



60 Years

IAEA

Atoms for Peace and Development

Current Status of IAEA Nuclear Forensics Coordinated Research Projects and Future Needs for R&D

Jerry Davydov

**Associate Nuclear Security Officer (Forensics)
IAEA Division of Nuclear Security**

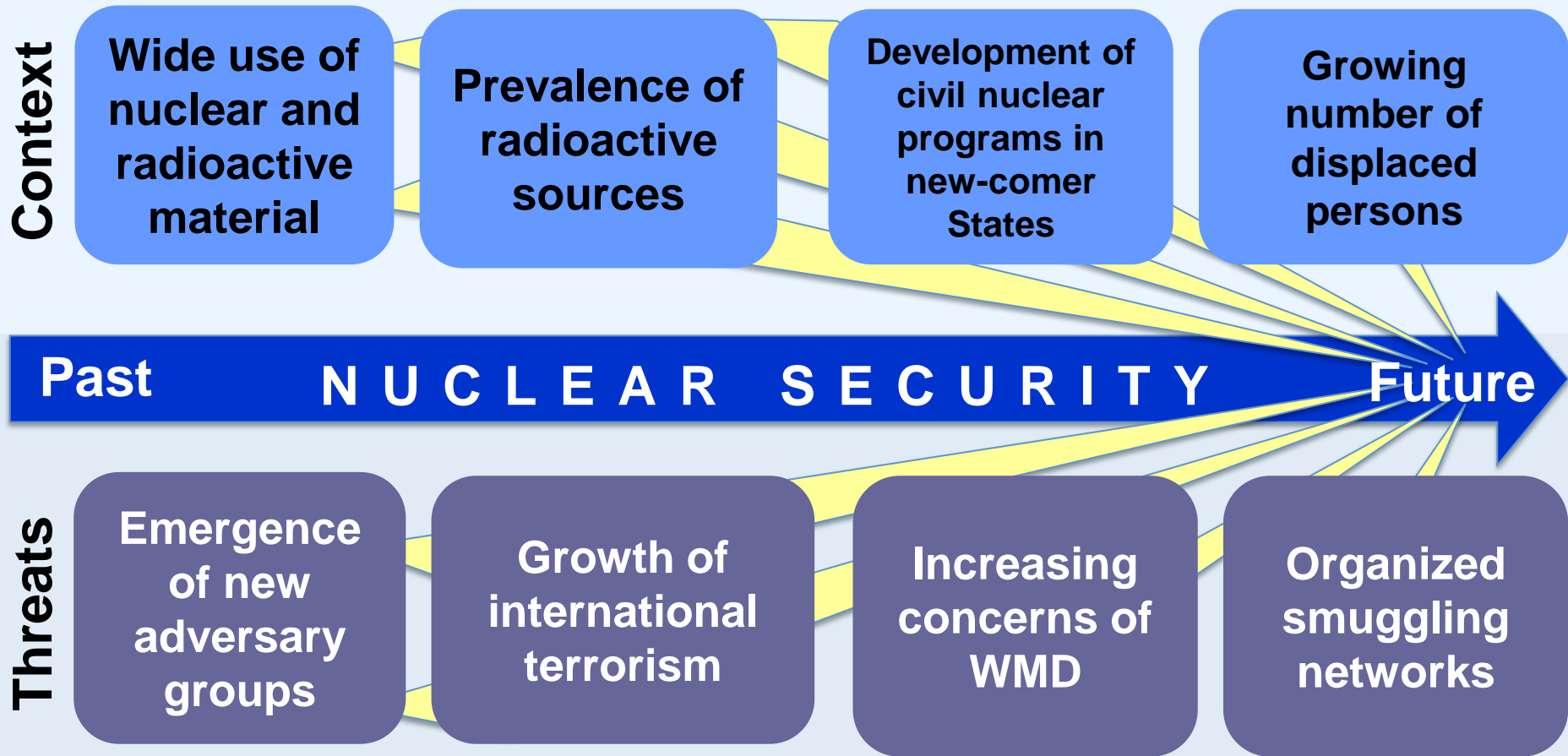
prepared for

**International Symposium on Technology Development for Nuclear
Forensics**

Tokyo, Japan

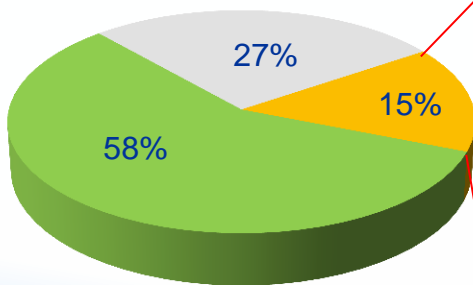
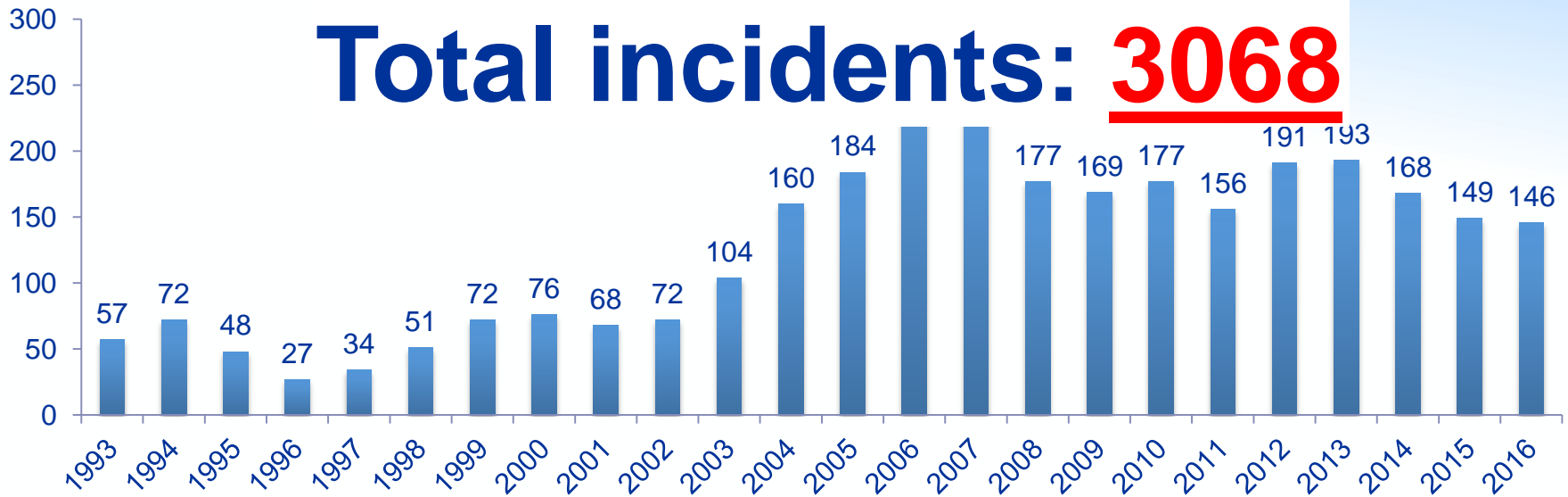
05 June 2017

The Real Threat of Material Out of Regulatory Control



By the Numbers: ITDB 1993-2016

Total incidents: 3068



■ Nuclear ■ Radioactive
■ Other/RCM

Confirmed Group 1:

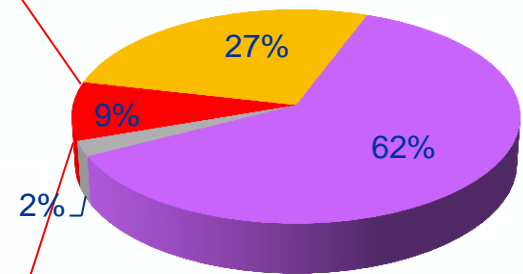
- highly enriched uranium (12), plutonium (2), and plutonium beryllium neutron sources (4)

Confirmed Group 2:

- high enriched uranium (3), plutonium (1) and plutonium neutron sources (4)

Confirmed Group 3:

- high enriched uranium (16), plutonium (1), and plutonium neutron sources (8)



