Building International Cooperation in Nuclear Forensics
"The ITWG"

International Workshop on Nuclear Forensics
Following on Nuclear Security Summit
Tokai, Japan
5-6 October 2010

Tamás Bíró, Bernard Chartier, Benjamin Garrett, Klaus Mayer & Paul Thompson
Executive Committee, Nuclear Forensics International Technical Working Group (ITWG)

ITWG
Nuclear Forensics

Background on the ITWG

The Nuclear Forensics International Technical Working Group (ITWG):

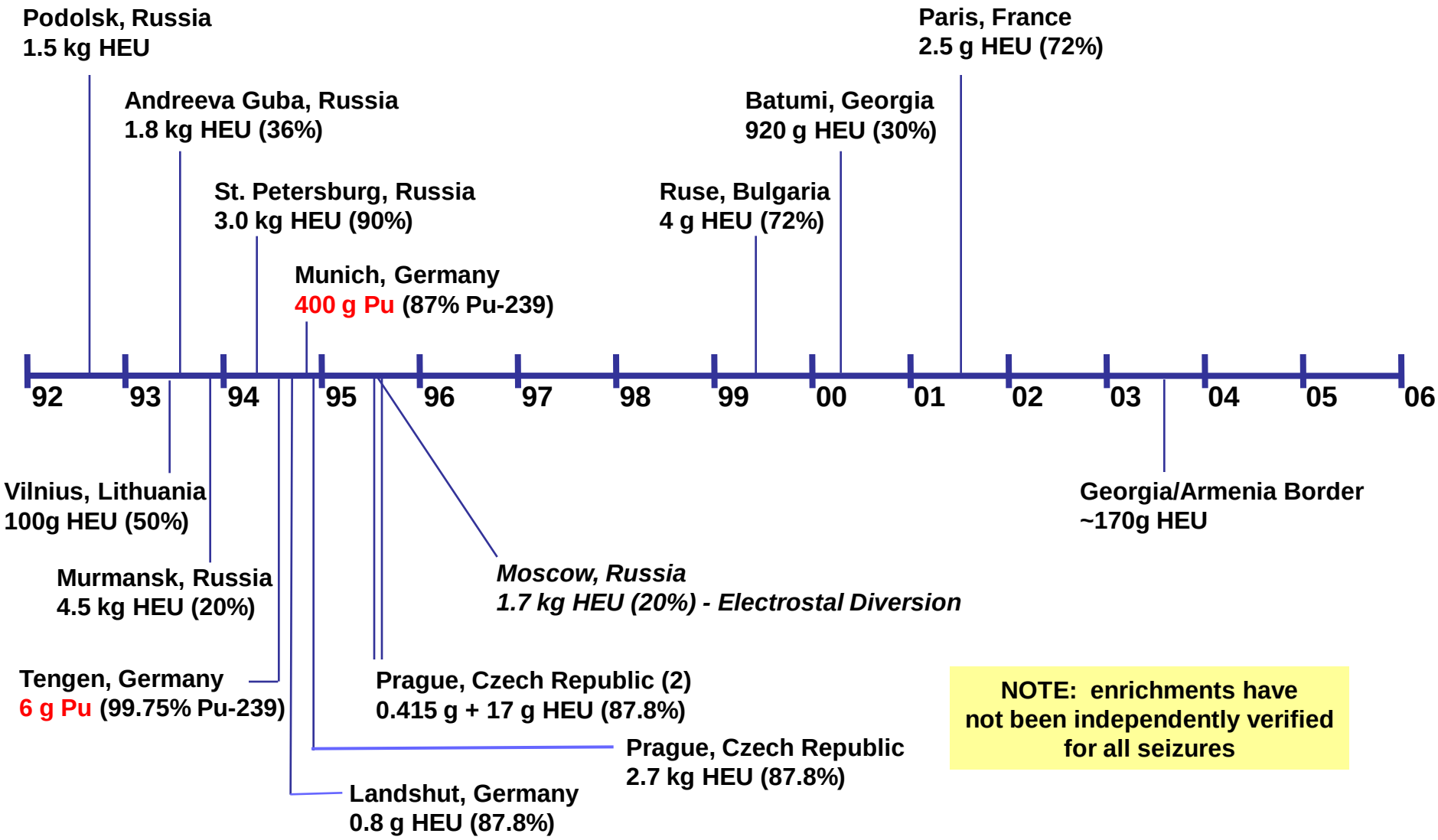
- Was founded as a result of a G-8 initiative (Ottawa Summit 1995 and Moscow Nuclear Security Summit 1996) under the Non-Proliferation Experts Group (NPEG)
- Currently reports informally to the Nuclear Safety & Security Group of the G-8

Background on the ITWG

The Nuclear Forensics International Technical Working Group (ITWG):

