Requirements and Challenges for a Nuclear Forensic System

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International Atomic Energy Agency

A focal point: the definition of forensic science…….

- OED: “Of, relating to, or denoting the application of scientific methods and techniques to the investigation of crime”
- OED: “Scientific tests or techniques used in connection with the detection of crime”
- American Academy of Forensic Sciences: “Any science used for the purposes of the law is a forensic science”

The forensic sciences are used around the world to resolve civil disputes, to justly enforce criminal laws and government regulations, and to protect public health

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What is nuclear forensics?

Nuclear forensic science, referred to as nuclear forensics, is a subset of forensic science

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

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Nuclear forensics: a time of transition

Nuclear forensics has emerged as an effective capability for States to criminalize nuclear and other radioactive material out of regulatory control and remedy nuclear security vulnerabilities

In a time of unprecedented change and competing national priorities, a critical challenge is *sustainability*

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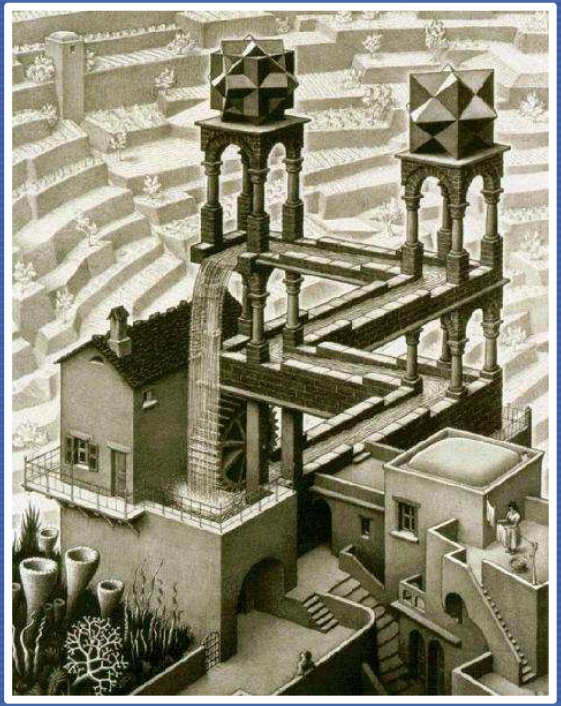
Sustaining nuclear forensics leverages existing capabilities within the State

- Nuclear forensics is not – and should not be - a full time job
- However, nuclear forensics serves as a preventive measure against MORC and requires readiness
- Enabling partner disciplines, training, research, and international cooperation (ITWG, GICNT, IAEA and bilateral) are essential

"National nuclear forensics capabilities, personnel, expertise and equipment require State commitment for effective maintenance, *sustainability* and motivation to ensure a prompt response. If neglected, State nuclear forensics capabilities, can deteriorate rapidly as human resources require on-going education and training" (GICNT, 2013)



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(Some) nuclear forensic requirements

- Evolving threat of nuclear and radioactive materials out of regulatory control
- Political endorsement
- National laws and international legal instruments that criminalize MORC
- A national response plan to include nuclear forensics
- Awareness and understanding of the nuclear forensics model action plan
- Ability to categorize nuclear and other radioactive material
- Identification of indigenous capabilities and subject matter experts for nuclear forensics
- International nuclear forensics assistance
- Exercises to demonstrate confidence in findings

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Outcomes from an international conference

CN-218 Opening

CN-218 Plenary

- IAEA 2014 *International Conference on Advances in Nuclear Forensics*, held 7 – 10 July 2014 (CN-218)
- Outcomes:
  - i) continued development of subject matter experts and experienced practitioners,
  - ii) advancement of new analytical tools and methods,
  - iii) sustainment of technical nuclear forensic capabilities once developed and
  - iv) strategic international engagement
- Outcomes are mutually complementary: experts inform the science; international engagement enhances the nuclear forensics technical base

