

TECHNICAL SESSION V
NUCLEAR FORENSICS RESEARCH AND DEVELOPMENT: NATIONAL RESEARCH
AND DEVELOPMENT EFFORTS

APPLYING OAK RIDGE NATIONAL LABORATORY NUCLEAR FORENSICS SCIENCE R&D TO ADDRESS THE NUCLEAR SECURITY THREAT

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1. INTRODUCTION

Oak Ridge National Laboratory (ORNL) continues to make broad contributions to pre- and post-detonation nuclear forensic science by building on the organization's rich history in nuclear operations and research and utilizing the laboratory's extensive basic science and research and development (R&D) capabilities. ORNL continues to establish new capabilities to support nuclear forensic science growth and has developed new scientific programs to address the nuclear security threat. ORNL's core capabilities include leveraging neutron science for nuclear forensics research, specialized material handling facilities for highly radioactive to trace materials, and a comprehensive suite of radiochemical counting instruments and state-of-the-art elemental mass spectrometry.

2. ORNL NUCLEAR FORENSICS R&D

ORNL nuclear forensics focus areas include traditional environmental sampling, reference materials characterization, and samplers, sensors and test beds for unmanned aerial vehicles.

In terms of environmental sampling, turnaround time for processing and analyzing IAEA swipe samples requiring high resolution mass spectrometry has been significantly reduced through the development of automated chromatography capable of separating low level uranium (U) and plutonium (Pu) at trace levels [1-3]. Using this technique, samples are processed in an unattended manner allowing for 24-hour operations and provision of clean-room level blank values for U and Pu without cleanroom infrastructure. The system would potentially be very useful in a hypothetical surge situation for the IAEA Network of Analytical Laboratories. Additionally, the system may be modified to collect americium or thorium from samples which would be necessary for age dating Pu or U materials, respectively.

ORNL also screens IAEA swipes for radionuclides using of neutron activation analysis (NAA) at the High Flux Isotope Reactor (HFIR). This technique is currently under evaluation for trace element quantification in uranium ore concentrate (UOC).

Other forensics focus areas include the characterization of reference materials for nuclear forensic purposes [4], and automated separations and detection of trace elements using high-pressure ion chromatography (HPIC) coupled to mass spectrometric analysis in fuel cycle and post-detonation materials [5-6].

Through the development of a patented "Global Communication and Control" system [7] and deployment approach developed in-house, determination of plume trajectory in near-real time for fielded systems has significantly enhanced the ability to transect plumes with mobile platforms, e.g., unmanned aerial systems (UAS), equipped with sensors and collectors. This technology has been field verified in multiple staged surrogate material release studies across the chemical, biological, radiological, nuclear and explosive weapons (CBRNE) regime. Additionally, this technology allows for rapid repositioning of sampling systems to improve the probability of plume transect.

Multiple modular sensor/sampler suites have been developed for both ground and UAS platforms. Each module is tailored for the material of interest and the operational scenario targeted. For some materials, a sensor provides a

queue for samplers such that they are powered on during periods when the plume is projected to intersect the system. This method significantly reduces collection of background species that lower signal to noise unnecessarily.

3. ORNL FACILITIES

In addition to development of sampling methods to enhance the probability of detecting key materials, ORNL has leveraged multiple nuclear processing facilities to test leading edge signal collection and data analytics technologies. One such facility is the Radiochemical Engineering Development Center (REDC) that currently has a mission to produce and separate plutonium-238 for NASA. Such facilities allow for testing of newly developed collector/detector systems against an operating nuclear facility. ORNL also has a robust UAS program that has several established test beds including a unique netted enclosure for testing new platforms and sensor packages.

ORNL has also made key advancements and investments in training on-the-ground personnel in forensics methods and investing in world-class facilities such as the Ultra-Trace Forensics Science Center (UFSC). The UFSC provides basic research expertise and support to various high-impact national security and basic science missions that rely on ultra-trace analysis and high-precision measurements.

4. CONCLUSION

ORNL has significant experience in engaging international entities on matters associated with enhancing indigenous nuclear forensics capabilities. ORNL is leveraging these experiences and technical nuclear forensics capabilities to identify novel ways to respond to incidents involving nuclear and other radioactive materials out of regulatory control. This presentation will highlight ORNL's current nuclear forensic science research and development, and future opportunities to link these nuclear forensics approaches with investigative requirements and successful prosecution of nuclear security events.

