised nuclear weapon.

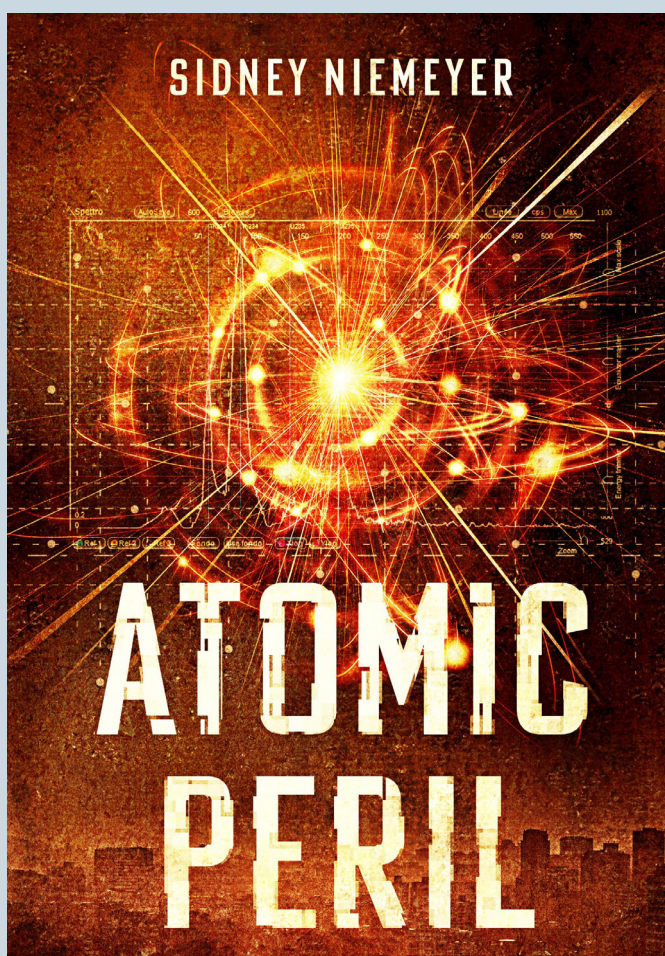
Steven Carter leads a team of the 'best and brightest' nuclear forensic scientists at Lawrence Livermore National Laboratory in northern California. A case originating half a world away, involving the seizure of 100 grams of highly enriched uranium oxide powder in Moldova, reaches Livermore; now the Federal Bureau of Investigation's (FBI) lead investigator, Special Agent John Kittrick, has come to the laboratory to oversee an examination of this material to learn more about its exact isotopic enrichment and the ensuing national security implications. The FBI presses the team to find out whether the powder is similar to that confiscated in other smuggling cases and whether it possibly originated from a larger global inventory of vulnerable uranium.

As the laboratory analyses proceed, discussions continue at a terrorist camp in Afghanistan on a plan to attack the West with a nuclear weapon. And in Turkey, terrorists perfect a means to cast enriched uranium into metal ingots.

Steven's wife Carissa is the tether that holds the Carter

family together; it is her commitment to the family that has enabled Steve in his pursuit to develop the nation's leading nuclear forensics capability. Yet that success has come at an emotional cost.

The Moldovan case yields additional information that indicates a more serious threat; however, the leadership of the FBI is not so easily convinced. Steven takes a huge risk and continues the laboratory's forensic investigation with his team without informing the FBI. His dogged belief in the significance of this case, as part of a larger plot involving a nuclear attack, leads him to the US intelligence community with his theory. Steven's colleagues and Carissa urge caution as he proceeds with this unprecedented step. Despite the uncertainty, his meetings at the Central Intelligence Agency (CIA) yield receptive ears. The forensic



<sup>1</sup> Niemeyer, S., *Atomic Peril: A Nuclear Forensics Thriller* (Quantum Publishing: Carnforth, Oct. 2023), ISBN (paperback): 979-8-9889843-0-6.

investigation continues at a heightened pace, taxing Steven, his technical staff and—outside the laboratory fences—his family.

As a forum of scientific and law enforcement practitioners, the ITWG enables Steven to pursue leads in the Moldovan case with experts from Eastern Europe who have insights into the likely origin of the highly enriched uranium.

Uranium ingots are illicitly shipped through the southern border crossing with the United States. Steven gets caught between the CIA and the FBI, with the latter learning of his unauthorized work with the intelligence service. Based on the convergence of nuclear forensics evidence, some enriched uranium is confiscated at the border after an expedited search and urgently returned to Lawrence Livermore

Making use of international collaboration, including that developed at prior ITWG annual meetings, Steven and John urgently work to narrow the likely origins of the seized uranium samples. As the threat of an imminent nuclear attack is realized by the US government, Steven crosses the line from national laboratory scientist to an operative deployed in the search for the terrorists and their improvised weapon. Steven and John pursue the suspects to the end.

