European Commission

European Nuclear Security Training Centre (EUSECTRA)

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A dedicated training facility

Over the last two decades, increasing security concerns with respect to illicit trafficking of nuclear and other radioactive materials were largely acknowledged by the international community.
Following these concerns, the Joint Research Centre was tasked by the European Commission (DG HOME) to set up a dedicated European Nuclear Security Training Centre (EUSECTRA) as recommended by the EU CBRN Action plan adopted by the European Council in December 2009.
Located at the European Commission Joint Research Centre Institute for Transuranium Elements (ITU) in Karlsruhe and Ispra, this centre serves as a platform for knowledge transfer and for networking of experts.

Realistic training with Special Nuclear Material

Based on the unique combination of scientific expertise, specific technical infrastructure and availability of a wide range of nuclear materials, EUSECTRA complements national training efforts by providing realistic scenarios with real special nuclear material. The training program offers a unique opportunity for trainees to see and experience actual materials and commodities. In particular, EUSECTRA is one of the few places in the world where a wide range of samples of plutonium and uranium of different isotopic compositions can be used for training in detection, categorization and characterization.

Wide range of topics

EUSECTRA courses include border detection, train-the-trainers, national response plans, nuclear forensics core and advanced capabilities, radiological crime scene management and nuclear security awareness. In addition, EUSECTRA continues to cover safeguards training activities.

New facility inaugurated in 2013

The new EUSECTRA facility at the ITU Karlsruhe site was inaugurated on 18 April 2013, complementing the sister facility operated by ITU in Ispra since 2009. It provides an indoor training area to simulate airport conditions, equipped with pedestrian portal monitors and an x-ray conveyor and a dedicated laboratory for safeguards courses. Outdoor facilities with different types of radiation portal monitors are also available for border detection training.

International dimensions

The EUSECTRA benefited from the experience and the cooperative work of the Border Monitoring Working Group in elaborating comprehensive training schemes for front line officers, first responders, measurement expert support teams and nuclear forensic experts comprising practical and table-top exercises. Such reference and standardised training materials have been developed in close collaboration with international experts (e.g., from IAEA, US-DoE, FBI, NFI, CEA) to integrate different available modules into a coherent and comprehensible set of training courses which ultimately shall aim to cover both detection and response strands.

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Joint Research Centre

ESTABLISHING OF NUCLEAR FORENSICS CAPACITY IN REPUBLIC OF MOLDOVA

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Introduction

The Republic of Moldova has no operational power or research reactors and currently has no plans for the construction of a nuclear power plant. But this status may be reviewed at any time, because there is a strong dependence of the country's economy on the import of energetic resources, price of which rises early drastically.

In Chisinau – the capital of Republic of Moldova there is a central radioactive waste disposal facility for LLW & HLW. The major users of radioactive sources is the medicine, industry and research area.

Nuclear security statute

Starting from the axiom that the issue of national security is primarily the task of the State, the National Security Concept was approved in Republic of Moldova, which among the major risks reiterated the separatist regime, international terrorism, consequences derived from human activity, as well as organized crime and corruption. In spite of the nuclear/non-nuclear status no state can be sure that the threats and risks of proliferation will not be applied on its own territory. Unfortunately, the Republic of Moldova is not an exception, as it can be seen through recent events of 2010 and 2011 when the illicit trafficking of nuclear material with depleted uranium and highly enriched uranium, was spread on the front pages of international news.

For prevention, detection and response actions Moldovan authorities have received multilateral assistance from foreign partners as IAEA, EC, Swedish Radiation Safety Authority, US DoE, US NRC. With large external support, we develop and maintain effective measures to account and secure of nuclear and radioactive materials, its use, storage, transportation, effective physical-protection measures and border control, law-enforcement efforts to detect, prevent and combat of illicit trafficking. In connection with the recognition of a growing threat of use of RDD we have undertaken political commitments to accept and applied such international instrument as the CoC, UNSCR 1540 and International Convention for the Suppression of Acts of Nuclear Terrorism, etc. Participation in international non-proliferation mechanisms has given Moldova the opportunity to be recognized as a partner at many international and regional initiatives (PSI, GTRI, GICNT).

Through this conventions and agreements the Republic of Moldova has assumed obligations to provide adequate physical protection of nuclear material that is used for peaceful purposes during its use, storage and international or domestic transportation. The Government has designated the National Agency for regulation of Nuclear and radiological Activities as a national authority, which has the responsibility for state control and supervision of implementation process about physical protection of nuclear materials and to notify the IAEA and its member states in cases when coordination of action regarding the nuclear material is required.

The Law no. 132 concerning safety deployment of nuclear and radiological activities has the following purposes:

* prohibit the proliferation of nuclear weapons, materials, and equipment pertinent to the proliferation of nuclear weapons and other explosive devices with radioactive material;
* establish mechanisms to ensure the safety and security of nuclear and radiological activities and maintaining them at an appropriate level;
* prevent unauthorized carrying out of nuclear and radiological activities;
* protect personnel, population, property and the environment against the negative impacts of ionizing radiation;
* prevent theft, illicit trafficking of nuclear and radioactive materials and ensuring the physical protection of nuclear and radiological facilities.

Interdepartmental cooperation

In order to increase the efficiency of cooperation and create the interaction mechanisms to ensure nuclear/radiation safety and security in the country, the National Agency has initiated and signed Memorandums of Cooperation / Understanding with most tangent relevant national institutions: Customs Service, Border Police, Civil Protection and Emergency Situations Service, State Medicine and Pharmacy University, Technical University of Moldova, NGO Technical Support Organization "INOTEH".

Human resources development

In framework of realization of the INSSP, with support of the United State of America, Swedish Radiation Safety Authority and local stakeholders in second half of 2012 and 2013, three regional and national workshops are organized:

