

Activities of the IAEA in Nuclear Forensics

IAEA Practical Introduction Training
Course for Nuclear Forensics

14-18 November 2022

Australia Nuclear Science and
Technology Organisation



IAEA Assists Member States in Nuclear Forensics



Source: IAEA/ Dean Calma

Human resource development

- Introductory and advanced trainings in nuclear forensics and radiological crime scene management
- Seminars and Webinars
- Participation in the Nuclear Security Fellowship Programme (formerly, the Residential Assignment programme)

Other mechanisms

- Publications
- Technical visits and advisory services (INSServ)
- Coordinated Research Projects



Source: IAEA/ Dean Calma

Basic Introduction to Nuclear Forensics



- A comprehensive overview of key nuclear forensics topics, primarily intended for a non-technical audience
- Assists Member States in determining next steps they can take in the development of nuclear forensics

Practical Introduction to Nuclear Forensics (this course!)

- A hands-on one week training course in nuclear forensics, intended for personnel who would perform the examination
- Involves work in the laboratory, using analytical instrumentation
- This course is offered every 1 to 2 years, and is hosted by **Australia** and **Hungary**



Source: IAEA/ Dean Calma



Source: IAEA/ Dean Calma

Nuclear Forensics Methodologies Training Course



- A hands-on two week training course in nuclear forensics, intended for personnel who would perform the examination using advanced instrumentation
- Offered approximately every 2 years, making full use of a range of laboratory instrumentation
- Hosted by the **USA** (Pacific Northwest Nat'l Lab) and the **European Commission** (JRC-Karlsruhe)

Courses in Radiological Crime Scene Management



Source: IAEA/ Dean Calma

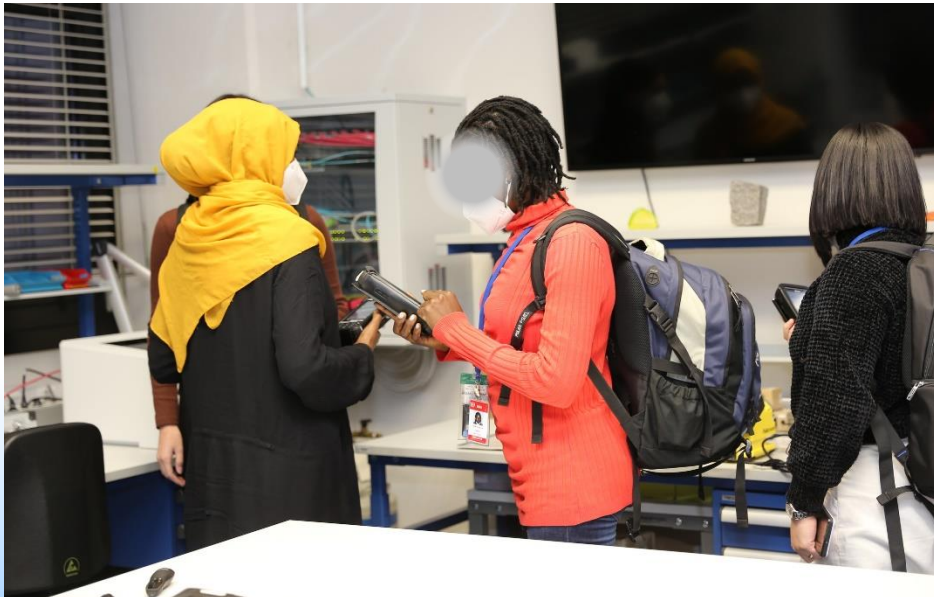
- The IAEA offers a course in the foundations on radiological crime scene management (RCSM) and an instructor course in this topic
- This course take a hands-on approach to ensuring the transfer of key knowledge to Member State personnel who would act in a response role
- Expert missions and RCSM starter pack with RCSM equipment are available from the IAEA

The Nuclear Security Fellowship Programme in Nuclear Forensics

IAEA designs a Nuclear Security Fellowship in partnership, utilizing Host Organization capabilities

Each Fellowship is unique, and may focus on one or more analytical techniques or approaches used in nuclear forensics

All Fellowships are led by experts in Host Member States with considerable experience in nuclear forensic analysis



Applying for Nuclear Security Fellowships

Applicants will be considered on the basis of their technical skills and experiences; role in nuclear security; relevance for the particular Fellowship; and other factors

IAEA selects the successful candidate from the pool of applicants

Nuclear Security Fellowships May Focus On:

Characterization of nuclear or radioactive material

- Using multiple nuclear forensics techniques to characterize nuclear or radioactive materials that may be encountered out of regulatory control in the Member State