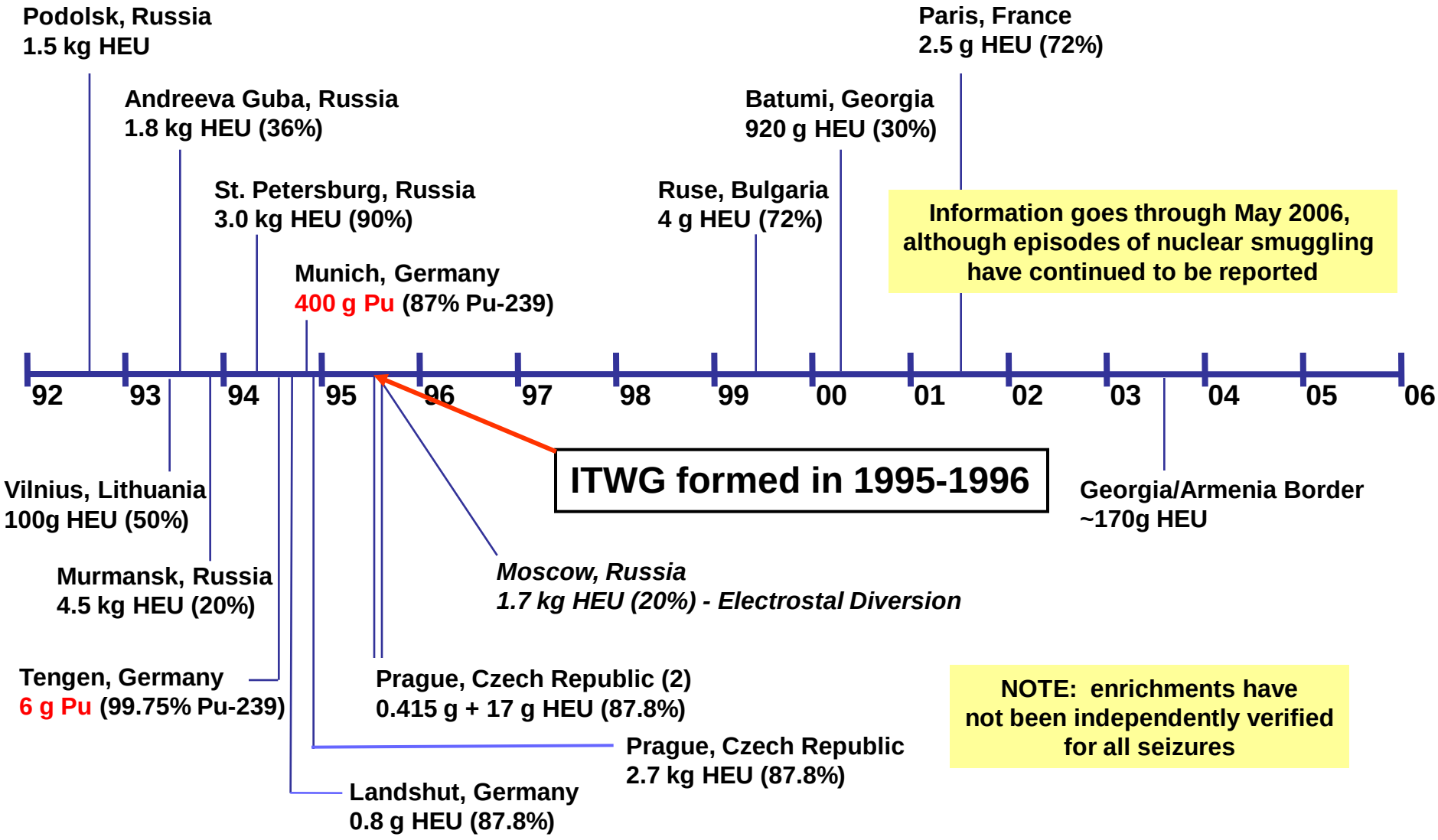
- Is a multinational, informal association of nuclear forensics practitioners
- Is open for membership to competent, qualified individuals from any nation who has an interest in nuclear forensics and who is affiliated with a competent national or international authority

Timeline on nuclear smuggling



NOTE: enrichments have not been independently verified for all seizures

Timeline on nuclear smuggling



Background on the ITWG

- Effective 28 June 2010, the name of the ITWG changed from "Nuclear Smuggling International Technical Working Group" to "Nuclear Forensics International Technical Working Group"

- Change reflects emphasis on forensics as well as the broad nature of the work of the ITWG

ITWG
Nuclear Forensics

Role of the ITWG

The role of the ITWG in nuclear forensics is to:

- Serve as a platform for international cooperation

ITWG - 13
2008
Sofia, Bulgaria

Role of the ITWG

The role of the ITWG in nuclear forensics is to:

- Advance best practices for nuclear forensics, starting at the site of an incident or event and running through data interpretation and delivery of the final report

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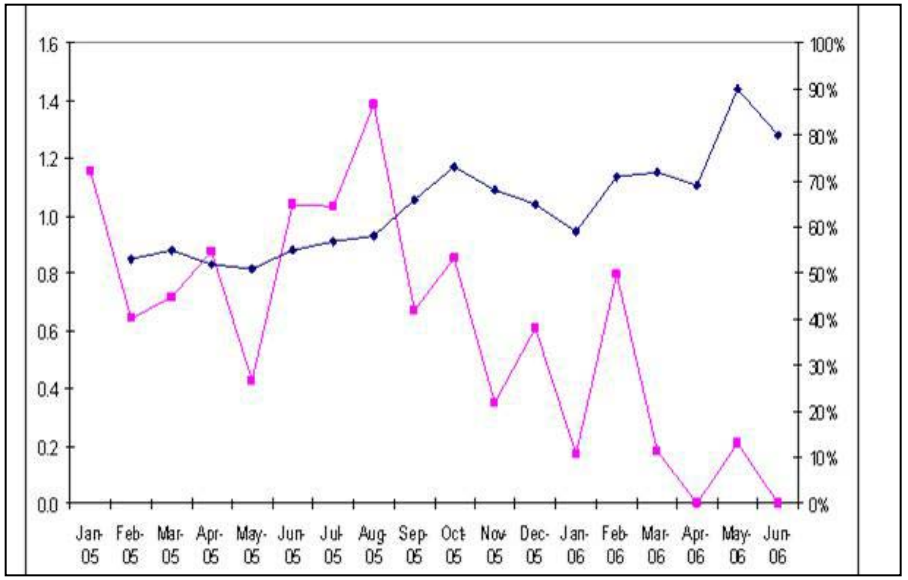