■ Group I
■ Group II
■ Group III
■ Unable to determine

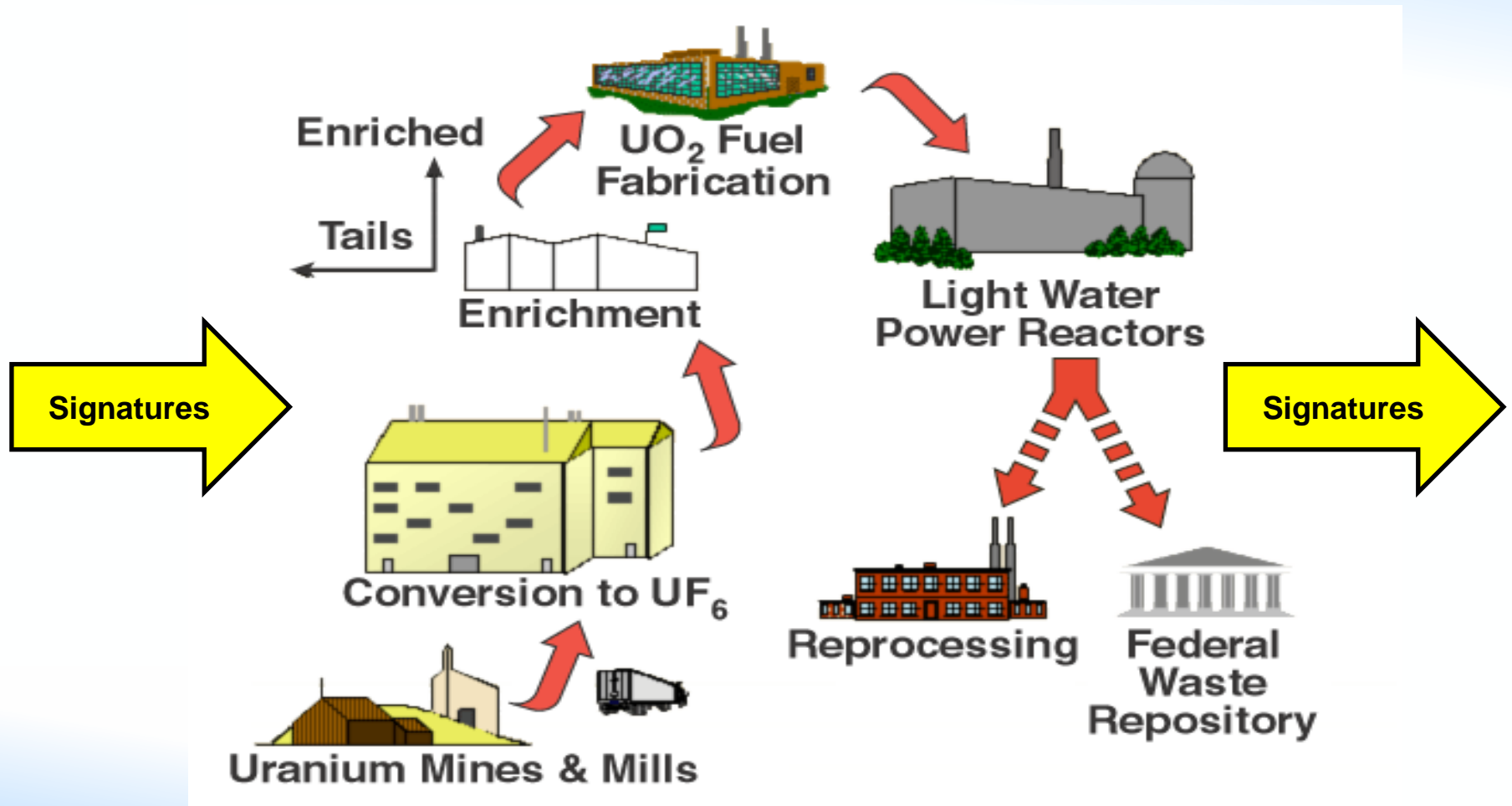
What is Nuclear Forensics?

Nuclear forensics is the examination of nuclear or other radioactive materials, or of evidence contaminated with radionuclides, in the context of legal proceedings under international or national law related to nuclear security

✓ **The goal of forensic science is to discover linkages among people, places, things and events**



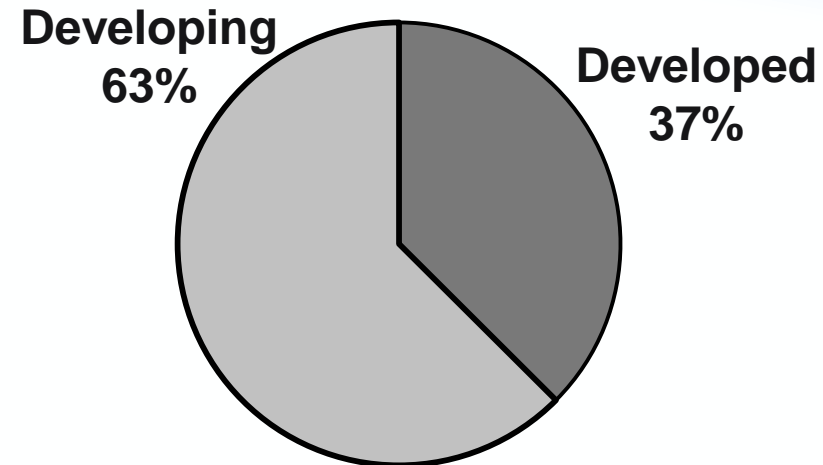
Signatures of the Nuclear Fuel Cycle and their Bearing on Origin and History