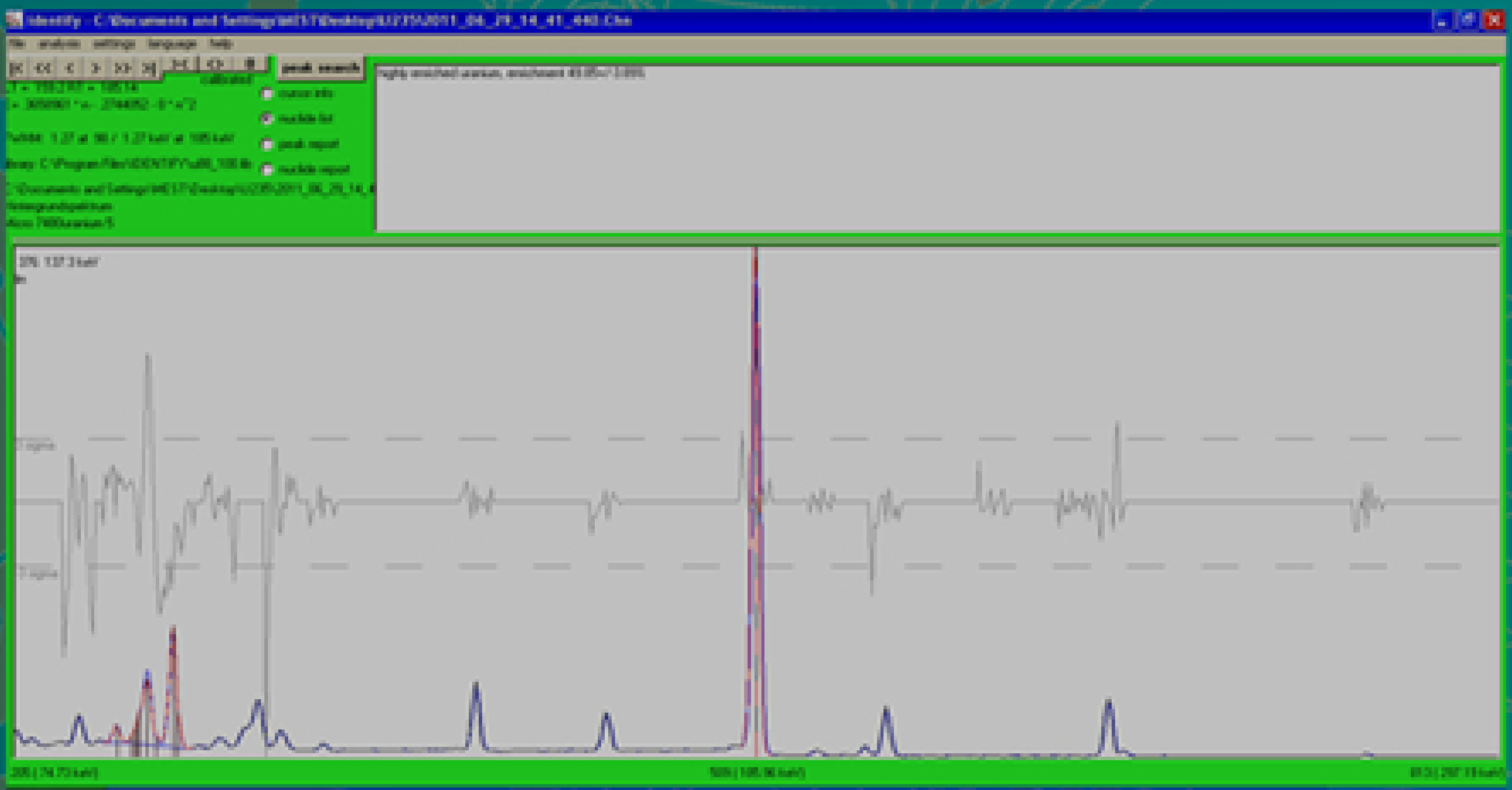
- Regional Workshop on Nuclear Forensics;
- International Workshop on Nuclear Security Issues.
- International Conference in Illicit Trafficking of Nuclear Materials Issues in Black Sea regions.

For prompt response to notifications received from the Customs Service and other authorities, the National Agency has established the Mobile Expert Support Team (MEST), equipped with advanced detection equipment installed on the vehicle, specially designed for such purposes. For more effective feedback the National Agency has received the mobile laboratory for performing measurements under the TACIS program. IAEA and Swedish Radiation Safety Authority supported acquisition of detection equipment to support establishing MEST concept. The equipment includes HPGe gamma-spectrometer, RID, PRDs and MMCA.

Tentative of illicit traffic of nuclear materials

Among the main results we note the possibility to carry out the primary identification of nuclear materials, captured in actions of combating illicit trafficking in the summers of 2010 and 2011 years

By nondestructive methods - gamma-spectrometry with HPGe detector in a few minutes were established the type and nature and average enrichment of trafficked nuclear material.



Samples of these materials were sent for advanced forensics expertise to Institute of Transuranic Elements of the European Commission from Karlsruhe, Germany and to United States. The results of analysis demonstrated that the sample is uranium oxide with approximately 76 % enrichment.

The National Agency has signed Memorandums of Cooperation with the National Commission for Control of the Nuclear Activities of Romania, Cooperation Agreement between the Swedish Radiation Safety Authority, Memorandum with the Institute for Transuranium Elements of the Joint Research Centre from Karlsruhe, (Germany) for assistance in nuclear or radioactive material forensic analysis.

In context of fortification of national capacity in combating of illicit trafficking of CBRN materials, Moldova is part of Actions Plans launched by Centers of Excellence of European Union, UNICRI and other. In this context carries on large projected of establishment of modern forensic expertise laboratories of CBRN materials which will be recognized by national legal system. Parallel with this activities will start the training of national experts and laboratory personnel in this area.

NATAIONAL SECURITY SYSTEM TO COMBAT NUCLEAR AND RADIATION THREATS IN GEORGIA

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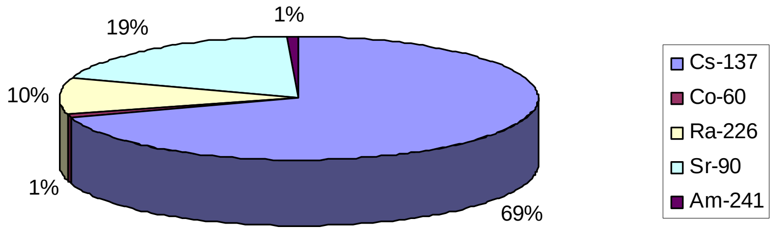

Fig.1 Found and recovered orphan radioactive sources

Nearly 300 discarded radioactive sources have been found in the country. These out-of-control sources even brought some tragic consequences to Georgia.

Georgia have received difficult heritage form Soviet related to nuclear security situation. The country already took some steps to combat nuclear and radiation threat. Developing of nuclear forensics capability is one of the important step to reach set goals to establish nuclear security regime.

Among the found orphan sources the most important are RTG. Each of them contains radionuclide $^{90}Sr/^{90}Y$ (initial act ivity of ^{90}Sr is 1 290 TBq). There were found and recovered six RTG-s.