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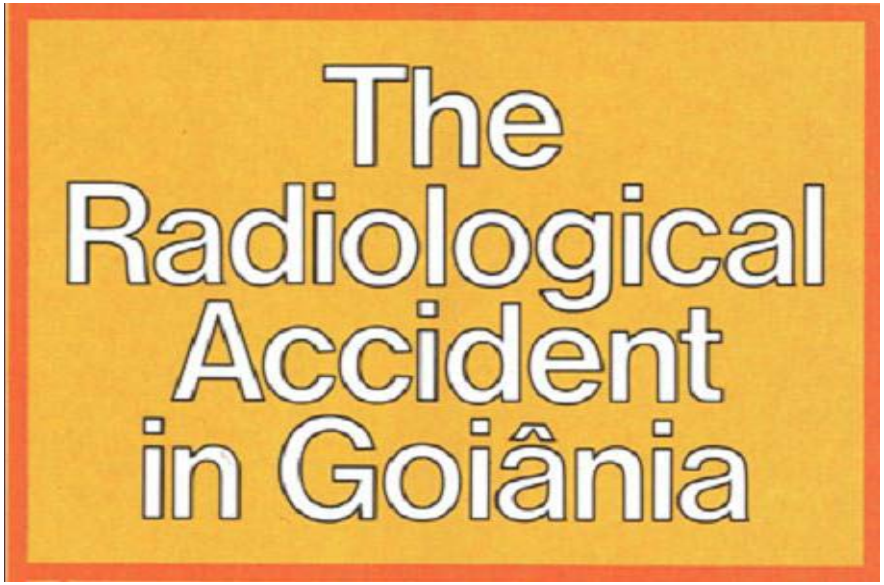
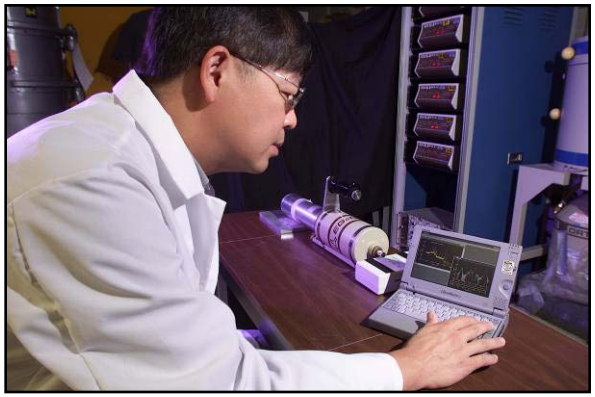
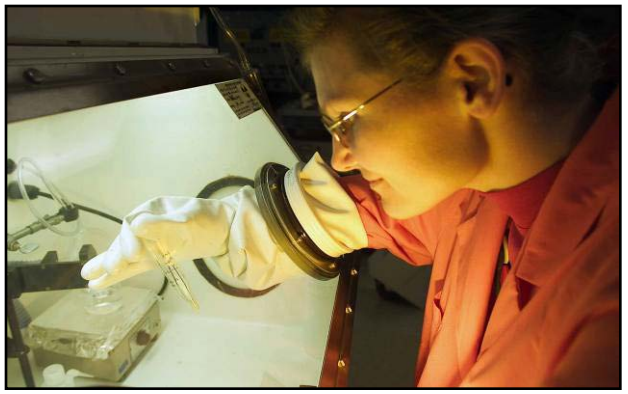


ITWG Terms of Reference

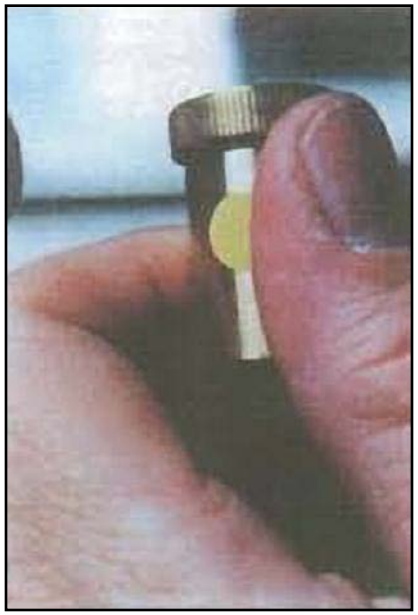
- Identify and prioritize techniques and methods for forensic analyses of seized nuclear materials to answer questions regarding sources and the intended use of these materials





ITWG Terms of Reference

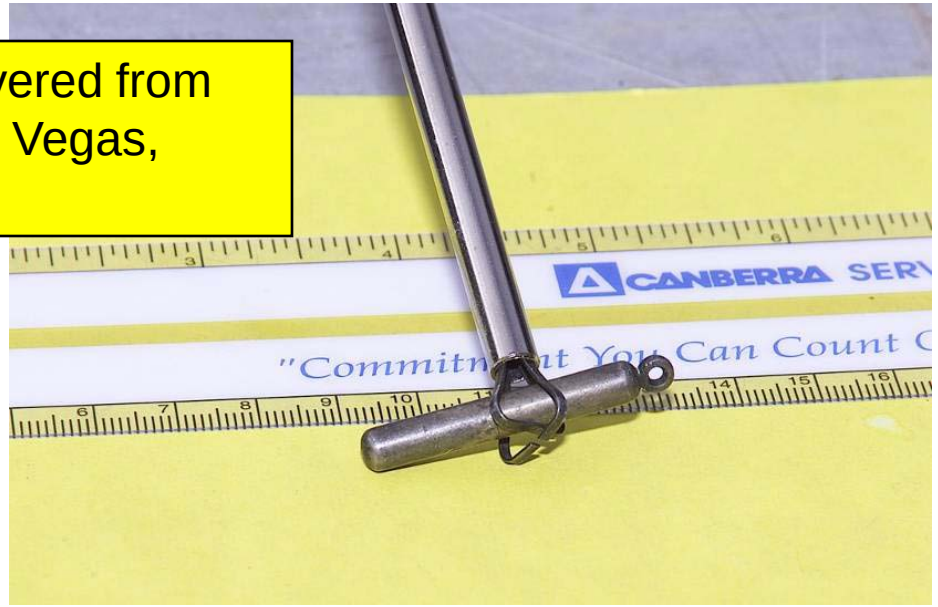
- Identify and prioritize techniques for the forensics analyses of non-nuclear materials associated with seized nuclear and radiological evidence