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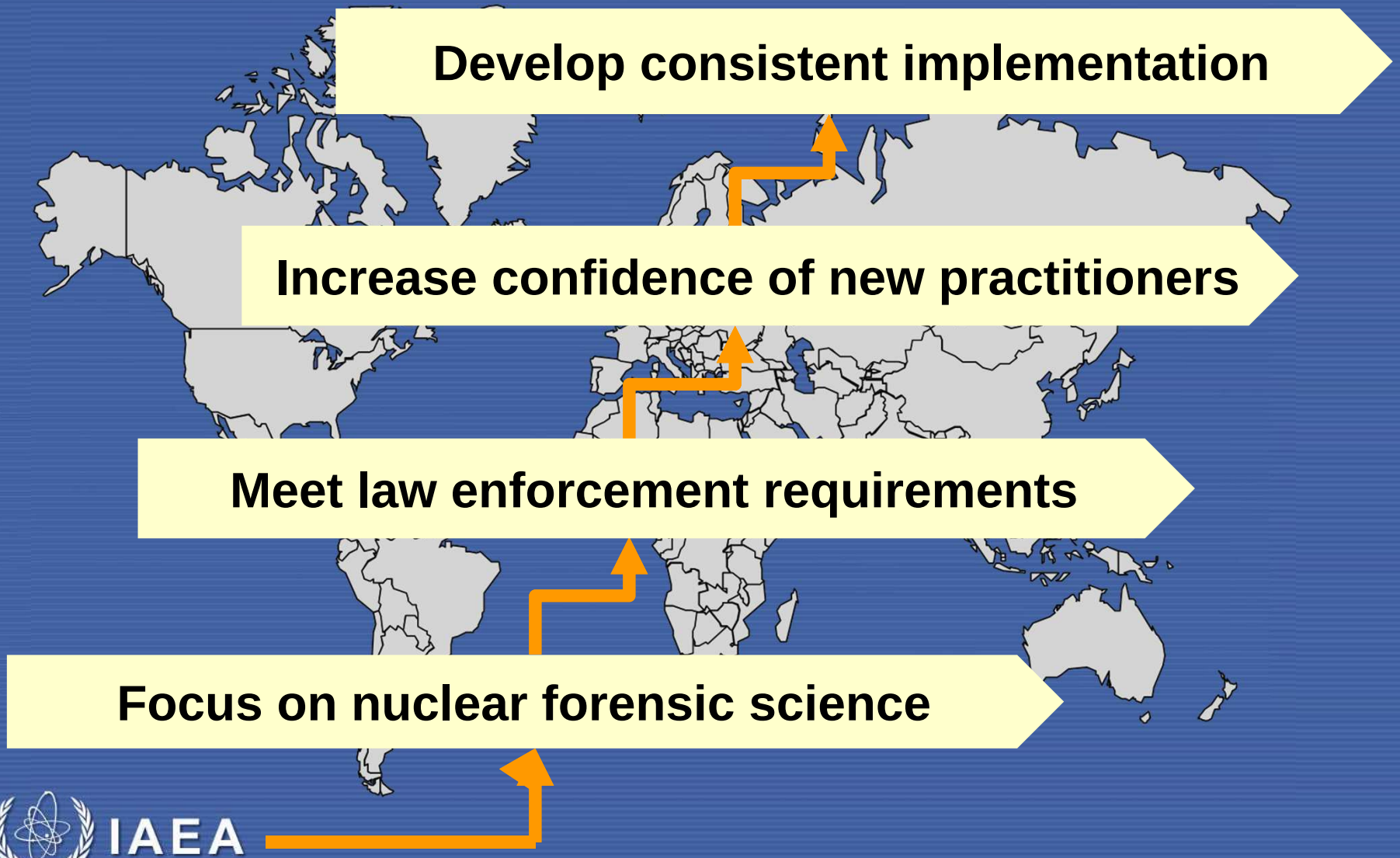
Nuclear forensics: a path forward



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Nuclear forensic science

- Nuclear forensics science is important for *innovation* as well as *engagement* with international partners (using example of ITWG)
- Some recent scientific advancements:
  - rapid and complete radiochemical separations
  - precision and accuracy of age dating (e.g., $^{230}Th/^{234}U$)
  - nanoscale and particulate analysis of nuclear materials (e.g., SIMS)
  - exploiting halogens, rare earths and minor isotopes to determine origin
  - high fidelity computer simulations (spent fuel)
  - development of nuclear forensic analytical reference materials (e.g., ^{229}Th, ^{134}Ba)
  - thermodynamics of signatures across nuclear fuel cycle
- Future scientific inquiry (e.g., pathways and route attribution, exploiting digital evidence in a nuclear security event)
- Leverage existing knowledge (e.g., nuclear institutes, environmental)
- Scientific peer review builds acceptability of nuclear forensic findings

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Law enforcement requirements (legal admissibility)

- Establish scene control
- Perform common hazards risk assessment
- Reduce radiation hazards
- Maintain control over the nuclear and radiological material
- Preserve items of evidentiary value
- Implement forensics evidence collection plan and initiate chain of custody
- Collection, packaging, transit of evidence to the nuclear forensic laboratory

Ensuring the "handshake" between response at the radiological crime scene and commencement of the nuclear forensics examination

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Differences between processing traditional and radiological evidence at a nuclear security event

Traditional

- **Time** – personnel have unlimited time to process the scene – ***No Rush!***
- **Distance** – personnel can get ***as close as they wish*** when collecting items or processing the scene
- **Shielding** – personnel require ***minimal shielding*** from the exhibits that they are collecting

Radiological

- **Time** - personnel must manage time spent on scene to minimize radiation dose – ***Time Constrained!***
- **Distance** - personnel typically must be ***as far as possible*** from items contaminated with radioactive material
- **Shielding** - personnel must use ***physical measures to shield*** themselves from any radioactivity

Using ALARA principle

Increasing the confidence of new practitioners

- Recognize the prevalence of ‘other radioactive materials’ (e.g. radioactive sources) within many developing States
- Outreach to States affected by MORC: African, Latin American, South American, Gulf State and Central Asian partners
- The role of a group of leading States to ensure dissemination
- Active programs of technology development and information exchange in nuclear forensics
  - academic fellowships
  - use of technology centres for advanced instrumentation and understanding
  - joint research initiatives
  - international technical conferences
- Importance of international outreach

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Nuclear forensics is not ‘one size fits all’ yet requires consistent implementation

- It is not about specialized instrumentation; it is about human capacity to prevent and respond to conduct an examination
- Actualizing elements of the nuclear forensics “model action plan”
  - Criminalization of MORC;
  - Categorization and characterization of MORC
  - Identification of a nuclear forensics laboratory
  - Development of a nuclear forensics examination plan
  - Notional 24 hour, 1 week and 2 month reporting of findings
  - Development and utilization of a national nuclear forensics library, for States that so choose
- Mechanisms
  - Build on CPPNM and 2005 Amendment
  - Continued synchronization between ITWG, GICNT and ITWG

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To conclude…….

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