Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

Canada

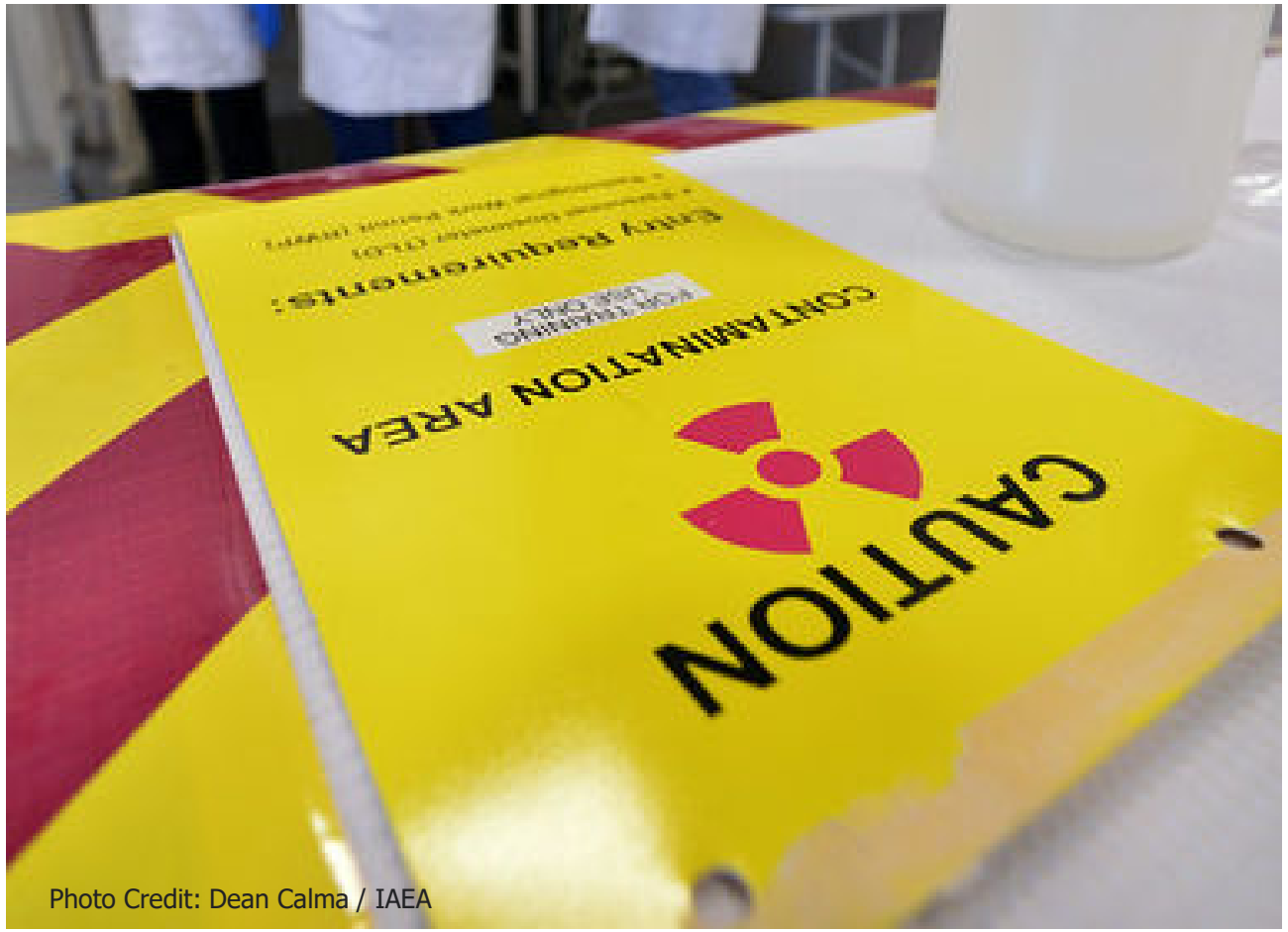


Photo Credit: Dean Calma / IAEA

Nuclear Forensics at the CNSC

CNSC STAFF PRESENTATION TO THE COMMISSION

FEBRUARY 25-26, 2025

CMD 25-M8

E-doc #7267425 (pptx)
E-doc #7463372 (pdf)

Outline

- Introduction to nuclear security and nuclear forensics
- Nuclear forensics in Canada
- CNSC nuclear forensics program
- National case example

Setting the Scene

Scenario:

Radioactive or nuclear material is discovered out of regulatory control.