ITWG Terms of Reference

- Improve technical capabilities for collection and preservation of evidence, initial on-scene categorization, identification of applicable laws and statutes, and assistance in nuclear forensic investigations

Radiological source recovered from suspicious individual, Las Vegas, Nevada, December 2003



ITWG Terms of Reference

- Formulate and execute inter-laboratory exercises to evaluate and improve forensic analysis of seized nuclear materials

Data evaluation meeting for ITWG Round Robin #2, June 2002

Work of the ITWG

ITWG conducts its work through Task Groups:

- Communication & Outreach
- Evidence Collection
- Exercises
- Guidelines
- National Nuclear Forensics (NF) Libraries

Communications & Outreach

- Cooperates closely with IAEA Office of Nuclear Security

ITWG Participants & Others at
Expert Consultancy, IAEA, 2009

Communications & Outreach

- And with Global Initiative to Combat Nuclear Terrorism (GICNT)

ITWG Participants & Others at GICNT Workshop on Nuclear Forensics and Legal Aspects of Countering Nuclear Terrorism, Jerusalem, June 2010

Communications & Outreach

- Works both with local experts who require technical information and with government officials who require an orientation to nuclear forensics
- Is responsible for the ITWG web-sites
  - Maintains restricted ITWG web-site
  - Is establishing an open ITWG web-site

General Ahtamsho Saidsharipov, Head, State Committee of National Security, Tajikistan, discusses his country's needs relative to countering nuclear smuggling, ITWG-15, June 2010

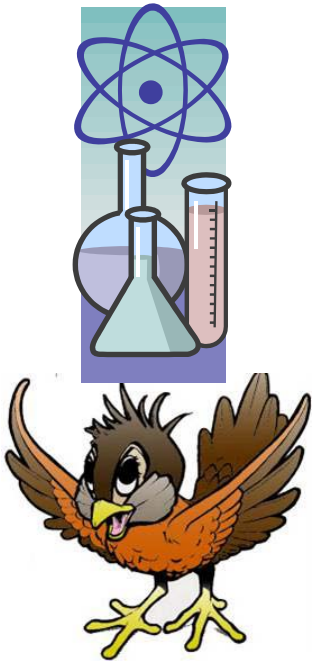
Evidence Collection

- Serves as a bridge between analytical experts & law enforcement on best practices for evidence collection
- Seeks to catalogue national level exercises that are relevant to nuclear forensics Developing a methodology for responding to crime scenes involving radioactive contamination

Guidelines

- Develops consensus guidelines for laboratory activities, including analytical techniques, sampling methods, and crime scene roles & responsibilities
- Products are generalized rather than prescriptive

Exercises



ITWG conducts scenario-based, laboratory exercises

- Participation is voluntary on the part of one or more laboratory in an ITWG participating nation
- Exercise method is referred to as "Round Robin"

Exercises

Goals of the Round Robin exercises include being able to

- Prioritize forensic techniques & methods
- Evaluate attribution capabilities
- Examine usefulness of databases for attribution

Exercises

Three Round Robin exercises have been conducted through ITWG:

1. Plutonium, 1998-2000
   - Six laboratories participated
2. Highly Enriched Uranium, 2000-2002
   - Ten laboratories participated
3. Highly Enriched Uranium, 2009-present
   - Nine laboratories are participating

Exercises

Highly Enriched Uranium (HEU) Round-Robin Exercise

Nuclear Smuggling International Technical Working Group (ITWG)

Participating Laboratories

ARC Seibersdorf GmbH, Seibersdorf, Austria
Nuclear Research Institute, Rez, Czech Republic
Institute for Transuranium Elements, Karlsruhe, European Commission
Commissariat à l'Energie Atomique, Valduc, France
Institut für Radiochemie, München, Germany
Institute of Isotopes and Surface Chemistry, Budapest Hungary
Çekmece Nuclear Research and Training Center, Istanbul, Turkey
AWE, Aldermaston, United Kingdom
Lawrence Livermore National Laboratory, United States of America

Round Robin Co-Chairs

Gordon Dudder, Pacific Northwest National Laboratory
Georges Herbillon, European Commission, DG-TREN
Richard Hanlen, Pacific Northwest National Laboratory

Objective

- Evaluate and improve the effectiveness of forensic techniques and methods
- Prioritize forensic techniques and methods
- Evaluate attribution capabilities
- Examine the utility of existing databases
- Learning experience vs. performance evaluation

Scenario

- Police seize smuggled materials suspected to be nuclear
- All materials sent to nuclear forensic laboratory for analysis and possible attribution

Results

Isotopic Composition

Laboratory Code	U-234	U-235	U-236	U-238	Methods
Azoras	0.97	89.99	0.68	8.37	LEGS, HRGS, ICP-MS, TIMS
Barbados		85.8%+/-3.8 U-235			HPGe
Borneo	0.85+/-0.15	86.7+/-1.5	0.57+/-0.06	11.9+/-0.9	ICP-MS
Chathan	0.960+/-0.001	89.94+/-0.06	0.642+/-0.002	8.452+/-0.006	TIMS
Galapagos	0.96	89.89	0.68	8.47	TIMS
Mindanao	0.96+/-0.48	89.91+/-0.11	0.678+/-0.23	8.443+/-1.29	TIMS
Tobago	1.05+/-0.07	89.37+/-1.8	0.69+/-0.05	8.88+/-0.2	ICP-MS
Tonga	0.967+/-0.001	89.99+/-0.02	0.679+/-0.001	8.362+/-0.005	TIMS
Trinidad	0.955+/-0.075	90.01+/-0.35	0.673+/-0.050	8.365+/-0.053	MC ICP-MS

Materials

- HEU oxide provided by Czech Republic
- Classical forensic evidence
  - fingerprints
  - plant seeds
  - shopping bag
  - vials
  - beer stained coaster with writing

Reporting Periods

(D) One Day: Issues associated with the public health and safety, and determination of criminal activity
(W) One Week: Preliminary forensic analyses and collection of evidence
(M) Two Months: Comprehensive forensic analysis of the materials

Key Findings

What is the material?
(D) highly enriched uranium
(D) (W) uranium isotopics • elemental analysis
(M) age-dated material to last processing

(D) Does the material represent a hazard or threat?

