ITWG Nuclear Forensics International Technical Working Group

ITWG NUCLEAR FORENSICS UPDATE

No. 17 December 2020

CHAIRPERSONS' ADDRESS

Welcome to the Nuclear Forensics International Technical Working Group newsletter, the ITWG Update, at the end of a very special year. We had hoped to celebrate the 25th anniversary of the ITWG at the occasion of our annual meeting in June 2020. The pandemic, however, turned things upside down and plans needed to be changed.

As we face a new year and reflect on what to carry forward from the challenges of the past, we hope that the ITWG Update has helped provide a virtual connection to the nuclear forensics community and contained information that you and your colleagues find useful. We also hope that new efforts, like the ITWG webinar series, have proven valuable to you and your colleagues. This newsletter features articles on the Nuclear Forensics Self-Assessment Tool that was developed by the Global Initiative to Combat Nuclear Terrorism (page 3) to help governments better align forensics capabilities and requirements. This edition also features an article by David Smith on the results from the July 2020 ITWG Membership Survey on Virtual Outreach (page 1). The results have been used by the ITWG leadership team to shape our engagement with you and the broader nuclear forensics community. This edition also includes an article on Latent Print Examination by the US Federal Bureau of Investigation that describes 'outside the box thinking' on this technique (page 5). Finally, we encourage you to review the calendar on page 7 to identify the latest ITWG webinar offerings.

We would also like to acknowledge the retirement of Ed Fei from the US Department of Energy. Ed was the invisible hand that initiated the ITWG Update in 2016 and we thank him for his contributions to this community. In addition, we would like to note that ITWG alumna, Dr Éva Kovács-Széles, was selected by the International Atomic Energy Agency (IAEA) to be the Unit Head of their Crime Scene Management and Nuclear Forensic Science team. Congratulations to Dr Kovács-Széles and to the many other very talented candidates that were considered for the position.

Wishing everyone a healthy and productive new year,
Klaus Mayer and Michael Curry

RESULTS OF THE ITWG MEMBERSHIP SURVEY ON VIRTUAL OUTREACH

DAVID KENNETH SMITH

Since its inception 25 years ago, the Nuclear Forensics International Technical Working Group (ITWG) has prioritized dissemination of international best practice in radiological crime scene response and the ensuing conduct of a nuclear forensic examination encompassing laboratory analysis, interpretation and reporting of findings. Since the beginning of 2020, the unprecedented global transmission of SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) has affected us all and complicated personal presence, including the ITWG. However, as noted in the last ITWG Nuclear Forensics Update (Curry and Smith, September 2020), the pandemic has not detracted from the ITWG's primary goal of communicating the progress of advancements in nuclear forensics. The lessons of SARS-CoV-2 also indicate the need for strong national response plans informed by science; this is also the case for nuclear forensics as an effective response and preventive to counter the continuing threat of nuclear and other radioactive material out of regulatory control.

The move to virtual outreach

In this vein, the ITWG has accelerated its plans and preparations for virtual outreach in 2020, for the purpose of strengthening technical engagement with our international membership in the areas of development and sharing of nuclear forensics

Continued page 2

Results of the ITWG Membership Survey... *continued from page 1*

technical guidelines for practitioners, collaborative analytical and virtual exercises, procedures for evidence recovery, utilization of national nuclear forensics libraries for material identification, and outreach and training. Additionally, the new virtual connections on the restricted (i.e. closed and password protected) ITWG website facilitate the internal cohesion of the ITWG executive and its task groups through rapid sharing of strategic objectives, plans and results (see Curry and Smith, September 2020).

ITWG survey on virtual outreach

Earlier this summer, the ITWG Executive requested that the Outreach and Training Task Group develop a survey to query the broader membership on their interests and desired formats for virtual engagements (e.g. webinars, podcasts, virtual online events) in 2020 and beyond, with the recognition that virtual events will increasingly play an important role in promoting efficiencies in information transfer and access to nuclear forensics expertise as well as lessons learned. The survey was posted on the restricted ITWG website in the second quarter of 2020. The ITWG leadership acknowledges the help of the French Alternative Energies and Atomic Energy Commission and their contractor in posting the survey and providing the ITWG leadership with the results.