Overview of IAEA Coordinated Research Projects (CRP)

- IAEA CRPs offer a mechanism for collaborative research and confidence building between Member States
- CRPs are developed in relation to a well defined research topic involving invited scientific participants
- Research contracts and agreements are placed with universities, research centres, laboratories and other institutions
- The CRP is planned normally over 3 years.
- Each member provides a progress report and a presentation at the Research Coordination Meeting

CRP funds awarded to developed and developing States



Each CRP is a network of 5 – 15 national research institutions working in an operational framework with the similar goal of nuclear technology:

<http://cra.iaea.org/>

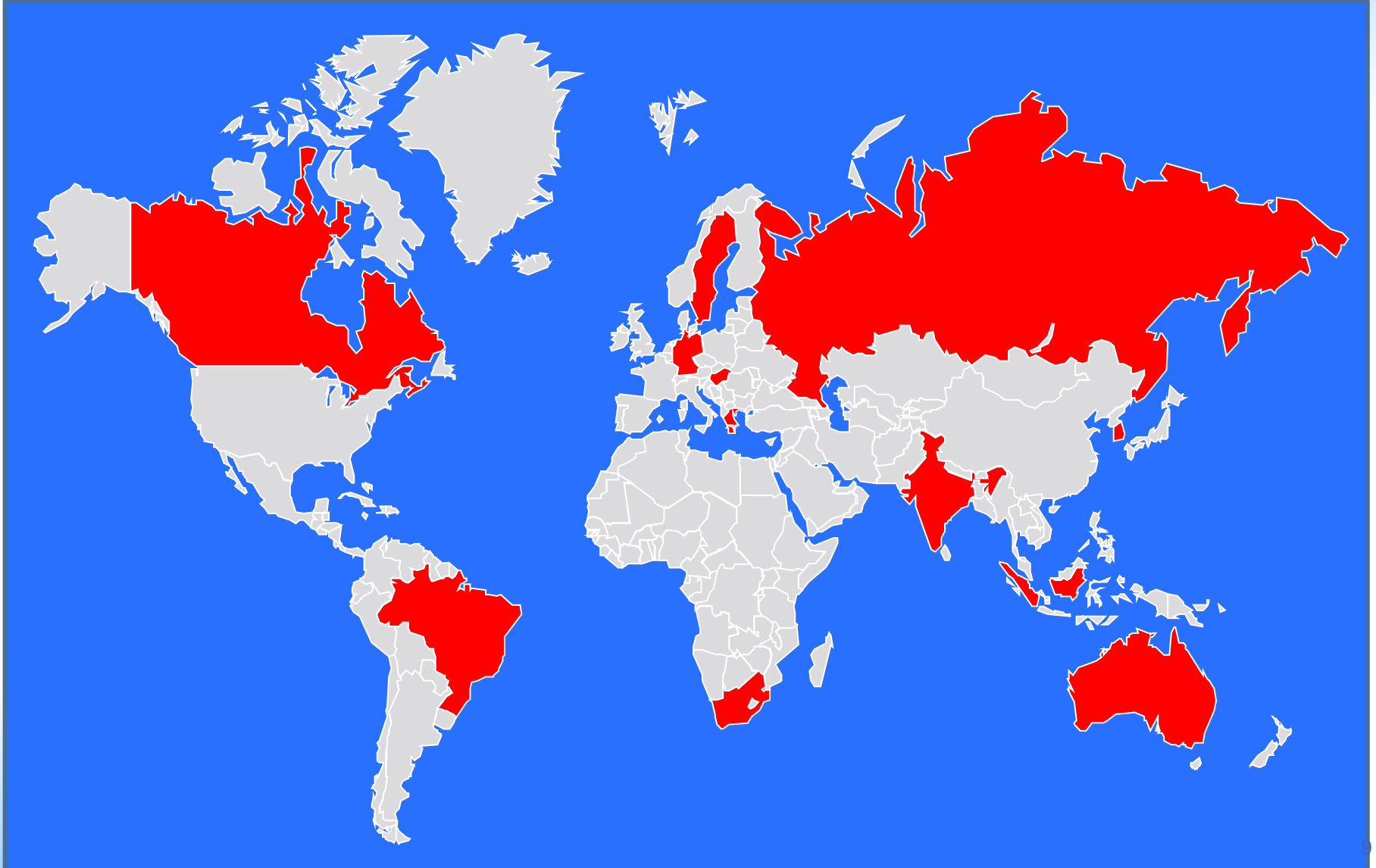
Coordinated Research Builds Confidence in Nuclear Forensics Findings

