

Overview of Nuclear Forensics in Support of Investigations

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Technical Session 2A

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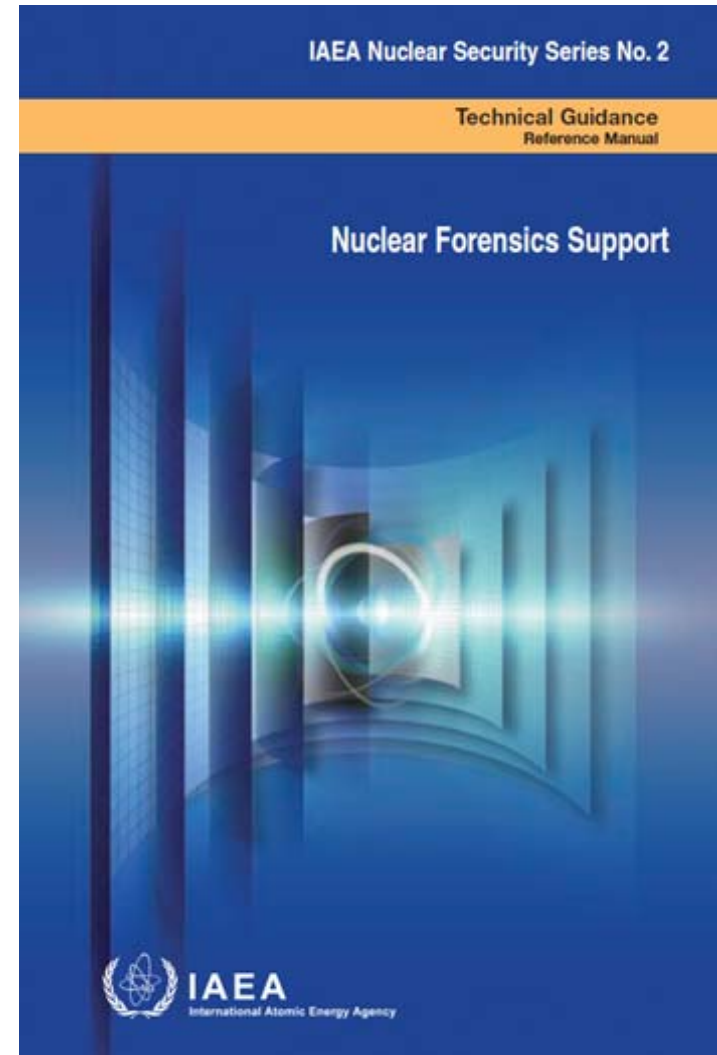
Canadian Nuclear Safety
Commission

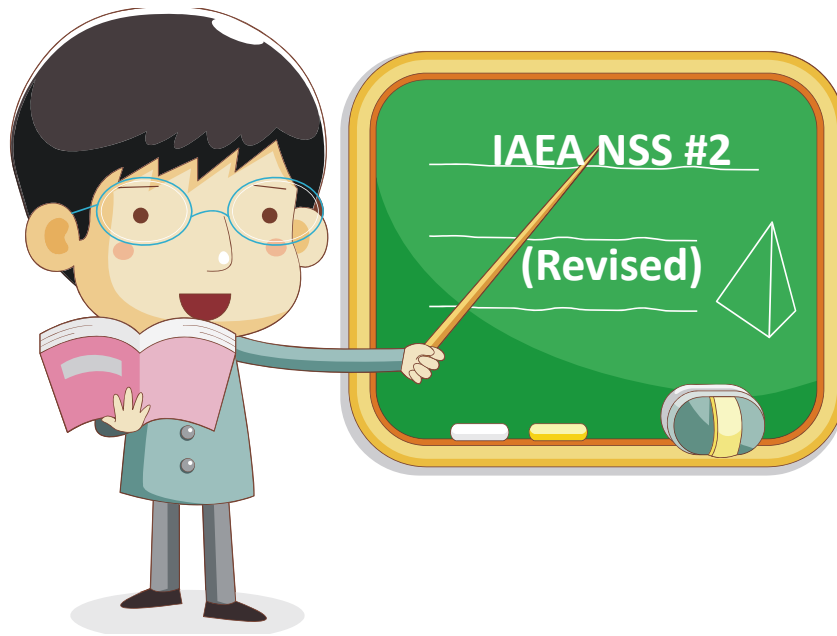
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Background

- Published in 2006
- Basis: *Model Action Plan for Nuclear Forensics and Nuclear Attribution*, developed by the Nuclear Forensics International Technical Working Group (ITWG)
- Outlined a generalized approach to the conduct of a nuclear forensic examination
- Revision timely due to further advances in nuclear forensics





What Does One Learn from the revised NSS #2?