The following are the abridged survey questions posted to the membership:

1. How many years have you been affiliated with the ITWG?
2. Describe your primary area of expertise?
3. Which ITWG task groups are you most interested in?
4. Are you in favour of virtual ITWG outreach formats (e.g. webinars or podcasts) to complement the current publication of the quarterly ITWG Update as well as traditional in-person exchanges at ITWG annual meetings?
5. Should virtual outreach focus on the internal cohesion of the ITWG and its task groups, reach out to a broader international audience, or both?
6. Are there past articles in published ITWG Updates that could be the subject of a virtual ITWG event?
7. What specific topics might you suggest for an ITWG virtual outreach event, as well as speakers and panellists?
8. Provide other suggestions for the development of ITWG virtual outreach.

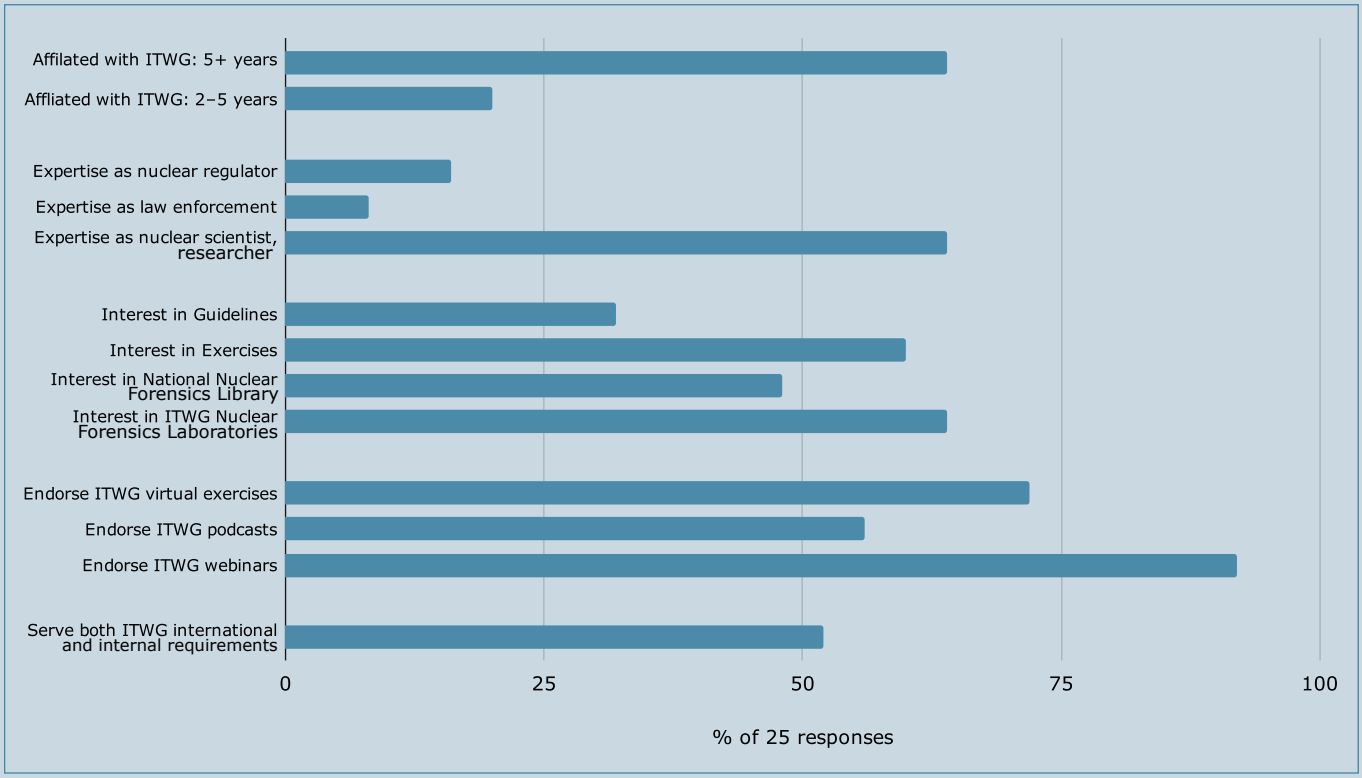

Figure 1. Summary of the ITWG membership survey on virtual outreach, Q2 2020

Survey results

Not unexpectedly, the ITWG membership was strongly in favour of expanded and enhanced virtual outreach events. Twenty-five ITWG members replied to the survey. Answers are reported as a percentage of the total number of respondents for each subject (see figure 1 for a summary).

The survey indicates that the largest number of respondents, 64 per cent, have been affiliated with the ITWG more than 5 years; 20 per cent of respondents between 2 and 5 years. The primary area of expertise, of 64 per cent of the respondents, is nuclear science or researcher. Sixteen per cent identify as regulators and 8 per cent as law enforcement. All task groups are of interest to the respondents; higher responses include 64 per cent who state an interest in the ITWG Nuclear Forensics Laboratories (INFL), 60 per cent in the Exercise Task Group and 48 per cent in the National Nuclear Forensics Library Task Group.