What is the material used for?
(W) (M) characterize as weapons usable

What is the source of the material?
(M) multiple sources cited

Shortfalls

- Procedural
  - transportation/receipt of "unknown materials" vs. transportation by exception
  - contamination control in preparation of samples
  - origin of material
- Technical
  - source attribution
  - lack of a comprehensive network of knowledge/databases to interpret data
  - non-nuclear forensics

Conclusions

Techniques and methods prioritization

	24 Hours	One Week	Two Months
Health & Safety	Dose rate (alpha, gamma, neutron) Surface Contamination Radiography		
Physical Characteristics	Visual Inspection Photography Weight Dimension Optical Microscopy Density	SEM (EDX) XRD	TEM (EDX)
Classical Forensics	e.g., Fingerprint		
Isotope Analysis	Gamma spec. Alpha spec.	Mass Spectroscopy (ICP, SIMS, TIMS)	
Element/Chemical		ICP/MS XRF IDMS	Ion Chromatography

Follow-up Topics

- HEU Round-Robin report
- Model action plan for seized/found material

Summary

- The ITWG has established a network of forensic laboratories which is developing a preferred approach to nuclear forensics, which addresses the needs of the law enforcement, nonproliferation, and policy communities
- A prioritized list of techniques and methods has been developed based on exercises, which has been implemented in real cases
- When this forensic capability is combined with the appropriate knowledge/database, it results in a significant capability to attribute the source of materials to a specific process or facility

Exercises

Procedural lessons learned from these exercises include:

- Shipping & receipt of samples lag expectations
- Ability to keep to reporting timeline (24-hours, 1-week, 2-months) competes with normal workload & higher priority samples

Exercises

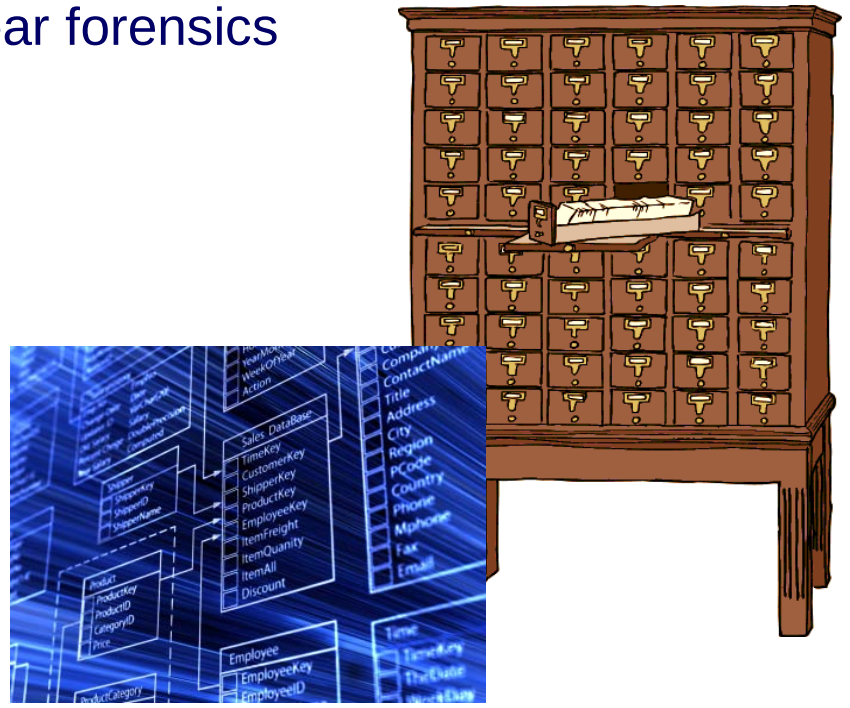
Technical lessons learned from these exercises include:

- Databases need to be more comprehensive & accessible
- Conduct of traditional forensic examinations is either overlooked or poorly done

National NF Libraries

ITWG is encouraging the development of national compilations of relevant data or of archival samples of radiological and nuclear materials

- Data would be used to support nuclear forensics interpretation



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- Task Group is relatively new – Approved in June 2009

National NF Libraries

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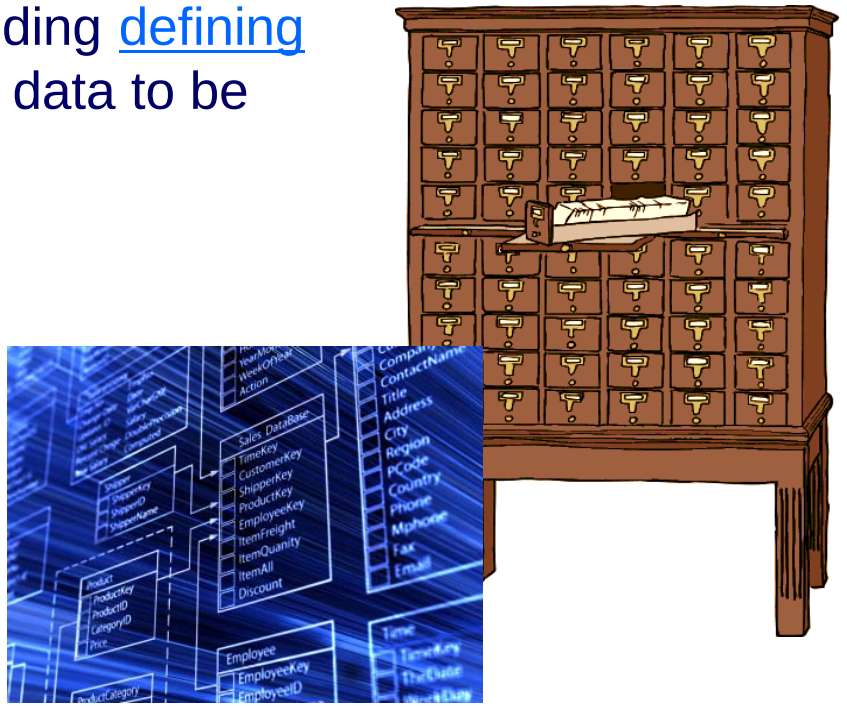
- Much work remains to be done, including defining and validating core characteristics of data to be included