REFERENCES

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FULL CONFERENCE PROGRAMME

Monday, 1 April 2019

08:30 – 10:00	Registration
10:00 – 10:30	Opening Presentation: Goals and Objectives of the IAEA Technical Meeting on Nuclear Forensics: Beyond the Science Mr David Kenneth Smith (IAEA)
10:30 – 11:00	Opening Session: IAEA Division of Nuclear Security Director Mr Raja Raja Adnan (IAEA) Welcome by Chairpersons of the Technical Meeting Ms Maria Wallenius (European Commission) Mr Frank Wong (United States of America)
11:00 – 12:00	Progress and Potential: Nuclear Forensics in the Context of Nuclear Security Invited Panel Session Ms Kathleen Heppell-Masys (Canada) Mr Klaus Lützenkirchen (European Commission) Ms Maria Klimova (Russian Federation) Mr Grant Ford (United States of America) moderated by Mr David Kenneth Smith (IAEA)
12:00 – 13:30	Lunch
13:30 – 14:30	International Perspectives on Nuclear Forensics Invited Panel Session Mr John Buchanan (INTERPOL) Mr Ali El-Jaby (GICNT) Mr Klaus Mayer (ITWG) Ms Tegan Bull (INFCIRC/917) Mr Jerry Davydov (IAEA) moderated by Mr Richard Pappas (United States of America)
14:30 – 15:30	Nuclear Forensics Practices and Experiences: National and International Perspective I Technical Session Chair: Mr Ali El-Jaby (Canada) Ms Maria Wallenius (European Commission) Mr John Simm United Kingdom Mr Jon Schwantes (United States of America) Mr Pavel Lobanov (Kazakhstan)
15:30 – 16:00	Coffee/Tea Break
16:00 – 17:00	Nuclear Forensics Practices and Experiences: Case Studies Technical Session Chair: Mr Vitaly Fedchenko (Sweden) Ms Emily Alice Kroeger (Germany) Ms Andreea Elena Serban (Romania) Mr Eyal Elish (Israel) Mr Edouard Nzambimana (Burundi)

Tuesday, 2 April 2019

09:00 – 11:00	Radiological Crime Scene and Nuclear Forensics Scenario Radiological Crime Scene Video with Commentary Mr Peter Burton (IAEA) Mr Frank Wong (United States of America) Interactive Panel [With Audience Intervention] Mr John Simm (United Kingdom) Ms Ruth Kips (United States of America) Ms Tegan Bull (Australia) Mr John Buchanan (INTERPOL)
10:30 – 11:00	Coffee/Tea Break
11:00 – 11:30	Nuclear Forensics Special Topics: Nuclear Forensics and Criminal Prosecution Invited Presentation Chair: Ms Maria Wallenius (European Commission) Mr Andrei Apostol (Romania)
11:30 – 12:00	Nuclear Forensics and Criminal Prosecution Invited Panel Session Ms Elena Dinu (Romania) Mr Nikolay Kovalenko (Russian Federation) Mr John Simm (United Kingdom) Ms Maria Lorenzo Sobrado (UNODC) moderated by Mr Andrei Apostol (Romania)
12:00 – 13:30	Lunch
13:30 – 14:30	Nuclear Forensics Initiation and Sustainability: National Considerations I Technical Session Chair: Ms Ruth Kips (United States of America) Ms Éva Kovacs-Széles (Hungary) Mr Hudson Angeyo Kalambuka (Kenya) Mr Pavel Lobanov (Kazakhstan) Mr Vladimir Stebelkov (Russian Federation)
14:30 – 15:00	Nuclear Forensics Special Topics: Nuclear Forensics International Technical Working Group (ITWG) Invited Presentation Chair: Mr David Kenneth Smith (IAEA) Mr Klaus Mayer (European Commission)
15:00 – 15:30	Nuclear Forensics Human Resource Development: Residential Assignment Technical Session Chair: Ms Kerri Treinen (United States of America) Mr Ivaylo Ivanov (Bulgaria) Ms Marta Bavio (Argentina) Ms Areerak Rueanngoen (Thailand)
15:30 – 16:00	Coffee/Tea Break
16:00 – 16:45	Nuclear Forensics Human Resource Development: Residential Assignment Invited Panel Discussion <i>Career Perspectives</i> Ms Éva Kovacs-Széles (Hungary) Ms Maria Larisa Ganea (Romania)

	<i>Joint Research Centre - Karlsruhe</i> Mr Klaus Mayer (European Commission) Mr Andrei Apostol (Romania) <i>Lawrence Livermore National Laboratory</i> Ms Kerri Treinen (United States of America) Ms Marta Bivio (Argentina) moderated by Mr Jerry Davydov (IAEA)
16:45 – 17:00	Nuclear Forensics Special Topics: Perspectives from Russian Federation I Invited Presentation Chair: Mr David Kenneth Smith (IAEA) Vladimir Maltsev (Russian Federation)
17:30 – 19:00	IAEA Hosted Reception for Technical Meeting