The vast majority of respondents, 92 per cent, endorse virtual ITWG webinars of 30 to 90 minutes in duration. Fifty-six per cent favour ITWG podcasts lasting less than 30 minutes in duration and 72 per cent prefer ITWG virtual exercises (e.g. Galaxy Serpent to develop a national nuclear forensics library). Virtual outreach best reaches an international audience, but also promotes the internal cohesion of task groups; 52 per cent of respondents indicate both purposes are important.

Relative to solicited topics of interest for virtual events, the many subjects received are too numerous to list here. Some proposals include furthering the Co-Chair's perspective on 'nuclear forensics the way forward', a perspective on the differences between nuclear forensics and non-proliferation, development of a national nuclear forensics library, enhanced engagement of technical experts with law enforcement, and a forum on nuclear forensic science to include new analytical methods and radiochemistry.

Inaugural ITWG virtual outreach events following the survey

This survey has been invaluable in developing ITWG virtual outreach to include subjects and formats beneficial to both internal and international audiences. Following the survey, the ITWG convened its inaugural virtual event in October 2020 on the topic of objectives, plans and arrangements for the next collaborative material analytical exercise (CMX-7) to commence in 2021. Fifty-three participants took part in this event, hosted by the Exercise Task Group. Future ITWG virtual events will be scheduled at regular intervals later in 2020, throughout 2021 and beyond. Announcements of virtual events will be made through the ITWG website. •

THE NUCLEAR FORENSICS SELF-ASSESSMENT TOOL

GLOBAL INITIATIVE TO COMBAT NUCLEAR TERRORISM SUPPORT TEAM

The Global Initiative to Combat Nuclear Terrorism (GICNT) would like to highlight the availability of the Nuclear Forensics Self-Assessment Tool (SAT). The GICNT formally endorsed the SAT at the June 2019 GICNT Plenary Meeting, held in Buenos Aires, Argentina. The SAT has since been available for download and use by countries interested in conducting an analysis and assessment of their nuclear forensics capabilities. More recently, the SAT has been translated from English into four additional languages: Arabic, French, Russian and Spanish. The SAT remains available for unattributed download on the Global Initiative Information Portal (GIIP) (www.global-initiative.info/). It is also available on request to countries that have not joined the GICNT. Those interested are encouraged to contact globalinitiative@state.gov.

Figure 1. A presentation given at the June 2019 GICNT Plenary Meeting

The SAT provides a framework for structuring a voluntary, national-level interagency dialogue to inventory and assess the existing national policies,

Continued page 4

The Nuclear Forensics Self-Assessment Tool... *continued from page 3*

Figure 2. A workshop given at the June 2019 GICNT Plenary Meeting

Figure 3. A participant using an optical microscope at the June 2019 GICNT Plenary Meeting

response plans, and scientific, technical and operational capabilities that can be applied in the development and maintenance of a national nuclear forensics capability. Through the use of the SAT, national governments are able to identify strengths and gaps in their nuclear forensics capabilities, thereby laying the groundwork for near-term and long-term improvements and next steps.

The SAT is structured such that it includes three main sections. The first section, *Identification of Nuclear Forensics Stakeholders*, presents realistic radiological and/or nuclear (R/N) security scenarios and discussion questions to guide interagency dialogue in identifying the appropriate nuclear forensics stakeholders. The second section, *Collection of Information Related to Current Nuclear Forensics Capabilities*, consists of worksheets to facilitate and guide the assessment of nuclear forensics policies, response plans and capabilities in four areas: national policy and legal frameworks, nuclear forensic evidence management, material analysis and interpretation, and human resource education and development. The third section, *Identification of Strengths and Gaps*, provides a structure for a detailed assessment of each nuclear forensics capability and requirement identified in the second section of the SAT.

The key strength of the SAT is its ability to help any interested country identify which capabilities may be required—or not required—given its national legislative framework for the criminalization and prosecution for acts of R/N crime and terrorism. This has proven vital for countries looking to expand their national nuclear forensics capabilities, as the SAT helps guide discussions regarding the allocation and planning of resources and investment.

Before the endorsement of the SAT at the GICNT Plenary Meeting, its utility was validated at the Self-Assessment Tool Pilot Workshop hosted by Romania in November 2018 in Bucharest. Five states participated in this workshop, and two of them formulated and shared important outcomes for the development of nuclear forensics capabilities in their countries.