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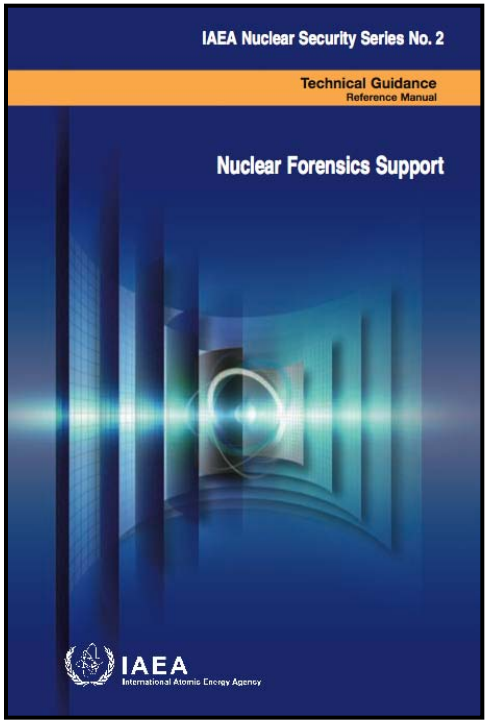
ITWG is encouraging the development of national compilations of relevant data or of archival samples of radiological and nuclear materials

Refining requirements for National NF Libraries via a scenario-based exercise, ITWG-15, June 2010

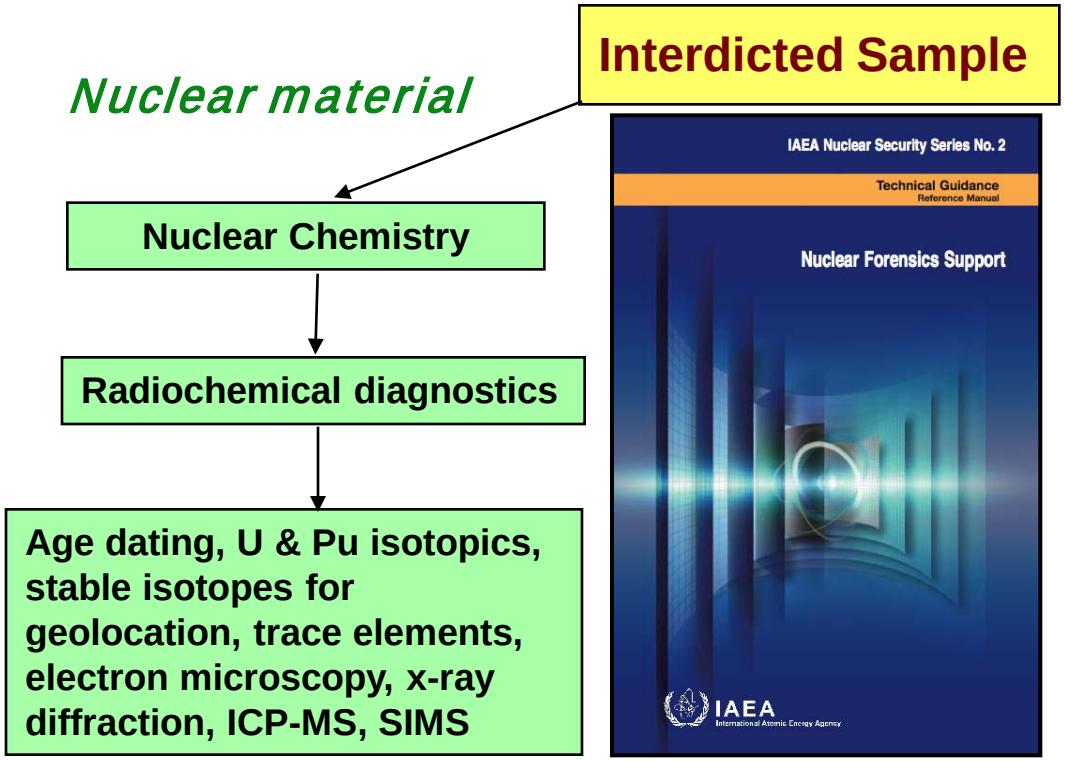
ITWG Product

Example of product of ITWG effort:



- The “Model Action Plan”
  - — Published by the IAEA as *Nuclear Security Series #2, Nuclear Forensics Support*
  - — Available via the IAEA website
  - — Describes process to go from incident to report, covering analysis of both traditional evidence & nuclear material