Wednesday, 3 April 2019

09:00 – 09:30	Nuclear Forensics Research and Development: Current Status and Future Needs Invited Keynote Chair: Mr Frank Wong (United States of America) Mr Klaus Mayer (European Commission)
09:30 – 10:15	Nuclear Forensics Research and Development: National Research and Development Efforts Technical Session Chair: Mr Klaus Mayer (European Commission) Ms Tracey-Ann Wellington (United States of America) Mr Yoshiki Kimura (Japan) Mr Kirill Zhizhin (Russian Federation)
10:15 – 10:30	Nuclear Forensics Special Topics: NUFOR 2019 Invited Presentation Chair: Mr Klaus Mayer (European Commission) Mr Roy Awbery (United Kingdom)
10:30 – 11:00	Coffee/Tea Break
11:00 – 11:30	Nuclear Forensics Special Topics: Perspectives from the United States of America Invited Presentation Chair: Mr Stephen Lamont (United States of America) Mr Tom Black (United States of America)
11:30 – 12:00	Nuclear Forensics Research and Development: Destructive Analysis Technical Session Chair: Ms Éva Kovacs-Széles (Hungary) Ms Joanna Denton (United States of America) Mr Zsolt Varga (European Commission) Mr Eric Pili (France)
12:00 – 13:30	Lunch
13:30 – 14:30	Nuclear Forensics Workforce Development and Sustainability Invited Panel Discussion

	<i>Hiring Managers</i> Ms Tegan Bull (Australia) Ms Ruth Kips (USA) <i>National Strategies</i> Mr Ali El-Jaby (Canada) Mr Roy Awbery (United Kingdom) <i>Career Perspectives</i> Ms Alison Goodsell (USA) Ms Andreea Elena Serban (Romania) moderated by Mr Christopher Hobbs (United Kingdom)
14:30 – 15:30	Nuclear Forensics Initiation and Sustainability: National Considerations II Technical Session Chair: Mr Vladimir Steblekov (Russian Federation) Ms Alina Nitrean (Moldova) Ms Mar Mar Oo (Myanmar) Mr Ramin Pashayev (Azerbaijan) Mr Hirofumi Tomikawa (Japan)
15:30 – 16:00	Coffee/Tea Break
16:00 – 17:00	Nuclear Forensics Poster Session (VIC M01 Exhibition Area) Co-Chairpersons: Ms Maria Wallenius (European Commission) Mr Frank Wong (United States of America) Ms Amélie Hubert (France) Mr Junghwan Park (Republic of Korea) Ms Harinate Mungpayaban (Thailand) Ms Marta Fernández (Spain) Ms Cynthia Cáceres Rivero (Peru) Mr Slobodan Jovanovic (Montenegro) Ms Diah Dwianna Lestiani (Indonesia) Ms Areerak Rueanngoen (Thailand) Mr Stephen Lamont (United States of America) Mr Jan John (Czech Republic)

Thursday, 4 April 2019

09:00 – 09:30	Nuclear Forensics Special Topics: Perspectives from the Russian Federation II Invited Presentation Chair: Mr Jerry Davydov (IAEA) Ms Maria Klimova (Russian Federation)
09:30 – 10:15	Nuclear Forensics Human Resource Development: Training Technical Session Chair: Mr Roy Awbery (United Kingdom) Mr Stephen Lamont (United States of America) Mr Jon Schwantes (United States of America) Ms Liz Dallas (United States of America) Mr Klaus Mayer (European Commission)
10:15 – 10:30	Nuclear Forensics Special Topics: Perspectives from Tajikistan Invited Presentation Chair: Mr Roy Awbery (United Kingdom)

	Mr Ilkhom Mirsaidov (Tajikistan)
10:30 – 11:00	Coffee/Tea Break
11:00 – 12:00	Nuclear Forensics Research and Development: Non-Destructive Analysis Technical Session Chair: Ms Jovana Nikolov (Serbia) Mr Hasan Dikmen (Turkey) Ms Maria Larisa Ganea (Romania) Mr Agus Sumaryanto (Indonesia) Ms Raluca Marginean (Romania)
12:00 – 13:30	Lunch
13:30 – 15:00	Nuclear Forensics Research and Development: National Nuclear Forensics Library Technical Session Chair: Mr Stephen Lamont (United States of America) Ms Ruth Kips (United States of America) Mr. Derek McLain (United States of America) Mr David Podlesak (United States of America) Mr Vadim Gladyshev (Russian Federation) Mr Jerry Davydov (IAEA) Mr James Borgardt (United States of America)
15:00 – 15:30	Nuclear Forensics Special Topics: Perspectives from Sweden Invited Presentation Chair: Mr David Kenneth Smith (IAEA) Mr Lars van Dassen (Sweden)
15:30 – 15:45	Coffee/Tea Break
15:45 – 16:30	Nuclear Forensics 2025: A Strategic Vision Invited Panel Discussion Mr Tomás Bieda (Argentina) Mr Bruce Warner (United States of America) Mr Roger Howsley (World Institute for Nuclear Security) moderated by Mr David Kenneth Smith (IAEA)
16:30 – 17:00	Closing Session: IAEA Division of Nuclear Security, Nuclear Security of Materials outside of Regulatory Control Section Head Mr Daming Liu (IAEA) Closing Remarks by Chairpersons of the Technical Meeting Mr Frank Wong (United States of America) Ms Maria Wallenius (European Commission)