For example, Ms Harinate Mungpayaban of Thailand's Office of Atoms for Peace explained that Thailand had decided 'to establish a national framework for building domestic capabilities and initiate an ISO/IEC 17025 lab accreditation process' as an outcome of using the SAT. She also noted that 'the ISO/IEC 17025 accreditation is a valuable investment because [it ensures] the [designated national] laboratory is certified [with] quality systems, principally in a case to comply with law and regulations for the criminal justice process'. Ms Mungpayaban expressed support for the SAT and noted that these important steps were undertaken as a direct result of outcomes identified through its use.

In another example, Ms Mihaela Ștefănescu of the Romanian Ministry of Foreign Affairs stated that Romania had used the tool to '[identify] nuclear forensics stakeholders, [review] the legal framework and [evaluate] the abilities of appropriate government agencies to cope with their role within the national security infrastructure'. Ms Ștefănescu further added that 'the experience [of using the SAT] was very useful in getting a clear picture of the national nuclear forensics infrastructure and in continuing projects developed so far at national levels in the nuclear forensics field'.

The core principle highlighted through the use of the SAT is that there is no single, universal framework encompassing policies, response plans and capabilities that is applicable to every country's national nuclear forensics needs. The GICNT recognizes that countries

will develop nuclear forensics capabilities to serve their unique national needs. Therefore, not all topics considered in the SAT may be applicable to all. Each country is given the discretion to determine which components or partial components of the SAT they wish to execute, as well as how information derived from conducting the self-assessment is collected and used. The SAT's sole purpose is to assist a national government process towards the development of a unique national framework appropriate to a country's R/N security context.

Use of the SAT is voluntary and countries are not obligated—under any circumstances—to share the information given or the results of the self-assessment with the GICNT or any other government or non-government entity, including multilateral organizations. However, if a GICNT partner nation is interested in assistance stemming from its SAT findings, the GICNT is able to provide follow-up in coordination with its multilateral network of subject matter experts within the Nuclear Forensics Working Group (NFWG). For more information about the SAT, please contact the GICNT at globalinitiative@state.gov. •

Figure 4. Participants of the June 2019 GICNT Plenary Meeting, Buenos Aires, Argentina

FBI LABORATORY LATENT PRINT HEAT EXAMINERS THINK 'OUTSIDE THE BOX'

NICOLE BAGLEY AND MONIQUE BRILLHART

Within the Latent Print Unit (LPU) at the FBI Laboratory in Quantico, Virginia, in the United States, there is a small, specialized group of qualified forensic examiners and photographers who comprise part of what is known as the Hazardous Evidence Analysis Team (HEAT). As part of this team, these forensic examiners undergo rigorous training at partner agency facilities across the nation to gain access to a category of evidence all of its own: chemical, biological, radiological, nuclear, and explosive (CBRNE)-contaminated materials. Given the very specialized nature of these materials, the standard approaches that the LPU takes to exploit evidence for the presence of latent prints need a bit of adjustment. As such, LPU HEAT is no stranger to thinking 'outside the box' when it comes to adapting their processes and procedures for each unique scenario. One such latent print processing technique that the team has taken a creative approach with is cyanoacrylate fuming, commonly known as superglue fuming (SGF).

Figure 1. Example of a latent fingerprint developed using cyanoacrylate fuming

The basics of cyanoacrylate processing

One of the workhorses of latent print processing, SGF is conducted by encapsulating an evidentiary item in some sort of closed chamber, and then introducing superglue fumes over time to coat the latent prints. This process is usually expedited by rapidly heating the liquid glue into a gas. Due to the lack of relative

FBI Laboratory Latent Print Heat Examiners... *continued from page 5*

humidity in many locations geographically, humidity is often introduced as a necessary way to enhance the development success of the technique. This is done to regenerate or rehydrate the moisture component of any latent print residue that may be present on the item. For rapidly controlled development, after the item is humidified, liquid cyanoacrylate is quickly heated to produce vapours that adhere to those regenerated latent residues. Lastly, the toxic fumes must safely be purged from the chamber. This entire process results in a plasticized latent print (such as the one seen in figure 1), aiding in both the preservation of forensic evidence, as well as visualization of the print for photographic capture. That photograph can then be digitally transmitted back to the FBI Laboratory, where an examiner awaits to analyse and (hopefully) compare the latent to any known subjects or search it against the millions of known fingerprint/palm print records maintained in the Federal Bureau of Investigation's (FBI's) database.