Objectives

To describe the role of nuclear forensics in support of investigations of a nuclear security event and provide a context for nuclear forensics within a national nuclear security infrastructure

To promote international cooperation by encouraging States to seek or provide assistance, where appropriate, with regard to developing capabilities or during an investigation of a nuclear security event

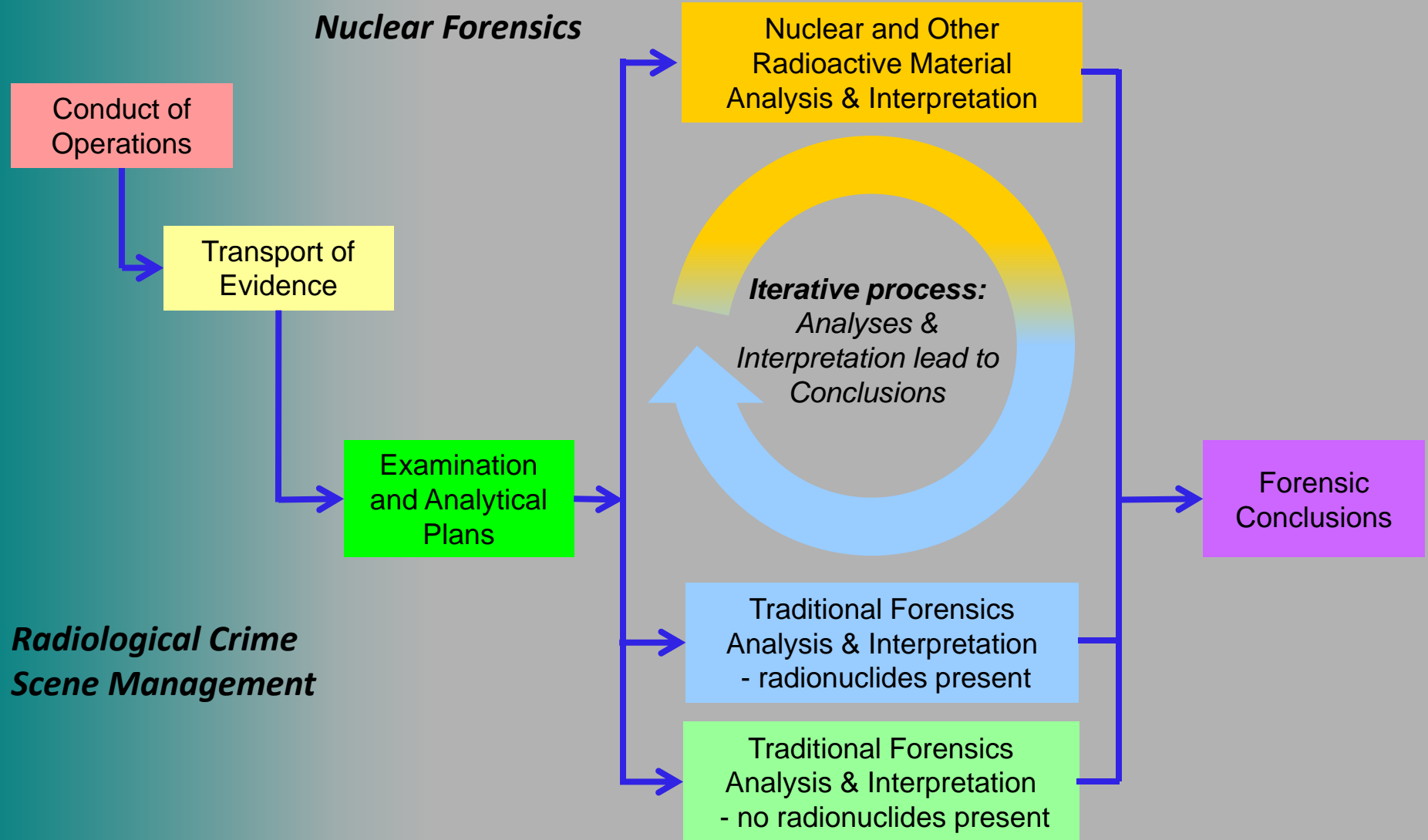
Section 2

THE ROLE OF NUCLEAR FORENSICS IN A NATIONAL NUCLEAR SECURITY INFRASTRUCTURE

Topic	Why Important?	What is Included?
National Framework for Nuclear Forensics (NF)	No need to develop national framework from “scratch”	Descriptions of NF as part of a National Response Plan; “Model Action Plan”
Legal Frameworks	Describe legal context for NF	NF supports implementation international and national legal frameworks
Preventive Measure	Describe NF as a preventive measure	NF may help improve nuclear security measures



Model Action Plan



Section 3

DEVELOPMENT OF THE FORENSIC EXAMINATION PLAN AND THE CORRESPONDING NUCLEAR FORENSIC ANALYTICAL PLAN

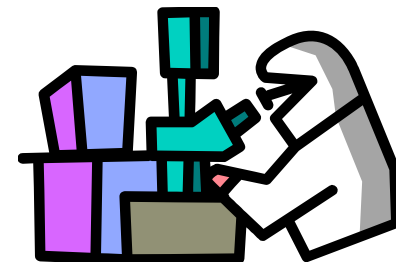
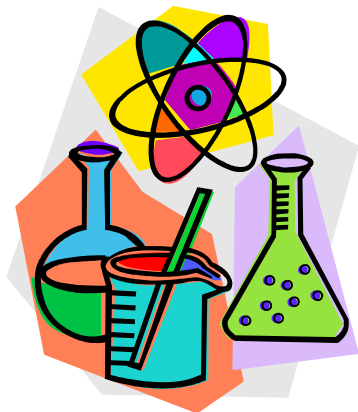
Topic	Why Important?	What is Included?
Forensic Examination Plan	Written examination plan ensures a coordinated investigation	Description of key plan elements
Nuclear Forensics Analytical Plan	Ensures the analyses meet the requirements of the investigation	Description of key elements of analytical plan
Evidence Sub-Sampling & Distribution	Evidence will need to be properly distributed for analyses	Key issues for awareness and consideration



Section 4

FORENSIC EXAMINATIONS OF EVIDENCE CONTAMINATED WITH RADIONUCLIDES

Topic	Why Important?	What is Included?
Contaminated Evidence	Need to properly define this key term	Proper definition used pertaining to NF
Handling Evidence Contaminated with Radionuclides	Awareness of two options for this type of evidence handling	Summary of key examination options and considerations
How to Select Appropriate Approach	Articulate pro/cons of the two approaches	Pro/Con descriptions



Section 5

NUCLEAR FORENSIC LABORATORY ANALYSIS

Topic	Why Important?	What is Included?
NF Characterization	Need to define	Definition and discussion
NF Laboratories	Need to describe environment where NF measurements will be made	Description of key laboratory capabilities, requirements, etc.
Sequencing of Methods	Set expectations of how long measurements will take	Revised original Table
Analytical Tools for NF	Describe relevant analytical tools	Descriptions
Sample Analysis	Describe what measurements are involved in Sample Analysis for NF	Description of relevant measurements and their methods