- What is this material?
- How did it get here?
- Where is it from?
- Is there more out there?

Nuclear Security Response

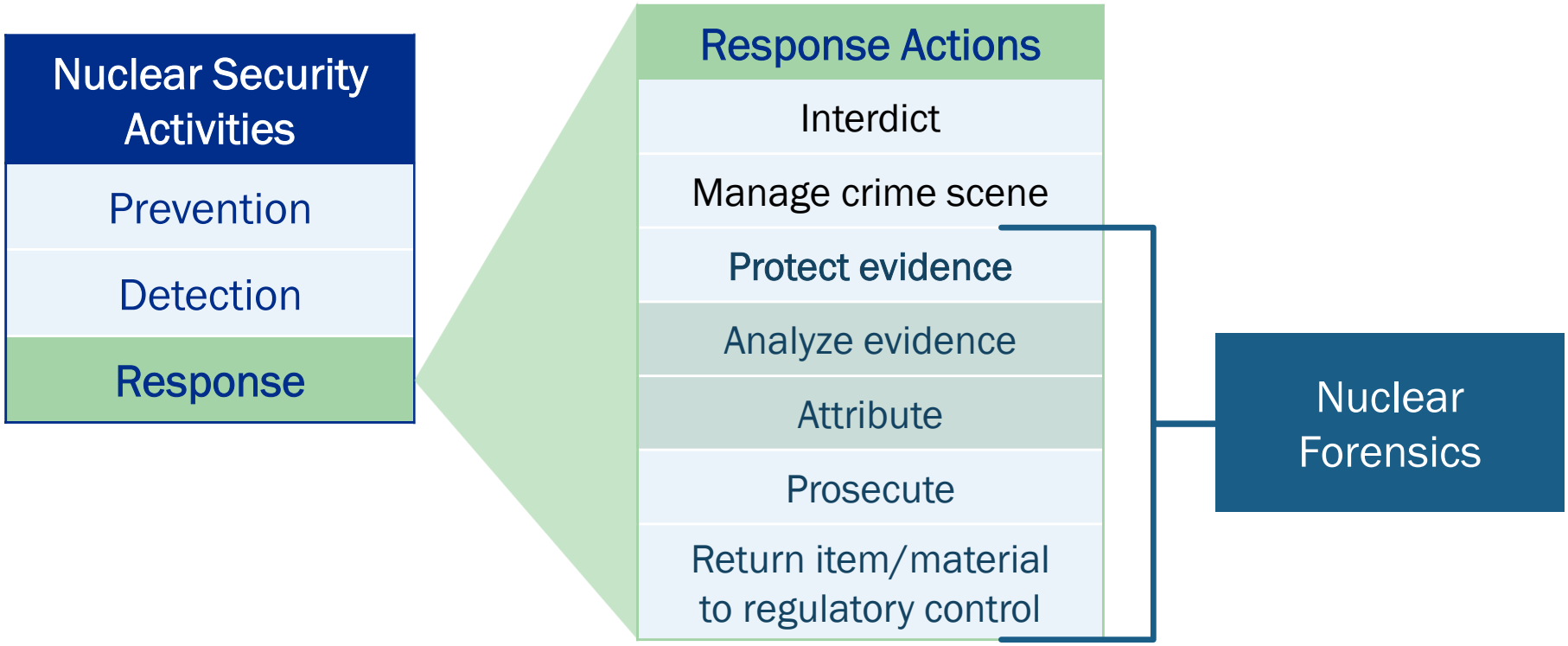
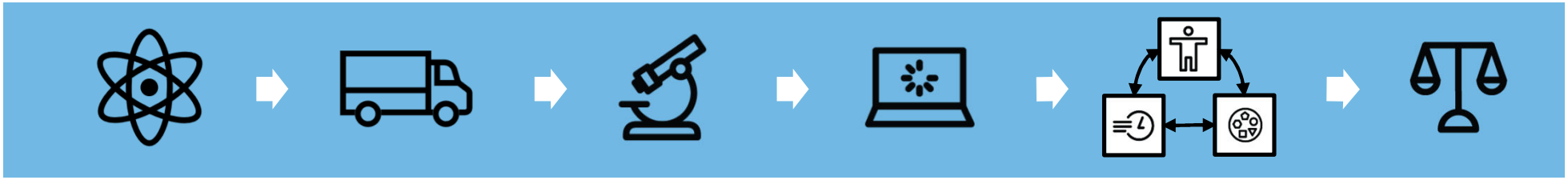