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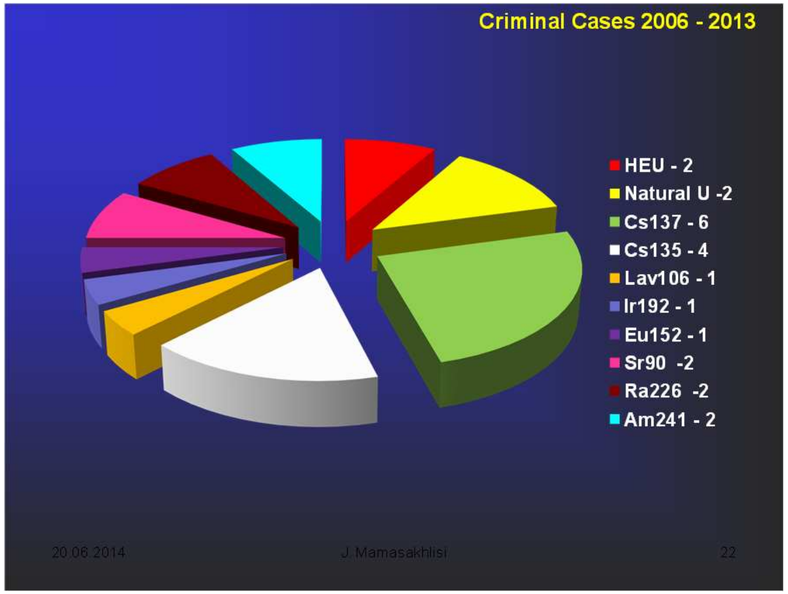
Nuclear Security Culture in Georgia



Georgia has taken a range of measures to strengthen its nuclear security culture and nuclear information security practices. The Nuclear Security Office of the IAEA is a major international player through its program for individual states, which is based on its INSSP (Integrated Nuclear Security Support Plan) and uses a “train and equip” formula. Georgia has taken a range of measures to strengthen its nuclear security culture and nuclear information security practices. The Nuclear Security Office of the IAEA is a major international player through its program for individual states, which is based on its INSSP (Integrated Nuclear Security Support Plan) and uses a “train and equip” formula.

Nuclear Forensics Laboratory in the Criminalistics Service of the Ministry of Internal Affairs is in the final stage of development.

Andronikashvili Institute of Physics. Main expertise and capabilities are:

•Fundamental research in low-temperature processes, study of cosmic rays and elementary particles, radiation material science, plasma physics, and bio-physics;
•Applied physical research, radioecology and pollution monitoring
•The Institute is operating a sub-critical assembly with an external neutron source
•The institute involved in national NF-related activities and possesses limited capabilities in identification of radioactive sources and fission materials (obsolete and contemporary (Canberra InSpector 2000) γ-spectrometric facilities)

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The Use of the Radioactive Isotopes for Cheating in Gambling - An Interaction Between Different Authorities

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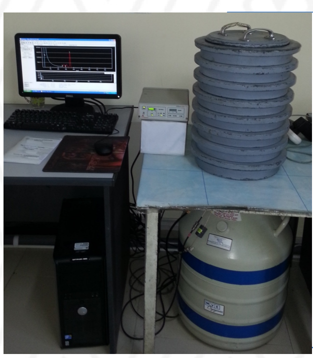
INTRODUCTION

A case study of the use of radioactive isotope of ^{125}I as a radioactive marker for playing dice is presented. During a routine check at the border cross at Chingis Khan international airport, the detector was triggered, indicating the presence of a radioactive substance in the bag of an incoming passenger. Three gaming dice with elevated radioactivity were discovered and sent to the Radiation Control Laboratory for the further analysis. The laboratory analysis showed that the side with four points was painted with paint containing ^{125}I. Spectral analysis showed characteristic X-ray and Gamma ray lines and decay half-life time, found by comparing the intensities of two measurements done two months apart, prove that the paint contains the ^{125}I isotope.

This investigation became possible thanks to the comprehensive array of radiation monitoring systems working in 15 check points around the Mongolian borders to check passengers, cars and trains crossing the international border. The monitors are capable detecting neutron and gamma radiation. The case showed the importance of interactions in between different regulatory and law enforcement agencies.

Detector gates at:
a. International border b.Chingis Khan international airport

SAMPLES AND METHODS



The CANBERRA gamma ray spectrometer, provided through TC project, with 20 keV LLD was used to detect both X-rays and gamma rays. The detector has a photopeak relative efficiency of about 40% and an energy resolution of 1.8 keV FWHM for the 1332 keV transition of ^{60}Co.

At the time of seizure, the total activity of three dices was more than 2 mSv/h near the surface. That means a person handling the dice for 10 hours could potentially get exposed to radiation exposure that are permitted for a radiation worker for a whole year.

Characteristics of γ and X-rays lines used

Iodine-125

Atomic number:	53	
Half-Life:	59.4 day	
Possible parents:		
Parent	Fraction (%)	Decay Mode
Xe-125	100%	e+b+
Decay products:		
Daughter	Fraction (%)	Decay Mode
Te-125	100%	e

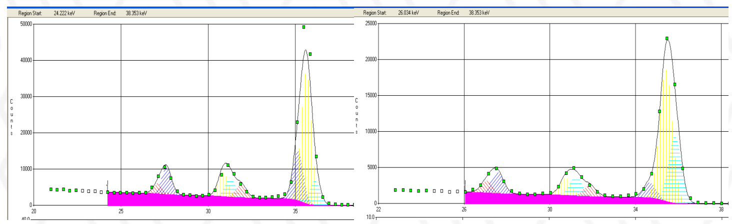
Iodine-125

Gamma emissions:

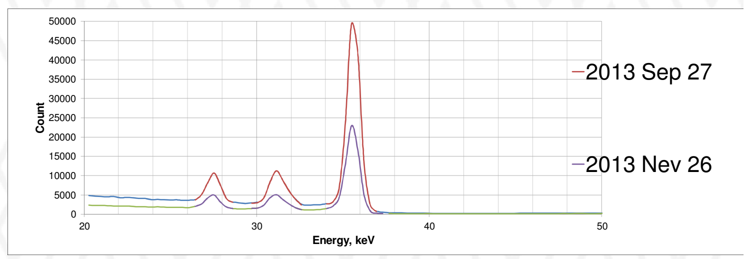
Energy, keV	Intensity, %	Decay mode
35.49	6.7	e

X-Ray emissions:

Energy, keV	Intensity, %	Assignment
27.47	75.7	Te Ka1
27.20	40.6	Te Ka2
30.99	13.2	Te Kb1
30.94	6.8	Te Kb3
31.70	3.8	Te Kb2



The characteristic spectrum taking on dices



RESULTS

Date of measurements	Energy, keV	Net photo peak count	Intensity, %	FWHM
2013 Sep 27	27.5	14761	1.02	0.671
	31.1	23055	0.83	0.685
	35.5	94457	0.29	0.701
2013 Nov 26	27.5	6028	1.49	0.67
	31.1	12218	1.24	0.685
	35.5	46161	0.43	0.701

I-125		
Half-Life, days	Nominal	59.4
	Found	60.6 ± 3.5

CONCLUSION

1. Characteristic X-ray lines 27.5 keV, 31.1 keV and γ line 35.5 keV for ^{125}I were detected. Half life found to be 60.6 ± 3.5 days and consistent with nominal value of 59.4 days for ^{125}I.
2. The dice handler during the 10 hours of a game could potentially get exposed to the radiation that is allowed for the radiation worker for whole year.
3. Considering that a similar case was detected in China[1] to mark a dice with paint containing Am-241 show that in the gambling world, players use marked dice to cheat.

REFERENCE **1. Radioactive Dice Seized in Xiamen Port (2010)**

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Australia's Experience in the Galaxy Serpent Table Top Exercise

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Introduction:

Australian Nuclear Science and Technology Organisation (ANSTO) National Security Research Program staff participated in the International Technical Working Group on Nuclear Forensics (ITWG) Galaxy Serpent National Nuclear Forensics Library (NNFL) Table Top Exercise.