The goal of the nuclear forensic CRPs is to identify signatures corresponding to stages of the nuclear fuel cycle enabling high confidence interpretation

- To identify novel signatures indicative of nuclear processing important to interpretation
- To answer how nuclear forensic signatures are imparted and how they persist throughout the nuclear fuel cycle
 - Distinguish geologic signatures at front end of the fuel cycle from anthropogenic processing signatures at the back end of the fuel cycle
- To address data requirements needed for nuclear forensics interpretation



Investigators in IAEA Nuclear Forensics Research Contribute Global Innovation and Broad Experience



IAEA Endorsements: Two CRPs have Significantly Contributed to Nuclear Forensics Innovation



Focus on research is a key finding from

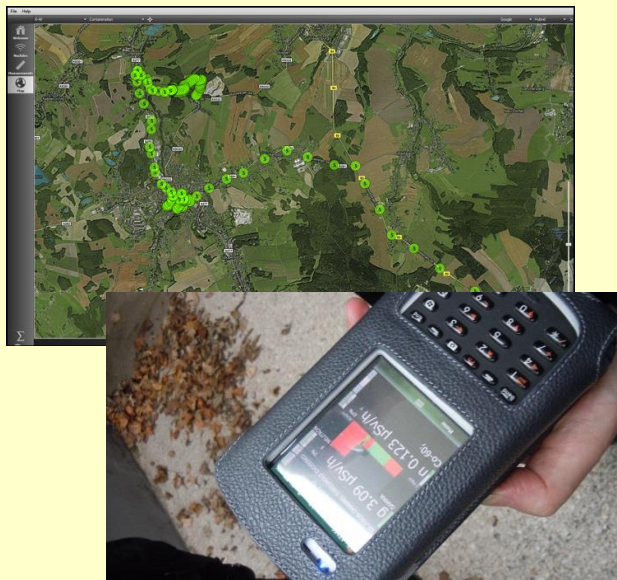
- **2013 and 2016 IAEA International Conferences on Nuclear Security,**
- **2014 IAEA International Conference on Advances in Nuclear Forensics,**
- **IAEA Nuclear Security General Conference Resolutions**

- **“Application of Nuclear Forensics in Illicit Trafficking of Nuclear and other Radioactive Material” J02001 (2008 – 2012): 7 contracts and agreements**
- **“Identification of High Confidence Nuclear Forensics Signatures for the Development of National Nuclear Forensics Libraries” J02003 (2013 – 2016): 10 contracts and agreements**

CRP J02001 “Application of Nuclear Forensics in Illicit Trafficking of Nuclear and other Radioactive Material” (2008 – 2012)

- Methods and procedures for categorization and characterization of seized material
- Preservation and analysis of traditional evidence contaminated by radionuclides
- Field collections and nuclear forensics analysis (variety of techniques)
- Modeling and interpretation of nuclear forensics signatures bearing on origin and history