Diagram adapted from:
Developing a National Framework for Managing the Response to Nuclear Security Events, IAEA Nuclear Security Series No. 37-G, IAEA, Vienna (2019)

From Crime Scene to Courtroom

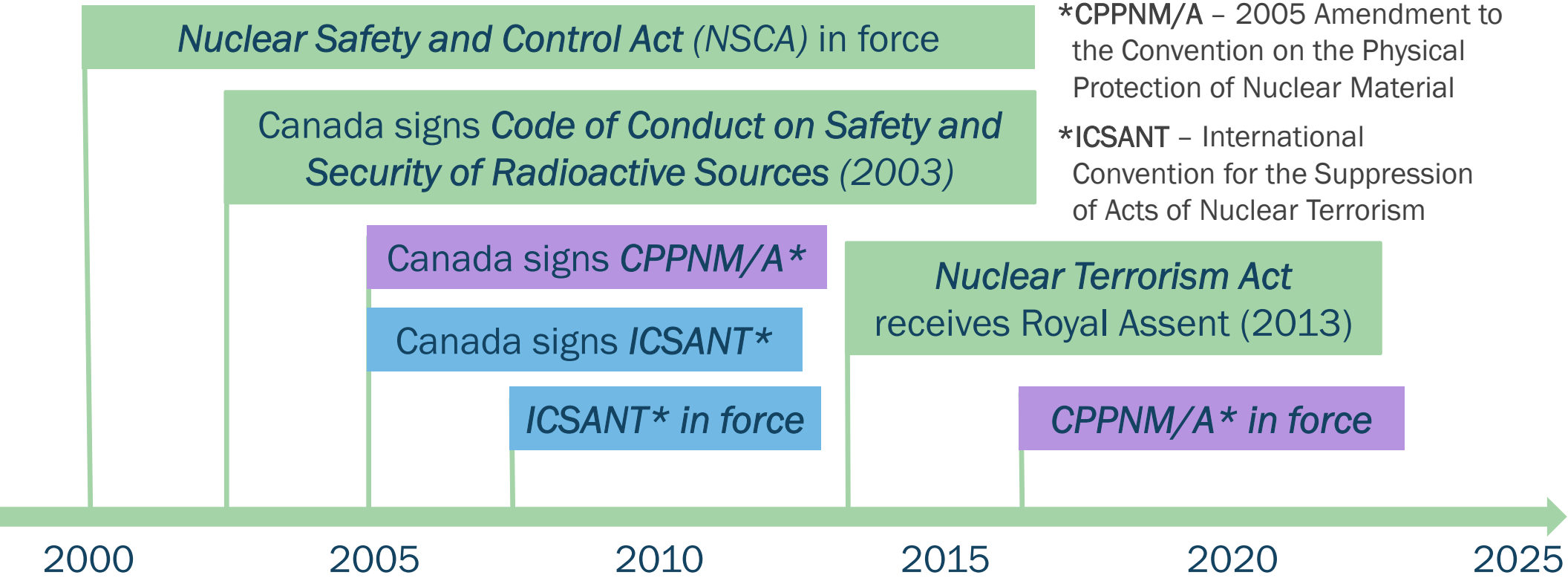


Nuclear or radioactive material discovered out of regulatory control	Transport sample safely and securely	Examination Plan and Laboratory analysis	Laboratory results interpreted with comparative database or library	Linking People Events and Materials	Findings Support Criminal Prosecution or Regulatory Findings

Nuclear Forensics Objective:

Provide insights into the history and origin of the material, as well as to potentially link these materials to people, places and events, to support decision makers.