Method:

We established a "Virgo Galaxy" NNFL using three isotopic datasets (named Anthea-PWR, Atlas-BWR and Enceladus-BWR) and compared an unknown (Clio) with the NNFL (using Microsoft Excel and Multivariate Analysis).

Results:

We determined that the Clio material was unlikely to have originated from our Galaxy.

Table 1. Extracted example of the Anthea-PWR raw data supplied as part of the TTX

No	Data Type	Cooling Year	Values	1 sigma uncertainty	Unit	Uncertainty (% 1 sigma)
1	Am-241	6.7	0.377	0.018473	kg/MTU initial	4.90
2	Am-241	6.7	0.679	0.033271	kg/MTU initial	4.90
55	Pu-238/Total Pu(RateOfWeight)	6.7	0.0196	0.00044296	None	2.26
56	Pu-238/Total Pu(RateOfWeight)	6.7	0.0326	0.00073676	None	2.26
440	burnup(by Nd-148 method)	6.7	46.5	1.1625	GWD/MTU	2.50
441	burnup(by Nd-148 method)	6.7	37.3	0.9325	GWD/MTU	2.50

Table 2. Extract of Isotopic correlations available from Virgo Galaxy reactors

Reactor	Sample number	U235% / U-236%	(Np-237/ U236)/ U-235%	(Pu/U238)/U235%	U235%/(Pu/U)
Anthe-PWR	1	1.347692308	0.200913242	0.019732891	51.10851809
	2	0.463768116	0.731884058	0.065831557	15.23809524
	3	0.89244186	0.331414287	0.030667225	32.8342246
Atlas-BWR	1	1.511221945	0.160901377	0.013940148	72.48803828
	2	4.530201342	0.043251305	0.004783467	212.5984252
	3	1.333333333	0.168717921	0.014759553	68.4144819
Unknown Clio-1	1	3.042896608	0.056679288	0.00484989	209.3833343
Unknown Clio-2	2	1.250392855	0.156975926	0.012935539	78.12343555
Unknown Clio-3	3	0.904797384	0.225616535	0.01880911	53.64692536
Unknown Clio-4	4	1.802190937	0.102894731	0.008253987	122.6554573

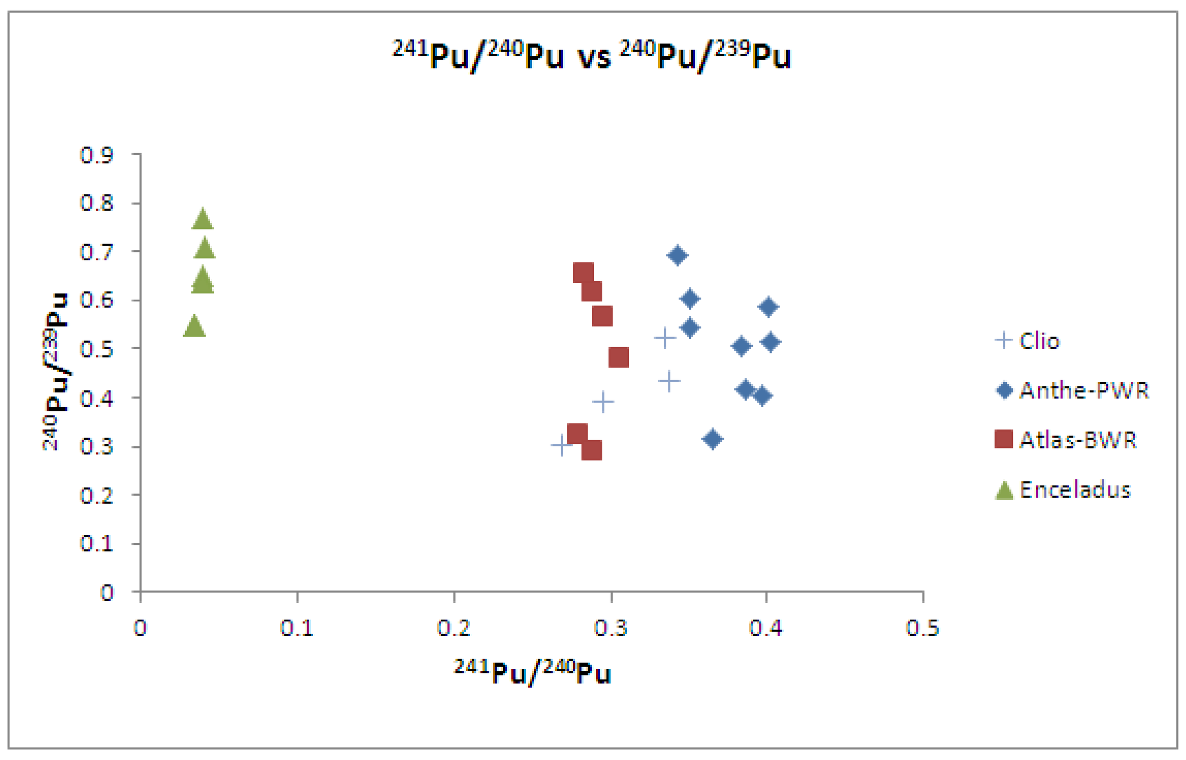

Figure 1. The isotopic correlation $^{241}Pu/^{240}Pu$ vs $^{240}Pu/^{239}Pu$ comparing "Virgo Galaxy's" three reactors to the intercepted Clio sample