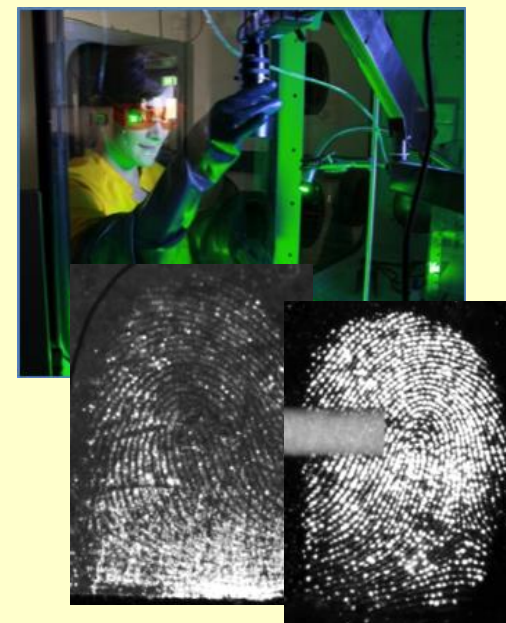
Field categorization



Lab Characterization



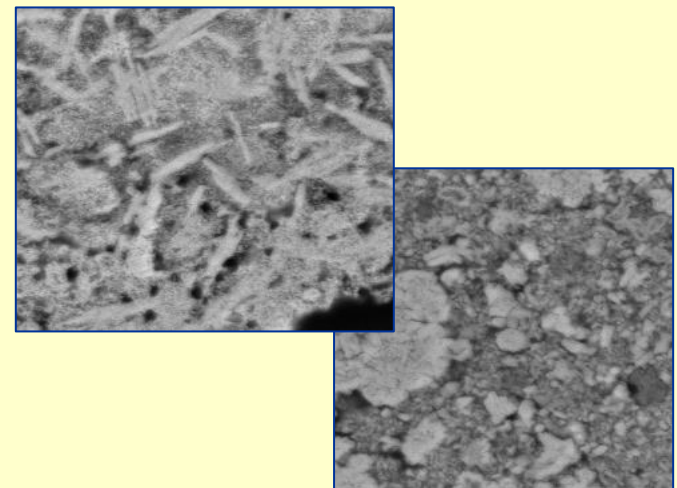
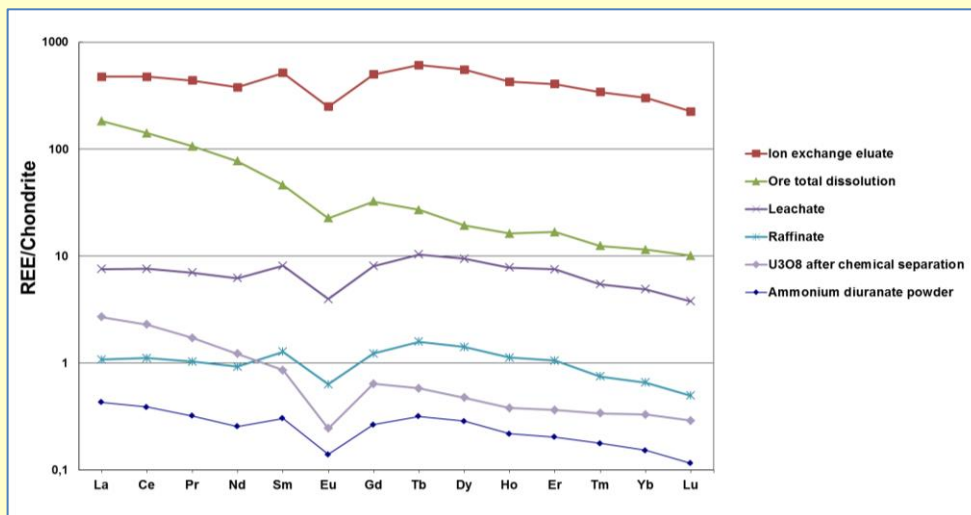
Traditional forensics



CRP J02003 “Identification of High Confidence Nuclear Forensics Signatures for the Development of National Nuclear Forensics Libraries” (2013 – 2016)

- Identify isotopic, chemical and physical signatures corresponding to stages of the nuclear fuel cycle (NFC) as well radioactive sources
- Accurate measurement and prediction of signatures (e.g., geologic and processing)
- Analytical methods and signatures of uranium ores and uranium ore concentrates, intermediate products and spent fuel
- Signatures of promise: REEs, $^{34}\text{S}/^{32}\text{S}$, morphology of UOCs, radiochronometry, isotopic contaminants in sealed sources ($^{192}\text{Ir}/^{60}\text{Co}$, $^{137}\text{Cs}/^{134}\text{Cs}$)

Signatures of Promise - UOCs



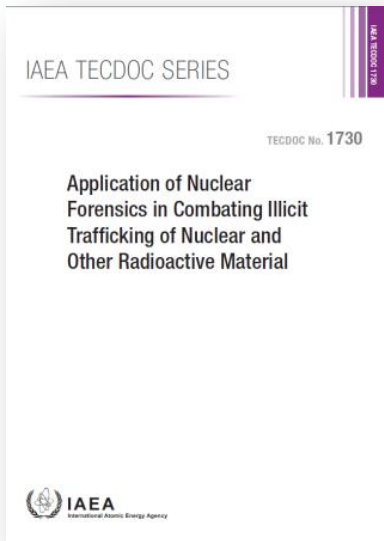
Current Status of Nuclear Forensics Coordinated Research

2008 - 2012

2013 - 2016

2018 - 2021

CRP:



CRP:

- Identification of High Confidence Nuclear Forensics Signatures...