ITWG Model Action Plan

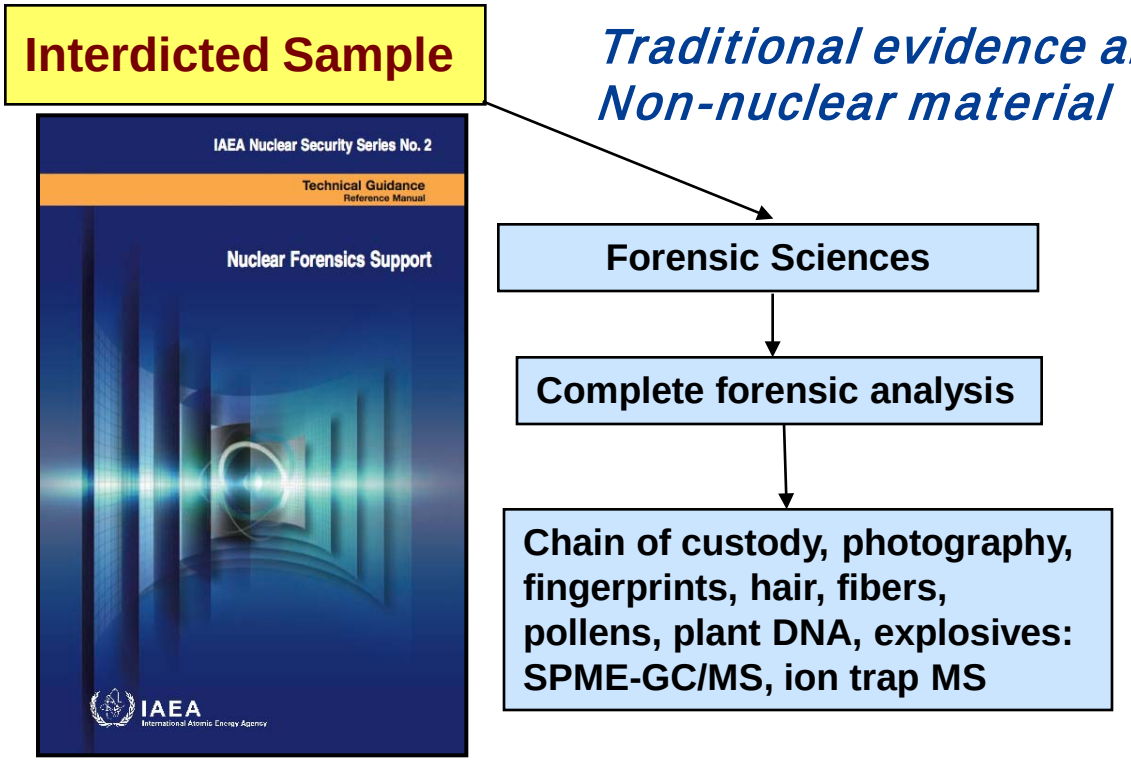


ITWG Model Action Plan
Published by the IAEA

One part of working with an interdicted sample involves various laboratory procedures associated with nuclear chemistry – necessary to identify and characterize the nuclear material itself

ITWG Model Action Plan

A second, equally important, part of working with an interdicted sample involves various laboratory procedures associated with forensic sciences – conventional examinations such as fingerprints & DNA



ITWG Model Action Plan Published by the IAEA

ITWG Model Action Plan

Interdicted Sample

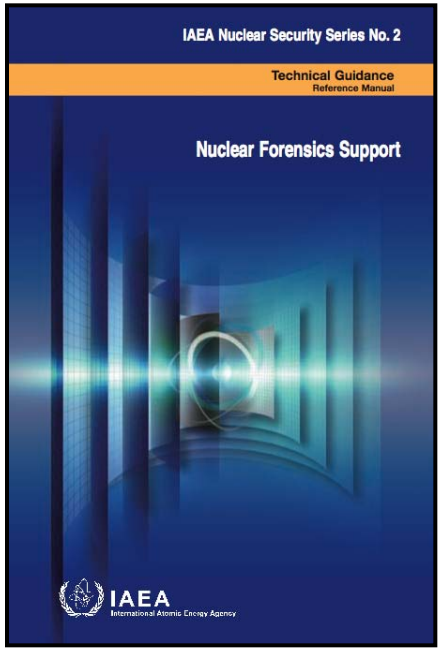
Nuclear material

Traditional evidence and Non-nuclear material

Nuclear Chemistry

Radiochemical diagnostics

Age dating, U & Pu isotopics, stable isotopes for geolocation, trace elements, electron microscopy, x-ray diffraction, ICP-MS, SIMS



ITWG Model Action Plan Published by the IAEA

Forensic Sciences

Complete forensic analysis

Chain of custody, photography, fingerprints, hair, fibers, pollens, plant DNA, explosives: SPME-GC/MS, ion trap MS

Interpretation, analysis and case development

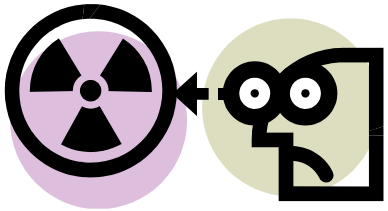
Aids in attribution & formulating response

ITWG Model Action Plan

Timeline for reporting results:

- 24 Hours
- 1 Week
- 2 Months

ITWG Model Action Plan



Timeline for reporting results:

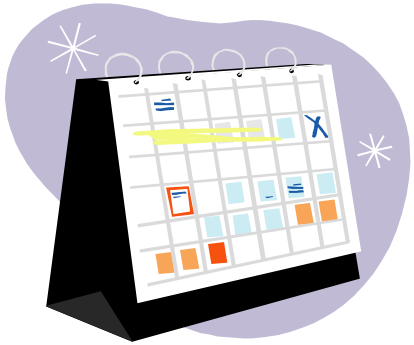
- After 24 hours, one should be able to
  - Determine the nature of the radiation risk, if any, to those responding to the incident or event
  - Predict the nature of the radiation risk relative to public health and safety
  - Establish whether a crime is known or is likely to have been committed

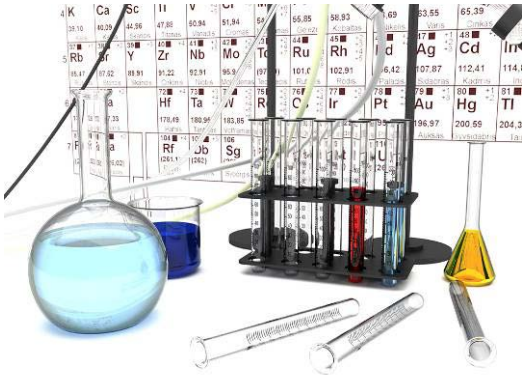
ITWG Model Action Plan

Timeline for reporting results:

- After 1 week, one should be able to
  - Refine the analysis, providing a confirmed identity of the nuclear material
  - Develop additional information that might be used for law enforcement purposes (such as establishing investigative leads) or for intelligence

ITWG Model Action Plan





Timeline for reporting results:

- After 2 months, one should be able to
  - Characterize the nuclear material (such as originally intended use, age, processing history, storage history)
  - Conduct comprehensive suite of traditional forensic examinations (such as fingerprints, trace evidence, DNA, non-nuclear chemical & material analyses, toolmarks)

ITWG Model Action Plan

However:

- The combination of results from nuclear chemistry + traditional forensic examination will likely need to be combined with other law enforcement investigative results as well as intelligence reporting to permit final attribution as to the origin of the material and the pathway it has taken

Meetings of the ITWG

ITWG meets annually

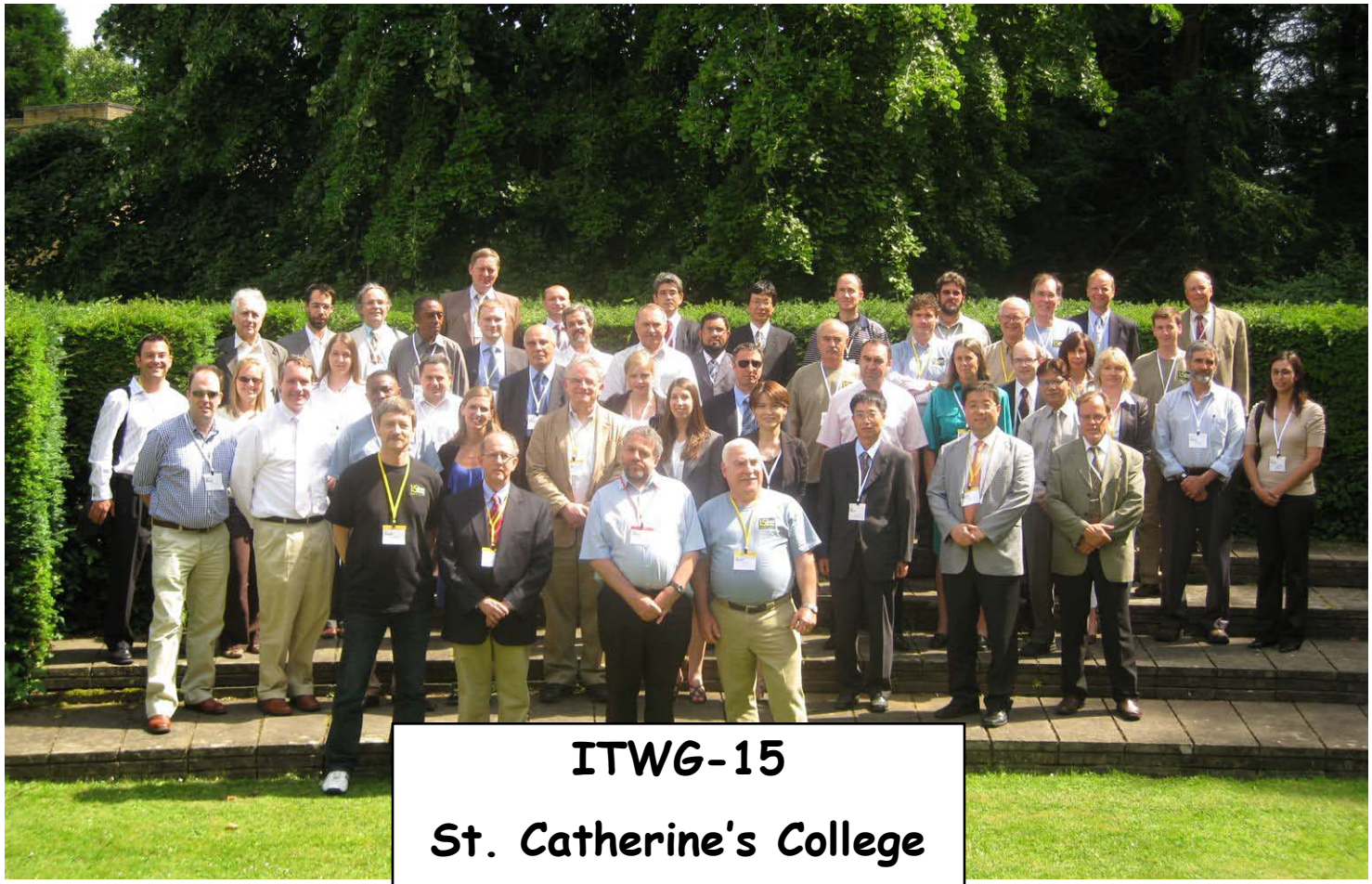
- Most recent meeting: ITWG-15
  - Venue: St. Catherine's College, Oxford, England
  - 28 June – 01 July 2010

Meetings of the ITWG

ITWG-15

- Atomic Weapons Establishment (AWE), UK served as the host
- Attended by 64 participants from 23 nations, 3 international bodies and 2 NGOs

ITWG-15



ITWG-15

St. Catherine's College

Oxford, England

Future of the ITWG

Going forward, the ITWG seeks to:

- Increase international participation, thereby expanding the community of active practitioners in nuclear forensics

Future of the ITWG

Going forward, the ITWG seeks to:

- Explore partnerships to facilitate expert training in nuclear forensics

Future of the ITWG

Going forward, the ITWG seeks to:

- Promote exchanges of samples & data, both through round-robin exercises and by contributing to the development of nuclear forensic data banks

ITWG - Summary

ITWG:

- Has maintained continuity & achieved progress over its 15-year history as an informal group
- Is multi-agency, inter-disciplinary & international in its membership
- Strives to advance nuclear forensics as a discipline to combat illicit trafficking of nuclear material

Questions?

- **Contact Information:**

Benjamin.Garrett@ic.fbi.gov
+1-703-632-7929