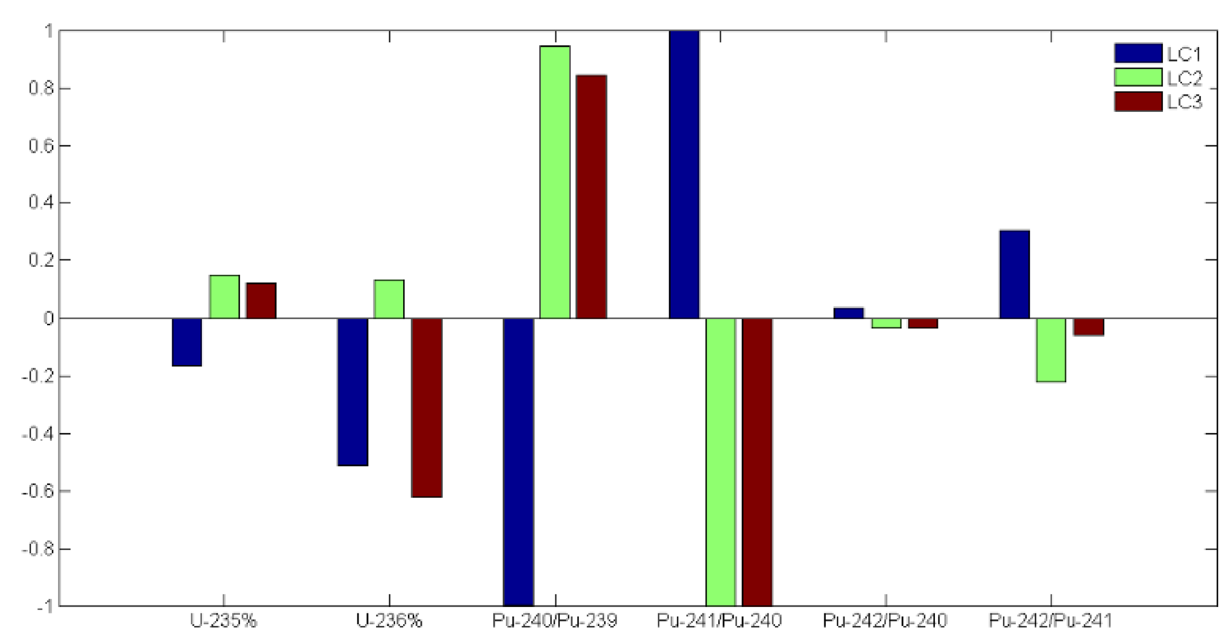

Figure 2. Fisher Linear Discriminant Analysis (FLDA) loading co-efficients of the $^{235}U\%$, $^{236}U\%$, $^{240}Pu/^{239}Pu$, $^{241}Pu/^{240}Pu$, $^{242}Pu/^{240}Pu$ and $^{242}Pu/^{241}Pu$ data types between the three reactors and intercepted sample Clio

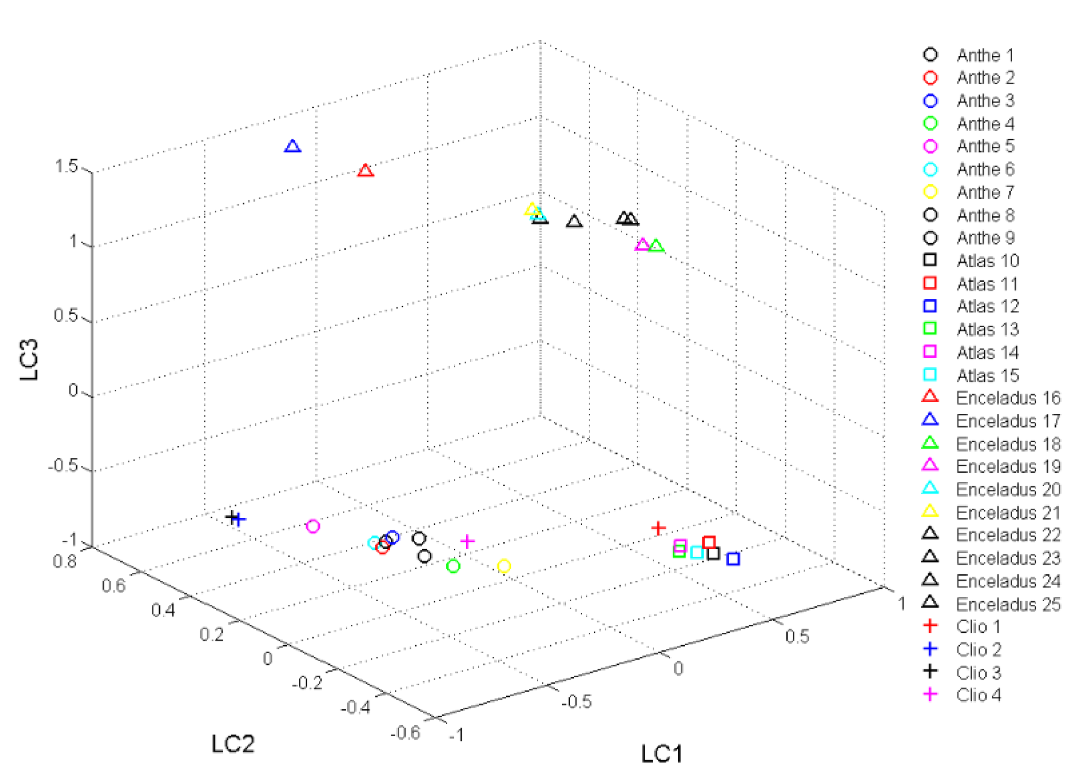

Figure 3. FLDA of the $^{235}U\%$, $^{236}U\%$, $^{240}Pu/^{239}Pu$, $^{241}Pu/^{240}Pu$, $^{242}Pu/^{240}Pu$ and $^{242}Pu/^{241}Pu$ data types between the three reactors and intercepted sample Clio

Table 3. A summary of the data types used in each statistical analysis to determine whether the intercepted sample Clio matched a reactor from the Virgo Galaxy

Data types analysed	Analysis tool	Clio data match to		
		Anthea-PWR data	Atlas-BWR data	Enceladus-BWR data
^{235}U (%wt), ^{238}U (%wt), $^{240}Pu/^{239}Pu$, $^{241}Pu/^{240}Pu$, $^{242}Pu/^{240}Pu$, $^{242}Pu/^{241}Pu$	FLDA	Suggestive positive	Suggestive positive	Conclusive negative
$^{241}Pu/^{240}Pu$ vs $^{240}Pu/^{239}Pu$	MS Excel	Inconclusive	Suggestive positive	Conclusive negative
All provided isotopes (% wt)	FLDA	Suggestive positive	Suggestive negative	Not analysed
Plutonium ratios, total $Pu/^{238}U$, total Pu/total U, $^{99}Tc/U$, ^{241}Am/total U, ^{237}Np/total U, $^{237}Np/^{236}U$, $^{236}U/^{238}U$	FLDA	Inconclusive	Suggestive negative	Not analysed
All isotopic correlation datasets	FLDA	Inconclusive	Inconclusive	Not analysed
> 0.1% of transuranic elements	FLDA	Inconclusive	Inconclusive	Not analysed
Amounts of indivudal isotopes in kg/MTU, burnup of isotopes in GWD/MTU, isotopic ratios	FLDA	Inconclusive	Inconclusive	Not analysed

Conclusions:

1. An NNFL can be readily generated using common software (such as Microsoft Excel).
2. If available, multivariate analysis (MVA) techniques can provide additional insight to Excel analysis.
3. SI units should be used to aid communication between stakeholder groups (e.g. nuclear engineers and forensic scientists).
4. In this study we compared averaged reactor fuel data with individual fuel pellet data. This may not reflect real world experience.
5. The experimental results from this study showed that the 'unknown' was a suggested negative match (unlikely) to have come from any of the reactors included in the Virgo Galaxy NNFL.