Techniques/methods	Conducted within		
	24 hours	One week	Two months
Radiological / health and safety	<ul style="list-style-type: none"> - Dose rate (α, β, γ, n) - Surface contamination - Radiography 		
Physical characterization	<ul style="list-style-type: none"> - Visual inspection - Photography - Weight determination - Dimensional determination - Optical microscopy - Density 	<ul style="list-style-type: none"> Microstructure, morphology, etc. - Scanning electron microscopy (SEM) - X ray diffraction 	<ul style="list-style-type: none"> Nanostructure, morphology, etc. - Transmission electron microscopy
Isotopic analysis	<ul style="list-style-type: none"> - High resolution gamma ray spectrometry (HRGS) 	<ul style="list-style-type: none"> - Thermal ionization mass spectrometry (TIMS) - Inductively coupled plasma mass spectrometry (ICP-MS) 	<ul style="list-style-type: none"> - Secondary ion mass spectrometry (SIMS) - Radioactive counting techniques
Radiochronometry	<ul style="list-style-type: none"> - HRGS (for Pu) 	<ul style="list-style-type: none"> - ICP-MS 	<ul style="list-style-type: none"> - HRGS (for U) - Alpha spectrometry
Elemental/chemical composition	<ul style="list-style-type: none"> - X ray fluorescence 	<ul style="list-style-type: none"> - ICP-MS - Chemical assay - Fourier transform infra-red spectrometry - SEM / X ray spectrometry - Isotope dilution mass spectrometry 	<ul style="list-style-type: none"> - Gas chromatography mass spectrometry
Traditional forensic science disciplines	<ul style="list-style-type: none"> - Collection of evidence associated with traditional forensic disciplines 		<ul style="list-style-type: none"> - Analysis and interpretation of evidence associated with traditional forensic disciplines

Section 6

NUCLEAR FORENSIC INTERPRETATION

Topic	Why Important?	What is Included?
Interpretation Methods	Provides context for NF measurements	Methods description
National NF Libraries	Key to determine if material is or is not consistent with a State's material holdings	Description of knowledge information system to help address "Is it ours?"
Process Knowledge (Fuel Cycle, etc.)	Interpretation is linked to material production processes	Description of such process impacts: create, persist, modify throughout fuel cycle
Deductive / Iterative Processes	Interpretation / Analysis is deductive-iterative process to arrive at conclusions	Description of deductive-iterative process

**Nuclear Forensics
Analytical Plan**

ANALYSIS

- Nuclear & Other Radioactive Materials
- Evidence Contaminated with Radionuclides

***An
Iterative
and
Deductive
Process***

COMPARISONS

Analytical Results
with Known Class
Characteristics

Class Excluded
from Further
Consideration

INTERPRETATION

Provides Context for
Analytical Results

Section 7

NUCLEAR FORENSIC FINDINGS

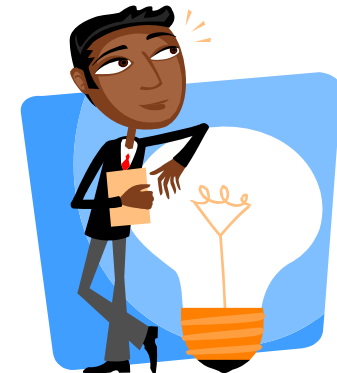
Topic	Why Important?	What is Included?
Confidence in Analytical Results	Always need to express confidence	Key factors in determining confidence
Communicating Results	Results always need to be communicated	Key factors in communicating findings with associated confidence
Reporting	Report(s) are needed for the investigation	Key factors in reporting
After Action Review (AAR)	AAR is needed to help improve a State's NF capability	Key elements of AAR



Section 8

INTERNATIONAL COOPERATION AND ASSISTANCE

Topic	Why Important?	What is Included?
International Partnerships	Building blocks of NF international community	Descriptions: IAEA, INTERPOL, GICNT, ITWG
International Assistance	Key function of NF international community	Types of assistance; considerations when requesting assistance



Section 9

NUCLEAR FORENSICS CAPACITY BUILDING

Topic	Why Important?	What is Included?
Capacity Building	State responsibility	NF context
Awareness	Need NF awareness for stakeholders	Key elements of NF for stakeholders
Training	Key international activity; sustains expertise	Summary of what is available
Exercises	Key international activity; sustains capability	Considerations for effective exercises of NF process
Expertise Development	Ensures a robust, sustained NF capability	Practical measures
R&D	Develops and evolves NF capabilities	Awareness of IAEA CRP; collaborative R&D



Questions?