With his many years working as a senior national laboratory scientist and leading national and international efforts to establish nuclear forensics as a capability to thwart terrorism, Sid Niemeyer is extraordinarily well placed to write this compelling thriller. Parts of the case portrayed early in the novel mimic responses and examinations that established

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

- Assulin, M., et al., ‘Oxygen isotope alterations during the reduction of U<sub>3</sub>O<sub>8</sub> to UO<sub>2</sub> for nuclear forensics applications’, *ACS Omega*, vol. 8, no. 37, 23 Sep. 2023, pp. 33651–57.
- Serban, A. et al. ‘Determination of age, isotopic ratios, and elemental impurities in nuclear materials by single quadrupole ICP-MS’, *Journal of Radioanalytical and Nuclear Chemistry*, vol. 332, no. 10, Oct. 2023, pp. 1–9.
- Sedgi, I. et al., ‘Nuclear forensic signatures of UO<sub>2</sub> fuel pellets for differentiation and provenance determination illustrated using synthetic database’, *Journal of Nuclear Materials*, vol. 587, 15 Dec. 2023, 154730.
- MacDonald IV, L. W. et al., ‘Review of multi-faceted morphologic signatures of actinide process materials for nuclear forensic science’, *Journal of Nuclear Materials*, vol. 588, Jan. 2024, 154799.
- Spano, T. L. et al., ‘Structural features of early fuel cycle taggant incorporation for intentional nuclear forensics’, *Journal of Nuclear Materials*, vol. 588, Jan. 2024, 154787.

National Laboratory in the context of an unfolding national emergency. The analyses reveal divergent and complex signatures. Working again with FBI Special Agent Kittrick, the hunt is on using all sources and methods to explain the differences in these results, as well as to identify processes involved in the manufacture of the distinct uranium samples.

The terrorists operationalize their plan to fabricate an improvised nuclear weapon using the fissile uranium smuggled into the USA. At the same time, national and family crises converge for Steven, which he must untangle with Carissa.

the viability of nuclear forensics as a discipline over twenty-five years ago. The conduct of the investigation is spot on. In the book and in real life, a deductive approach using an array of scientific methodologies is paramount. The question from ministers gets asked early and often: ‘How confident are you?’.

With only incomplete data and the pressures of an immediate response to senior officials, this question is not easily answered.

The main characters in the novel, drawn from scientists involved in early case studies, are all too real. The institutional bureaucracies, the professional

**UPCOMING TRAINING COURSES AND MEETINGS\***

- Train the Trainers Course on Radiological Crime Scene Management for Subject Matter Experts, Seibersdorf, Austria, 11–15 December 2023
- IAEA Regional Peer-to-Peer Workshop on Nuclear Forensics, Yogyakarta, Indonesia, 6–10 May 2024
- International Conference on Nuclear Security (ICONS), Vienna, Austria, 20–24 May 2024
- 27th Annual Meeting of the ITWG, United Kingdom, June 2024, details TBC
- IAEA International Integrated Workshop on Radiological Crime Scene Management and Nuclear Forensics, Seibersdorf, Austria, Q2 2024 details TBC
- IAEA Regional Training Course on Practical Introduction to Nuclear Forensics, Saclay, France, 23–27 September 2024
- IAEA Regional Training Course on Practical Introduction to Nuclear Forensics, Budapest, Hungary, 30 September–4 October 2024
- IAEA International Training Course on Nuclear Forensics Methodologies, Karlsruhe, Germany, 14–25 October 2024
- IAEA Regional Training Course on Basic Introduction to Nuclear Forensics, Cairo, Egypt, 2024
- IAEA 2025 Technical Meeting on Nuclear Forensics, Vienna, Austria, Q2 2025, details TBC

\*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.

jealousies, and the tensions between government sponsors and laboratory scientists ring true. Of particular interest is the complexity of Steven's relationship with his family. His professional commitment to nuclear forensics eclipses his wife and children and it is Carissa's strength as a wife and mother that navigates these tensions. The many demands on a family accompanying a career in nuclear security are ever-present in this story and were, until now, unwritten.

Sid Niemeyer's thriller is an engrossing tale, the suspense growing with the turn of each page, and it is made only better by the author drawing on his early years leading the ITWG with one of us (Klaus Mayer). The account is clear to both specialists and non-scientists alike. The novel is also great fiction. As Sid acknowledges in his closing note, in reality

Steven's circumvention of the leadership at the Lawrence Livermore National Laboratory and the FBI is inconceivable, as is his transition from laboratory scientist to front line security operator.

*Atomic Peril* highlights the key role of the ITWG as an international forum to promote the state of practice in nuclear forensics, build partnerships between science and law enforcement, and exchange information useful in the pursuit of a nuclear security investigation. To our knowledge, this is the first time the ITWG has been included in a work of fiction. Several have noted that this novel is unique in its depiction of the dynamic evolution of a nuclear forensics case and of how nuclear forensics is a vital, if not fully acknowledged, capability that keeps the world a safer place. We could not agree more. •

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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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