Table 4. Isotopes of interest for establishing a National Nuclear Forensics Library – example from the papers appendix

Isotope	Significance Fissile, Fissionable, Fertile, stable Natural abundance Created by… fission of… Unique characteristics/ comments
^{235}U	Fissile Natural abundance 0.72 % Enrichment level depends on application. For example: Conventional enriched power reactor fuel contains 3-5% ^{235}U Low enriched Uranium (LEU) < 20% ^{235}U High enriched Uranium (HEU) > 20% ^{235}U
^{236}U	Weakly fertile Natural abundance: < $1x10^{-10}$ % Generated by ^{235}U (n,g) An effective burn up marker in nuclear forensic applications as it is not fissile and is weakly fertile. With supporting data, can be used to indicate initial U-235 enrichment in irradiated fuels.
^{238}U	Fertile and fissionable Natural abundance: 99.2745% Captures a neutron and becomes (indirectly) ^{239}Pu
^{238}Pu	Fertile and fissionable Generated by ^{238}Np (beta decay), ^{239}Pu (n, 2n) and ^{242}Cm (alpha decay) Relatively low yield in power reactors compared to other Pu isotopes
^{239}Pu	Fissile Generated by ^{239}U beta decay to ^{239}Np, then beta decay to ^{239}Pu Characteristic marker of fluence received in a reactor
^{242}Pu	Fertile and fissionable Generated by ^{242}Pu (n,g) Characteristic marker of large amounts of fluence received in a reactor
^{241}Am	Fissile Generated by ^{241}Pu (beta decay), Under neutron irradiation, ^{241}Am readily captures neutrons and transforms to ^{242}Am. In a stable environment, the weight % of ^{241}Am builds up steadily over time, consequently it is a characteristic marker of how long material has been out from a fissile environment.
^{137}Cs	Fission product ~6.3% fission yield from ^{235}U May be used as a burnup indicator for fuel elements working at relatively low temperature (<500°C) Short term heat emissions caused by ^{137}Cs in spent fuel is a limiting factor for geological storage A commonly used radioisotope in industrial applications and medical therapy to treat cancer
^{237}Np	Fissile Long-lived isotope, half-life of 2 million years considered as waste "bottle neck" Produced in the nuclear reactor from neutron irradiation of ^{235}U and ^{238}U Can be used in nuclear fission reactions and has similar critical mass as ^{235}U About 4-5% of ^{237}Np is found in spent nuclear fuel as Pu discharge
^{90}Sr	Fission product May be used as a burnup indicator for fuel elements working at relatively low temperature (<500°C) Short term heat emissions caused by ^{90}Sr in spent fuel is a limiting factor for geological storage A huge amount produced during nuclear weapon testing Used as a radioactive tracer in medical and agriculture studies
^{99}Tc	Fission product Short-lived parent ^{99m}Tc is a widely use radioisotope in medical diagnostic applications

Nuclear Security Capacity Building at the Centre for Applied Radiation Science and Technology (CARST)

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1. Background and Objectives

South Africa's New Nuclear Build Programme demands Human Resource and Infrastructure capacity building for training nuclear scientists in Nuclear Security and nuclear forensics research.

In this paper we give an overview of recent activities at the Centre for Applied Radiation Sciences and Technology (CARST) aimed at human and infrastructural capacity building to ensure Security of our acquired Eldorado 78 Co-60 Source. Secondly CARST is introducing a PhD Programme that will provide training of scientists in various fields including Nuclear Security and Nuclear Forensic as part of our Capacity building.

The latest progress, developments and weaknesses are highlighted.

2. Methodological Approach

2.1. PhD Programme for Capacity building in Nuclear Security

- Developing PhD Programme in Applied Radiation Science and Technology (ARST) for Faculty training in Nuclear Security.
- Developing teaching material for MSc- and Certificate- for training Postgraduates.
- CARST collaboration with IAEA on its Support for Nuclear Security Education Programme

2.2. The IAEA CN-218 Conference

1. Information exchange in Nuclear Forensics Capacity Building
   1.1. Awareness, training and exercises
   1.2. Research and development
   1.3. Education and development of expertise;
   As a sub-field of Nuclear Security, CARST seeks to be a Training Centre for the three bulleted sub-topics above.

3. Expected Results/Outcomes

3.1. Research and Training Project

The Center will offer training to Faculty and research Students

- on crime scene inspection to determine any nuclear activity.
- Sample collection and analysis in the Laboratory.
- attribution of material to origin, analysis for isotopic signatures
- Currently two staff members are being trained under the Partnership for Nuclear Security (NPS) Project at CARST.
- Installation of Physical protection system of the Eldorado Co-60 source is at an early stage. See Fig 1 and Fig 2.

The following are the expected Project outcomes:

Short term:

i. Faculty members trained under the faculty development Programme to offer the MSc and Certificate Curricula in Nuclear Security and PPS.
ii. Launch of PhD training Programme to commence in January 2015.

Long Term:

Sustainable training to Postgraduate in nuclear security, nuclear forensics, and providing the exceptional skills needed by South Africa's nuclear industry.

Who will benefit:

i. Three PhD's graduates specializing in nuclear security will be produced starting in January 2018. At least ten MSc students should be produced as from end of 2015.
ii. Customs, Police and Emergency Response Officers in Government.

3.2. Weaknesses

Need access to samples from demo crime scene for forensics studies.

Need Registration as one of the Nuclear Forensics Laboratories in South Africa.

Experimental Equipment and Results

Available at CARST are on –site inspection equipment for alpha, beta and gamma radiation using the Inspector 1000 (Canberra), Environmental Monitoring of atmosphere on site using the Eco-Gamma monitor (Canberra) and the Alpha Guard. The HPGe Detector (Canberra), ICP-MS Quadruple from Perkin Elmer NexION 300q) isotope ratio mass spectrometry will be used for the categorization at the nuclear forensics laboratory, and GC-MS Spectrometry system. Expected results are shown in Fig 1 below.

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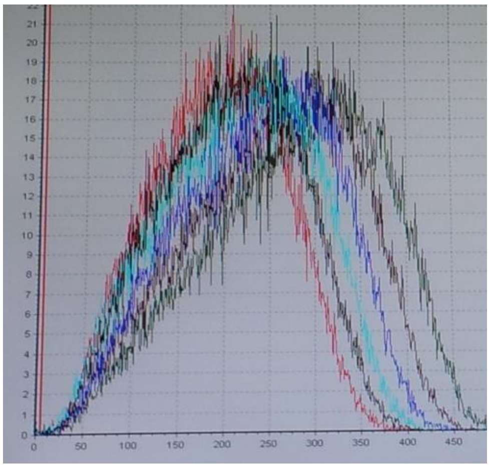

Fig. 1. *Sample spectrum from LSC at CASRT facility*

Fig. 2. *Perkin Elmer LSC spectrum for possible nuclear forensics research and training*

4. Conclusions and Acknowledgements

CARST is well equipped and has well-structured Programme for Capacity building (training of staff and Postgraduate students) in Nuclear security. It is capable of undertaking nuclear forensics analysis of crime scene samples.