Team exercise in the conduct of nuclear forensics

- Multi-week exercise in the conduct of a nuclear forensic examination, where participants collaborate to execute a nuclear forensic analytical plan

In-depth research in nuclear forensics

- Completion of a research project in nuclear forensics, focusing on advancement of new approaches, methods, or techniques, culminating in the preparation of a manuscript



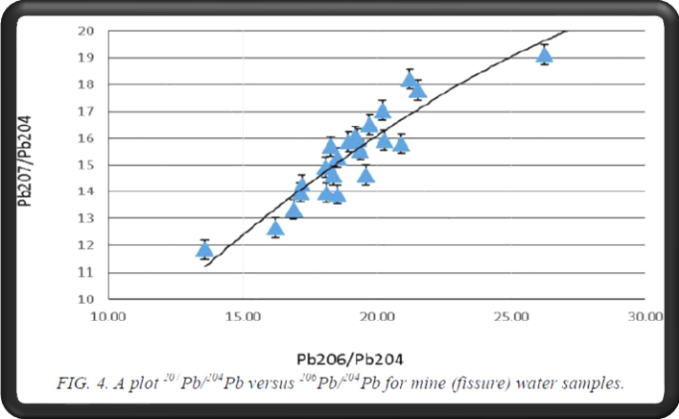
Coordinated Research Projects in Nuclear Forensics

- The IAEA has established three Coordinated Research Projects in nuclear forensics so far
- The third CRP (J02013) is set to conclude in Summer 2023



Source: IAEA / Dean Calma

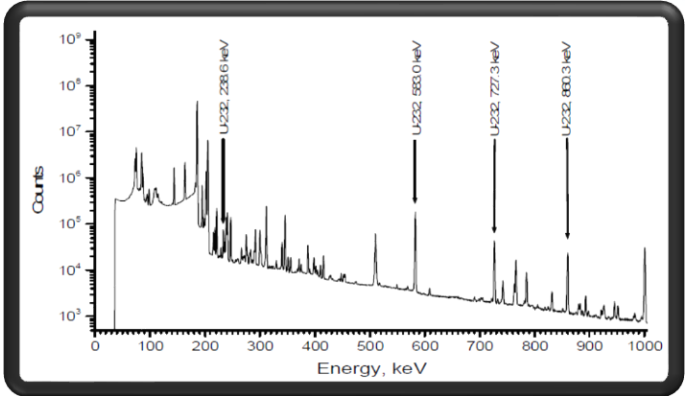
Types of CRP Projects in Nuclear Forensics