Technical Research Projects:

- Detection and Analysis of Alpha-Emitting Microparticles
- Measurement of the Characteristic Impurities of U_3O_8
- Gamma-Spectrometric Procedure for analysis of Spent Nuclear Fuel

New CRP

Discussion of the Results

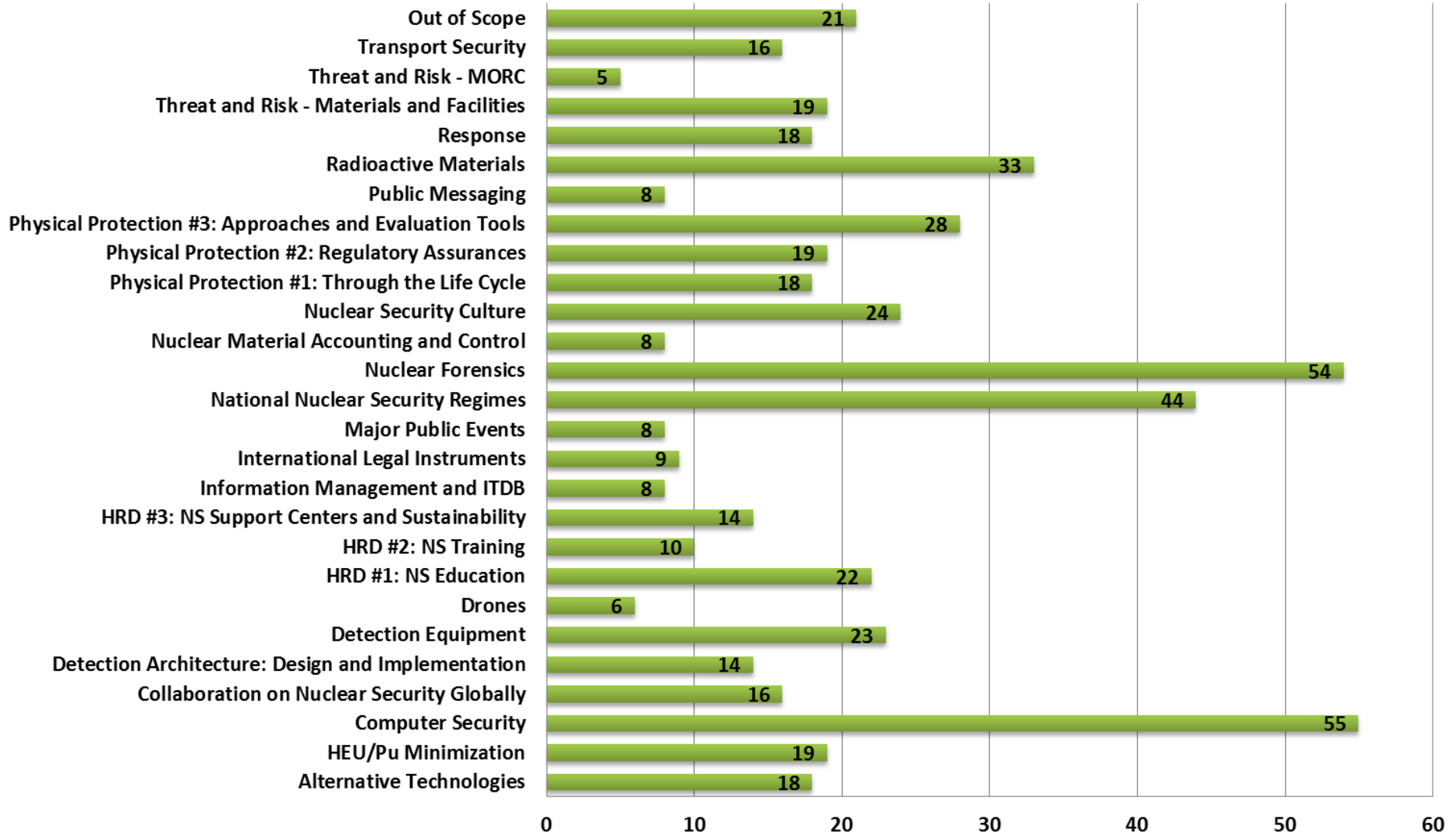
at the Joint meeting of the CRP and Technical Projects Investigators from 25-28 July 2016 (Center for Energy Research in Budapest)

“Nuclear forensics remains a technically complex challenge for the scientific and law enforcement communities. The difficulty in successful forensics work, especially as part of an attribution process, should not be underestimated. However, the potential for nuclear forensics to play a crucial role in analysis of both pre- and post-detonation materials is enormous.”