Nuclear Security Framework and Forensics



***CPPNM/A** – 2005 Amendment to the Convention on the Physical Protection of Nuclear Material

***ICSANT** – International Convention for the Suppression of Acts of Nuclear Terrorism

Nuclear Terrorism Act

Four new indictable offenses to the Criminal Code (Sections 82.3 – 82.6):

a) possess, use or dispose of ***nuclear or radioactive material*** or a nuclear or radioactive device, or commit an act against a nuclear facility or its operations, with ***the intent to cause death, serious bodily harm or substantial damage to property or the environment***;

b) use or alter ***nuclear or radioactive material*** or a nuclear or radioactive device, or commit an act against a nuclear facility or its operation, with the ***intent to compel a person, government or international organization to do or refrain from doing anything***;

c) commit an indictable offence under federal law for the purpose of obtaining ***nuclear or radioactive material***, a nuclear or radioactive device, or access or control of a nuclear facility; and

d) threaten to commit any of the other three offences.

Each of the new offenses is deemed as **"terrorist activity"** (Section 83.01(1)(a)(v)). The Act received Royal Assent on 19 June 2013, which allowed Canada to ratify the CPPNM / A (on 3 Dec 2013) and ICSANT (on 21 Nov 2013).

Nuclear Forensic Parties of Interest

Law Enforcement:

- Public Safety Canada (PSC)
- Royal Canadian Mounted Police (RCMP)
- Canada Border Services Agency (CBSA)
- Justice Canada

Regulatory Bodies:

- Canadian Nuclear Safety Commission (CNSC)
- Health Canada (HC)

Policy Makers:

- Privy Council Office (PCO)
- Global Affairs Canada (GAC)
- Natural Resources Canada (NRCan)

Research Partners:

- Defence Research and Development Canada (DRDC)
- Canadian Nuclear Laboratories (CNL) / Atomic Energy Canada Limited (AECL)
- National Research Council Canada (NRC)
- Natural Resources Canada (NRCan)
- SNOLAB

Academia:

- University of Ottawa
- Royal Military College (RMC)

Global Impact

Canada's nuclear forensic community benefits from international engagements while also contributing to and influencing the global nuclear forensics community.

Multilateral Engagements

International Atomic Energy Agency (IAEA)

Nuclear Forensics International Technical Working Group (ITWG)

Nuclear Forensics Collaboration on Material Provenance Assessment (COMPASS)

Supports Our Mandate

- Regulate the use of nuclear energy and materials to protect health, safety, security and the environment.
- Implement Canada's international commitments on the peaceful use of nuclear energy.
- Disseminate objective scientific, technical and regulatory information to the public.

Nuclear Forensics at the CNSC

Analyze Evidence - Measurement

What is the material?

What are its properties?

- Physical measurements
- Morphology
- Chemical measurements
- Isotopic measurements

Attribute Evidence - Interpretation

How does this material relate to other materials or processes?

Where should this material be?

- Subject matter expert opinion
- Reactor modeling
- Radiochronometry
- Databases or libraries

Is it Canadian?
How did the material fall out of regulatory control?

Material Groups

Radiological and nuclear materials can be divided into **five distinct groups:**

Group 1: Front-end fuel cycle materials (e.g., ore, ore concentrates)

Group 2: Fresh nuclear fuel

Group 3: Irradiated nuclear fuel

Group 4: Nuclear waste and other processed material

Group 5: Radioactive sources

CNSC Laboratory

- Internationally Recognized Capabilities
- Nuclear Forensic Library
- Designated Analysts
- Nuclear Forensic Exercises
- New Laboratory Facility

Picture of testing laboratory staff receiving ISO17025 accreditation certificate from the Standards Council of Canada, November 2023. Source: CNSC

Internationally Recognized Capabilities

Contributions to Nuclear Forensic Science:

- Introduced laser ablation method for nuclear forensics
- Trilateral work on radiochronometry method development
- Support for radiological nuclear emergencies at home and abroad

Nuclear Forensics Library

- Library is comprised of Uranium Ore Concentrate (UOC) trace element data from 20 manufacturers worldwide
- 97% accuracy rate when comparing unknown samples to the library
- Work continues to keep the library up-to-date