From Mathuthu *et al.*, 2017



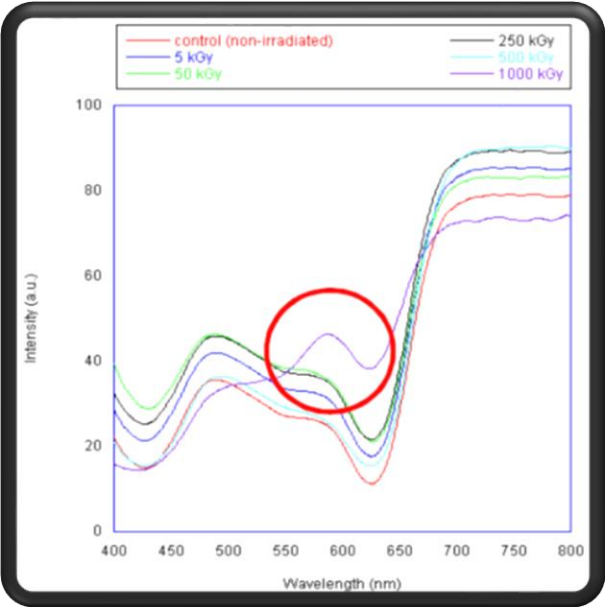
From Doerfel, 2014



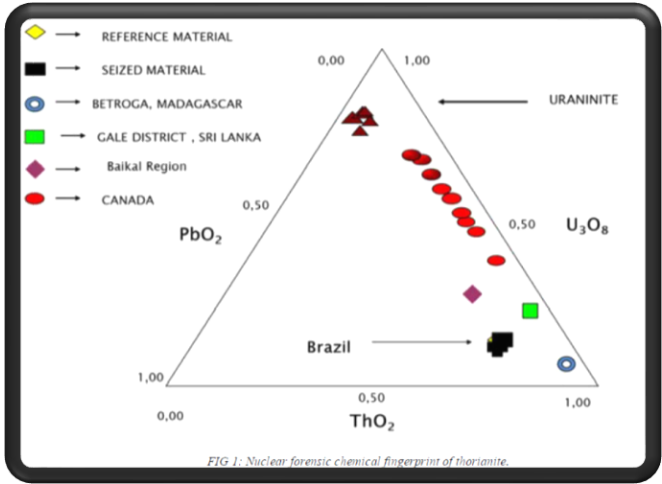
From Lakosi *et al.*, 2014

TABLE 5. TRACE ELEMENT CONCENTRATION				
Mine location	Eko Remaja	Sungai Marta	Tor Siandulimat, Sumatra Utara	Boteng, Mamuju
Trace element concentration in µg/g (ppm)	Ce: 2318.51±11.49 Eu: 9.79±0.61 Hf: 38.16±4.85 La: 1138.65±3.62 Sc: 7.60±0.68 Sm: 222.93±2.14 Th: 30.42±6.51 U: 158.52±3.24	As: 1068.66±7.69 Ba: 7105.24±215.91 Ce: 4894.06±109.05 Co: 105.94±7.04 La: 872.13±1.80 Sb: 45.79±2.22 Sc: 15.22±0.30 U: 1.90±0.05	As: 804.21±3.62 Ce: 140.10±27.04 Cs: 46.09±2.77 Eu: 3.57±0.35 Hf: 17.09±1.85 La: 123.93±1.20 Sb: 21.13±1.11 Sc: 8.47±0.50 Th: 92.70±3.22 U: 1482.65±5.17	As: 1015.56±3.99 Ce: 632.82±17.63 Cs: 66.74±1.69 Eu: 3.59±0.36 Hf: 22.17±1.53 La: 162.74±1.17 Sb: 11.18±0.68 Sc: 9.44±0.27 Th: 109.18±1.86 U: 1843.39±4.37

From Briyatmoko, 2017



From Evans and Colella, 2014



From de Souza Sarkis *et al.*, 2014

New CRP in Nuclear Forensics – J02020

(Now open for proposals!)

1. Move laboratory to radiological crime scene: fast in-field analysis of nuclear or other radioactive materials and radionuclide-contaminated material.
2. Improve data transfer and communication systems to nuclear forensics laboratory.
3. Develop requirements for robots at a radiological crime scene.
4. Maximize quality of data collected using in-field instrumentation for categorization and initial characterization:
 - gamma spectrometry
 - X-ray fluorescence
 - other field-deployable techniques



Source: IAEA/ Dean Calma

New CRP in Nuclear Forensics – J02020

(Now open for proposals!)

5. Improve the quality of physical data (macro- and micro-scale analytical techniques) for powder, particulate, and microparticle samples of nuclear or other radioactive material.



6. Develop approaches to measure heterogeneously-distributed nuclear forensic signatures in nuclear or other radioactive material.
7. Improve physical, elemental, chemical, and isotopic measurements of non-nuclear evidence like packaging, shielding material, paper and associated documents.
8. Develop new nuclear forensics signatures.

Source: IAEA/ Dean Calma

New CRP in Nuclear Forensics – J02020

(Now open for proposals!)

- 9. Measure key nuclear forensics signatures using sustainable, cost-effective instrumentation.
- 10. Develop approaches to measure sealed radioactive sources and other radioactive materials used in industry and medicine.
- 11. Improved statistical and data analysis tools for mathematical inclusion/exclusion when comparing signature data to data compiled in a national nuclear forensic laboratory.
- 12. Development and application of advanced nuclear technologies to nuclear forensics.



Source: IAEA / Dean Calma

Guidance Documents and Other Publications

IAEA Nuclear Security Series No. 2-G (Rev.1)

Implementing Guide

**Nuclear Forensics in
Support of Investigations**

This document contains official IAEA guidance on the development and use of a nuclear forensic capability in support of investigations

Other Documents are on the IAEA Website



IAEA-TECDOC-1896

Nuclear Forensics: Beyond the Science

Summary of a Technical Meeting

Development of a National Nuclear Forensics Library: A System for the Identification of Nuclear or Other Radioactive Material out of Regulatory Control

TECDOC No. 1730

Application of Nuclear Forensics in Combating Illicit Trafficking of Nuclear and Other Radioactive Material

Coming in 2023! A new TECDOC on Nuclear Forensics

IMPLEMENTING A NUCLEAR FORENSIC CAPABILITY: APPLICATION OF ANALYTICAL TECHNIQUES

- Will go into more technical detail than IAEA NSS No. 2-G (Rev.1)
- Will cover all the key analytical techniques used by nuclear forensics laboratories around the world

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You Are Not Alone on Your Nuclear Forensics Journey

- There are several international organizations that are actively engaged in assisting Member States in the development of nuclear forensics
- In addition, many Member States that have developed an advanced nuclear forensics capability are more than happy to share their knowledge



Source: IAEA / Dean Calma



IAEA

International Atomic Energy Agency

Atoms for Peace and Development

Thank you!