The author gratefully acknowledge the IAEA CN-218 Programme Committee for the invitation and U.S. Department of State's Bureau of International Security and Nonproliferation, Office of Weapons of Mass Destruction Terrorism (WMDT) for providing Sponsorship to attend this sighnificant Conference

CHALLENGES IN IDENTIFYING RADIOACTIVE MATERIAL IN SCRAP METAL

IAEA – CN – 218/33

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Introduction

Since the installation of portal monitors at the entrances of the three major steel industries in Greece in order to facilitate the detection of radioactive material in scrap metal and to address the illicit trafficking threat several radioactively contaminated items and orphan sources have been detected in scrap metal.

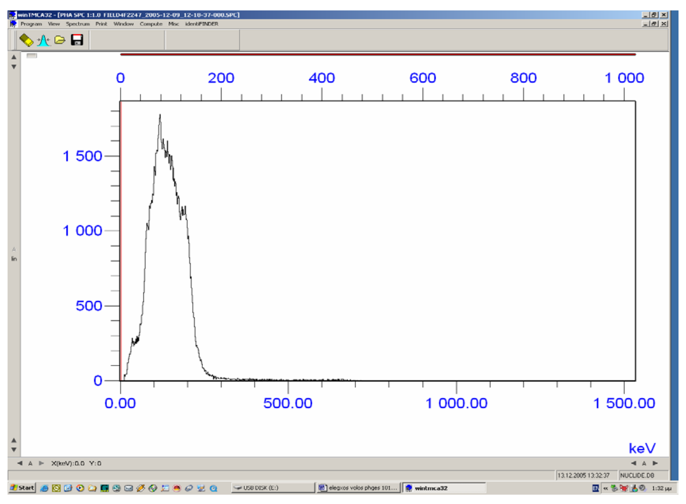
The scope of this work is to present noteworthy cases that have occurred and the challenges encountered in identifying the isotope in the detected orphan sources and other radioactive material employing gamma spectroscopy, specifically regarding the interpretation of the spectra acquired with NaI and HPGe detectors.

Methods

Equipment for isotope identification and activity estimations of the detected items: laboratory stationary and portable HPGe gamma spectroscopic systems (HPGe), NaI spectroscopic systems, portable detectors for gamma dose rate measurements and total α/β survey meters.

Radioactive objects located in the scrap metal load

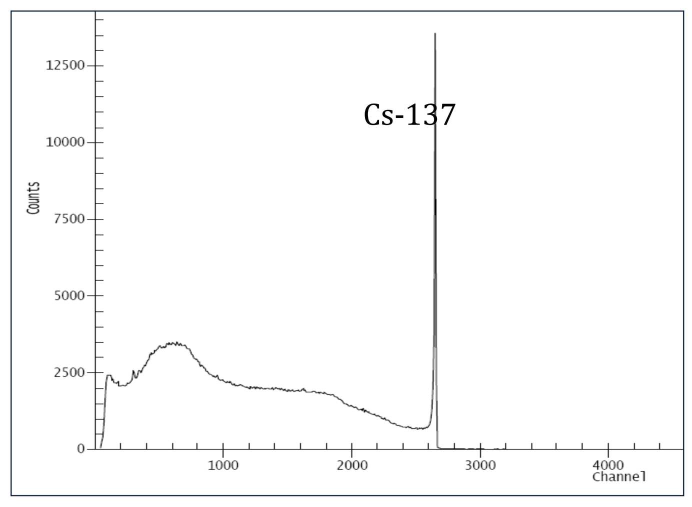
Results



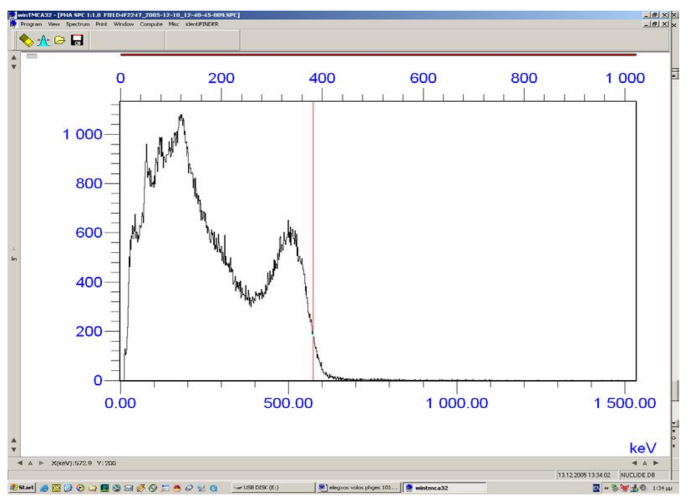
NaI spectrum in contact with the shielding

Imported scrap metal load:

- Cs-137 industrial source, dose rate up to 20μSv/h
- Ra-226 Part of lightning rod
- Ra-226 military device, dose rate up to 70 μSv/h
- NORM contaminated pipes dose rate up to 3 μSv/h
- Cs-137 industrial source, radius 15cm, dose rate ranging from 3- 500μSv/h, estimated activity 500 Ci (HPGe spectrum and Monte Carlo calculations)



HPGe spectrum in contact with the shielding

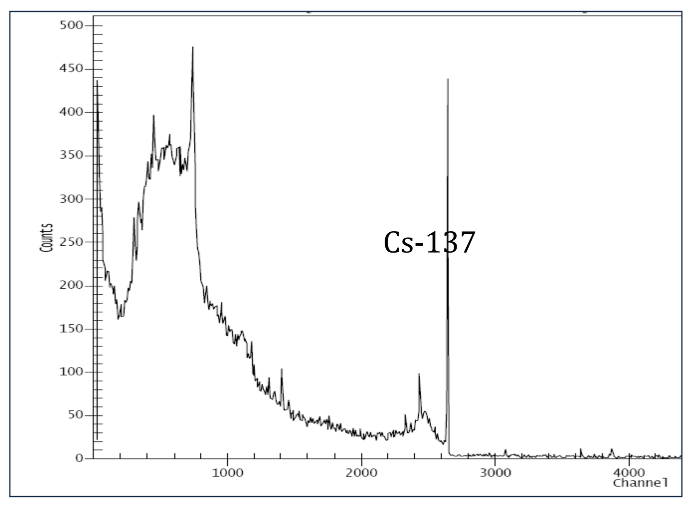


NaI spectrum at 2m distance from the source window

NaI detector identified the isotope as Ra-226, while the HPGe detector revealed that it was a Cs-137 source.

Reason for spectrum misinterpretation:

- a crack in the shielding in the opposite direction of the detector caused the source beam to reflect on a wall before reaching the detector
- the Compton effect of the scattering of the source beam due to the shielding

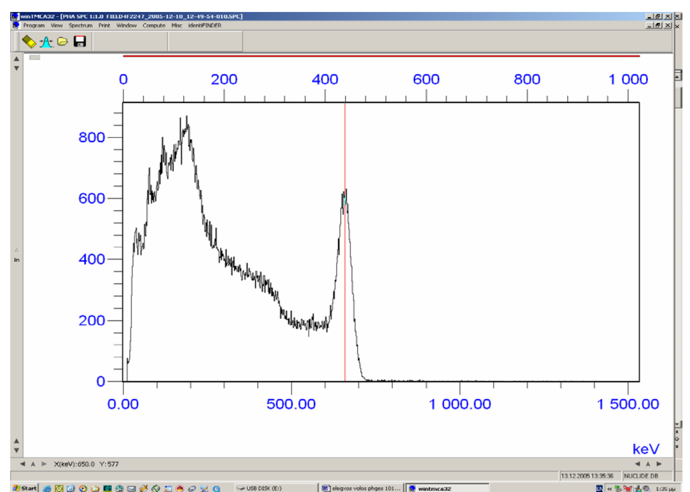


HPGe spectrum at 1m distance from the source window

Industrial source with small shielding, maximum dose rate 20 μSv/h.