While all of this is accomplished daily for run-of-the-mill evidence using automatic/pre-manufactured chambers in a controlled setting at the Quantico laboratory, LPU HEAT cases face a different set of challenges. For hazardous situations, LPU HEAT examiners designed a solution to carry out the SGF process effectively in a variety of environments, while accounting for both the item size and hazard variability that CBRNE evidence presents.

A creative yet simplistic path forward

To rise to this challenge, a specialized portable SGF kit was created (see figure 2). It was designed to be easily deployable to any location where a HEAT response may be needed. The kit is comprised of components that allow for chamber size versatility, and the materials were chosen keeping many common CBRNE safety issues in mind.

Figure 2. Cyanoacrylate fuming kit

To address the need for a safe encapsulating chamber, the kit contains varying sizes/shapes of Schedule 40 PVC pipe and fittings that can be connected to build a framework that Griffylon® Type-55 ASFR material is then draped over, isolating the evidence (see figure 3). Griffylon® Type-55 ASFR was chosen due to its anti-static, flame retardant, high puncture resistance properties, which are key when dealing with evidence that may have an explosive component. It is also an efficient, lightweight vapour barrier. While the kit includes enough PVC material and pre-fabricated Griffylon® Type-55 ASFR to build both a 5-foot cubed and 3-foot cubed tent, the PVC can easily be configured into whatever size/shape chamber may be needed for the task at hand, and covered as needed with the Type-55 ASFR material. The pre-fabricated tent shapes also have integrated sleeved ports where hoses can be attached to facilitate both humidification and de-fumigation, as well as a plastic 'window' to visually monitor development. In order to get such a large chamber up to optimal latent print processing humidity (~70 per cent), a portable, commercially available ultrasonic humidifier (see

Figure 3. Encapsulating chamber built from kit components

Figure 4. Ultrasonic humidifier for use with the fuming kit

figure 4) is used to pump cool mist into the tent with a vacuum hose (provided that evidence will not be negatively compromised or activated by the addition of moisture).

As a substitute for the electrical hot plate that would typically be used to vapourize the superglue, LPU HEAT achieves this step by utilizing Cyanoshots®, which combine an acidic activator solution with basic activator crystals to produce a localized exothermic reaction to heat the cyanoacrylate in an integrated metal dish. The number of Cyanoshots® used and runtime for each SGF cycle is dictated by the size of the chamber, and each deployment kit is equipped to be able to run several SGF cycles as the item or items are further exploited or disassembled. The de-fumigation process is then conducted in order to remove the toxic SGF fumes that are generated and cease the development of latent prints.

With its simplicity and portability, this kit has proven to be extremely beneficial to evidence exploitation in the field, and to LPU HEAT in support of the Disposition and Forensic Evidence Analysis Team (DFEAT) at the Nevada National Security Site (NNSS). Being able to affix transient latent evidence in the field prior to transporting it to a safer environment yields a better development success rate. As an added bonus, in the event that the equipment utilized cannot be effectively decontaminated after use and must be disposed of, the basic framing materials are relatively inexpensive and readily available at most hardware stores. The Type-55 ASFR material can also be purchased in large rolls for custom tenting. This new adaptation of a tried and true method is a testimonial that while the problem at hand may be complex, finding an effective solution may be much easier than initially perceived—if you just think outside the box. •

UPCOMING TRAININGS AND MEETINGS*

- ITWG Webinar on After-Action Review of CMX-6 hosted by the ITWG Exercise Task Group, Virtual, 12 January 2021
- ITWG Webinar on Galaxy Serpent Version 4 for Participating Teams hosted by the ITWG Nuclear Forensics Library Task Group, Virtual, Week of 8 February 2021 (TBC)
- ITWG Webinar on Gamma Spectrometry Applied to CMXs hosted by the ITWG Exercise Task Group, Virtual, 9 March 2021
- IAEA Regional Training Course on the Basic Introduction to Nuclear Forensics, Mexico City, Mexico, 10–13 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
- IAEA Regional Training Course on Nuclear Forensics for Association of Southeast Asian Nations (ASEAN) Members, Daejeon, Republic of Korea (South Korea), 18–22 October 2021
- ITWG-25 Annual Meeting, San Francisco, CA, USA, 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, UK, 13–14 October 2021
- Additional virtual events hosted by the ITWG Nuclear Forensics Laboratories (INFL) to be confirmed and scheduled in 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 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.

CONTENTS

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/

The 'ITWG Nuclear Forensics Update' is produced by the Stockholm International Peace Research Institute (SIPRI) on behalf of the Nuclear Forensics International Technical Working Group and with the financial support provided by the United States Department of Energy, National Nuclear Security Administration. The content and the views expressed here belong to the authors.