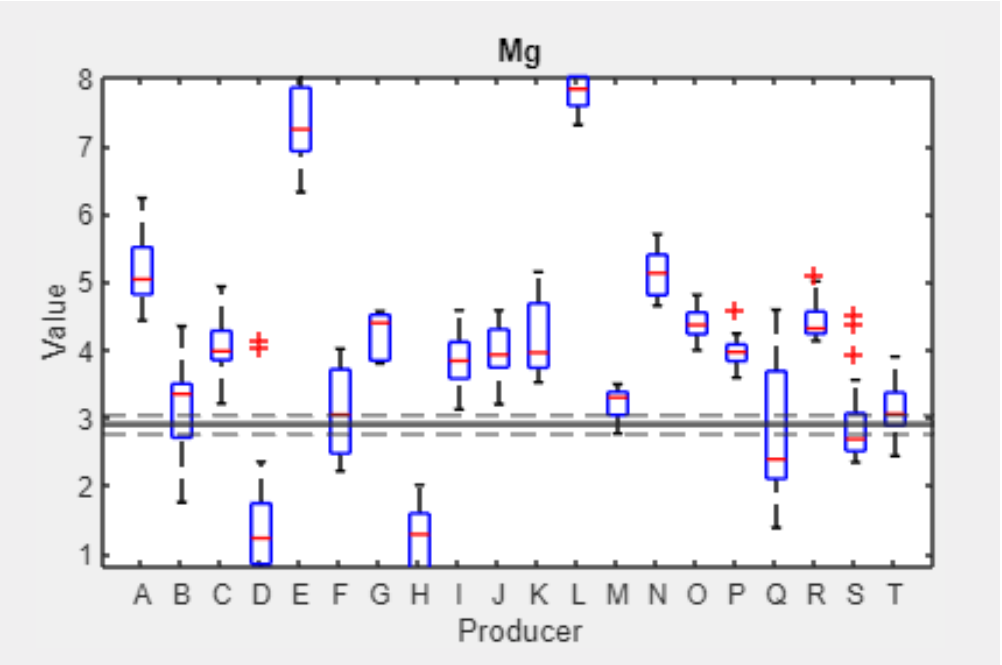


Diagram demonstrating concentration of magnesium (value on the y- axis) in UOC material analyzed (value 3) compared to 20 manufacturers worldwide (Producer A – T on the x-axis).
Source: CNSC

Designated Analysts

Commission Decision

In March 2023, the Commission approved the designation of analysts under the NSCA. The Commission also authorized Designated Officers to designate analysts on their behalf.

Analyst's Certificate

Designated analysts can certify lab results, which are admissible as evidence in the prosecution of an offence under the NSCA.

Analyses of Evidentiary Samples (Exhibits)

The CNSC laboratory conducted analyses to support 2 separate investigations led by Canada Border Services Agency (CBSA) in 2015 and 2018, involving illicit shipments of regulated material quantities into and out of Canada.

Nuclear Forensics Exercises

Collaborative Materials Exercise (CMX)

Examination of conventional and nuclear forensic evidence in a manner consistent with international best practices.

Galaxy Serpent

Exercises capability to respond to investigative-style questions using nuclear forensics databases and subject-matter expertise.

Picture of laboratory scientists and RCMP Officer opening CMX package. Source: CNSC

National Nuclear Forensics Library
Virtual Tabletop Exercise
"Galaxy Serpent"

New Laboratory Facility

Working with the RCMP, we have incorporated design requirements into the plans for the new laboratory facility to enable nuclear forensic work in the future.

Rendering of future laboratory facility. Source: AECOM

National Case – Unlicensed Export

March 2015

Canada Border Services Agency (CBSA) received allegations that an individual had been exporting radioactive material without a license, from 2011 to 2015.

CBSA requested CNSC assistance:

- Radiation protection during warrant service
- Analysis of seized samples
- Licensing determination
- Secure evidence storage

National Case – Findings

Findings

Several of the seized samples required a license for export, subject to the *Nuclear Non-proliferation Import and Export Control Regulations* (under the *NSCA*), as well as the *Export and Import Permits Act.*

Samples that require a license for export were confiscated.
One sample was returned to the owner.

In 2024, following exhaustion of all appeals, the confiscated materials were safely disposed.

Summary

- Nuclear forensics work supports our mandate by providing a framework for identifying material found outside of regulatory control
- Our efforts aim to ensure that national nuclear forensics capabilities are coordinated, complementary and available when needed
- Focus on the future includes continuing to exercise broad capabilities and formalize relationships with partners

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