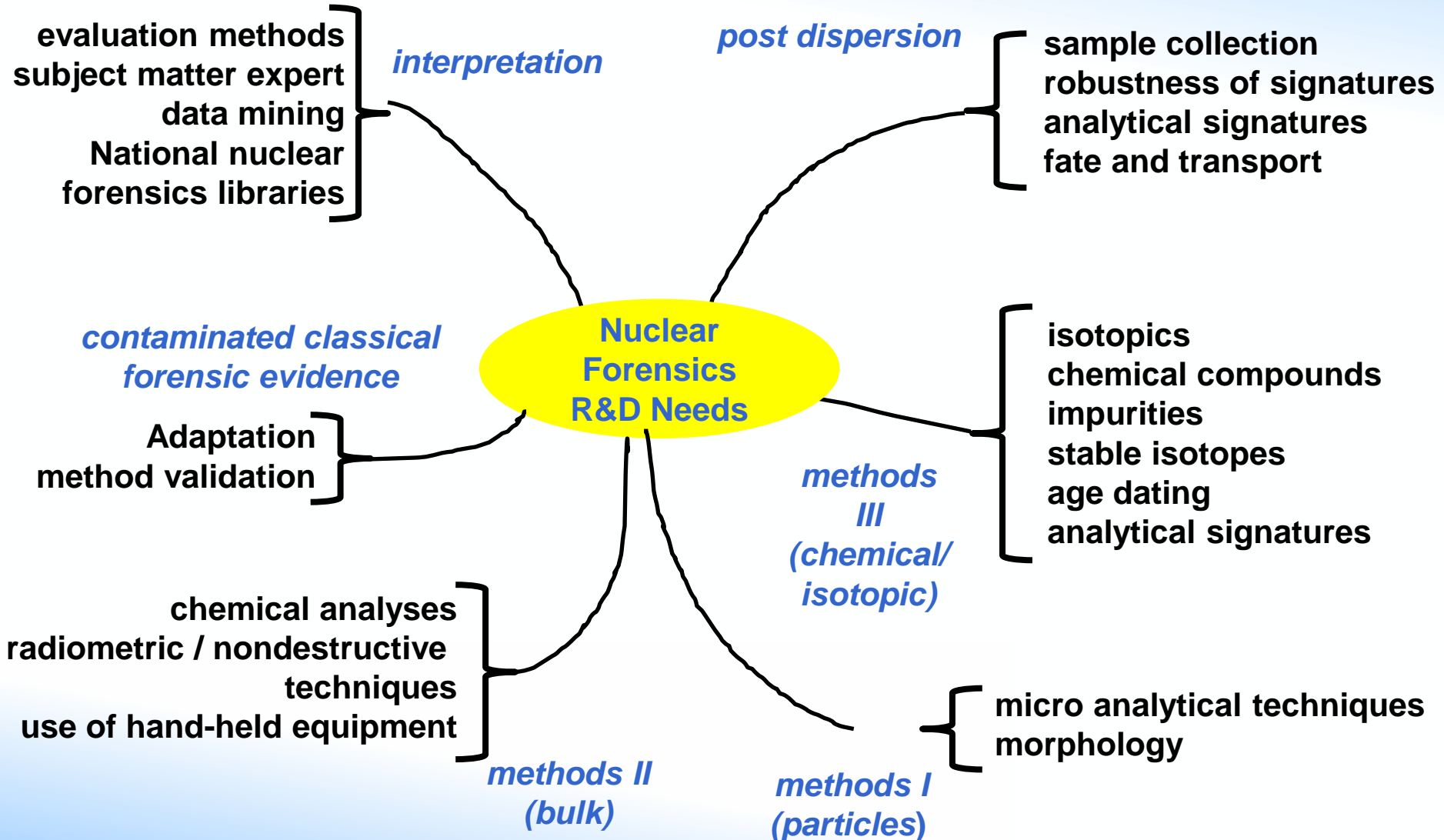
- **Research in nuclear forensics is necessary to increase the robustness of methods of examination to include the identification of signatures bearing on the origin and history of nuclear materials as well as their accurate and precise measurement**
- **Using a range of experience and capabilities, research also promotes confidence in, and validation of, methods and techniques**
- **Research promotes cooperation through peer-review and the technical interaction of experts**

Research Interest in Nuclear Forensics

Distribution of Abstracts by Session



Nuclear Forensics Research Map





60 Years

IAEA

Atoms for Peace and Development

“The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them”

**William Lawrence Bragg, OBE
(Nobel Prize in Physics, 1915)**



In its 60th anniversary year, the IAEA’s need for innovation to meet the needs of peaceful uses of atomic energy as well as stay ‘one step ahead’ of determined adversaries who threaten nuclear security globally has never been greater