Isotope identification as Cs-137 with a NaI detector was possible despite the pronounced superposition of the Compton continuum, due to scattering on the shielding.

Dose rate measurement in contact with the source



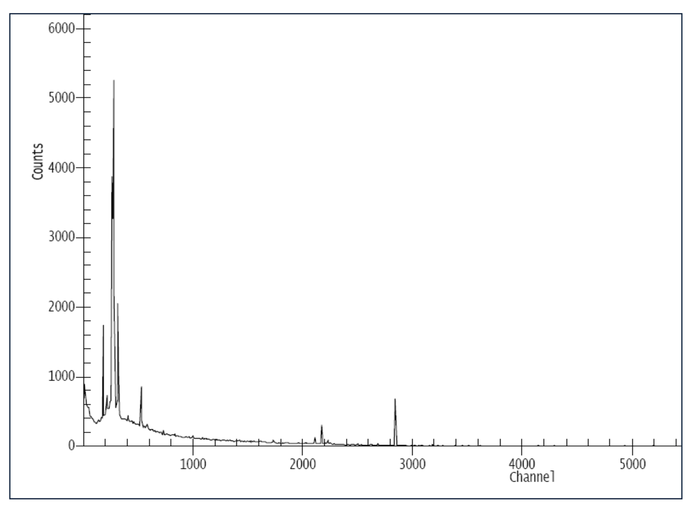
Gamma spectrum in contact with the source

Natural uranium ore (146g,) 50 -75 μSv/h

NaI detector : Ra-226, due to the presence of the 186 and 1001 keV photopeaks.

HPGe detector : U-238 of a specific activity of 5300 ± 160 Bq/g, 42.7% w/w.

Identification with NaI detector



HPGe detector spectrum

Conclusions

Isotope identification and activity determination of orphan sources and radioactive material located in scrap metal requires not only the conduction of measurements with gamma spectroscopy detectors, but also careful examination of the acquired spectra and awareness of equipment limitations.

CN-218 International Conference on Advances in Nuclear Forensics: Countering the Evolving Threat of Nuclear and Other Radioactive Material out of Regulatory Control,7-10 July 2014, Vienna, Austria

IAEA-CN-218/35

Countering the Evolving Threat of Nuclear and Other Radioactive Material out of Regulatory Control: Jamaica's Experience

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Abstract

Developing sustainable approaches to strengthen the safety and security of nuclear and other radioactive materials in Jamaica was propelled by the successful bilateral "Megaports" initiative of the US DOE's National Nuclear Security Administration (NNSA) and their Second Line of Defense and the Government of Jamaica through the Jamaica Customs (2006). Through this initiative, since 2009, four (4) discoveries of source of radiation have been uncovered, all found in shipments for international transport. Jamaica was prompted by these discoveries to becoming the 118th Member State of the then International Atomic Energy Agency's Incident and Trafficking Database (ITDB) as of 2013, and subsequently now in the final stages of completing a Jamaican specific Integrated Nuclear Security Support Plan (INSSP); a non-binding instrument with the IAEA. These two nuclear security systems both have the potential of lowering the evolving threat of nuclear and radioactive material out of control in Jamaica as we develop a legislative and regulatory framework which supports nuclear safety and security issues with reference to international legal instruments and IAEA guidelines.

Introduction

- Jamaica currently has the only nuclear reactor in the English speaking Caribbean, a small 20 kW 93% highly enriched uranium core, used at the University of the West Indies since 1984 as a research tool. Jamaica also has a long history of importing radioactive materials for productive use in medicine, industry, agriculture and other areas of research.
- The presence of sealed radioactive sources (SRSs) in scrap metal and the metal recycling industries, along with customs or border protection incidents are consistent with the problems of orphaned sources in other developing and developed countries.
- Developing countries like Jamaica have significantly lower radioactive source inventories relative to developed states such as the European Union (EU) and the United States of America (USA). Jamaica has also been faced with a weak national regulatory infrastructure which is believed to be the reason for a higher risk of sources becoming orphaned.
- The latest improvements to safety and security at the border protection and transhipment Port in Kingston, for monitoring of nuclear and other radioactive materials in import/export and transhipment trade is due mainly from resources donated through the USA's Department of Energy (DOE) and the National Nuclear Security Administration (NNSA), through their Second Line of Defence (SLD), under the theme "Megaports" Initiative. In June, 2006 the Government of Jamaica and the United States of America signed a Memorandum of Understanding (MOU) implementing the "Megaports" initiative at the ports of Kingston: the Port Authority of Jamaica's Kingston Wharves Limited (KWL) and Kingston Container Terminal (KCT).
- The aim of the program was specifically "to provide equipment, training, and technical support to its international partners to enhance their ability to deter, detect, and interdict illicit trafficking of special nuclear weapons of mass destruction (WMD) and other radioactive materials in the global maritime system"(2009).
- SRSs and other radioactive materials out of regulatory control have been discovered and intercepted at our ports. Sources were taken under control and are temporarily stored due to the efforts of Jamaica's Office of Disaster Preparedness and Emergency Management (ODPEM), the Jamaica Customs and ICENS.

Source	Type of Operation	No. of Sources
Cs-137	Medical	59
Co-60	Medical	2
Am-241	Medical	10
Sr-90	Medical	3
Radium	Medical	380
Linear Accelerator	Medical	1
Ir-192	Industrial	3
Industrial sources	Industrial	Unknown
U-235	Academia	1
TOTAL		459

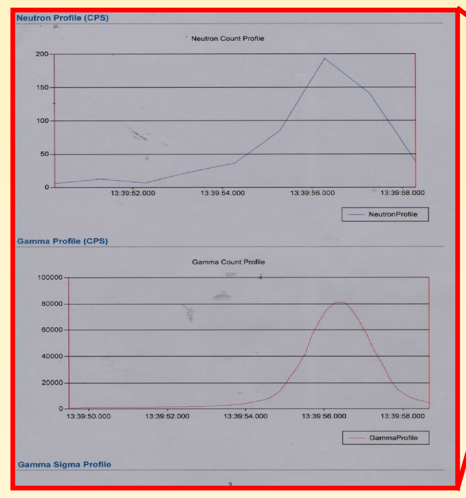
- Nuclear and Medical Source Inventory in Jamaica , No proper inventory for existing industrial sources (2012).

Methods

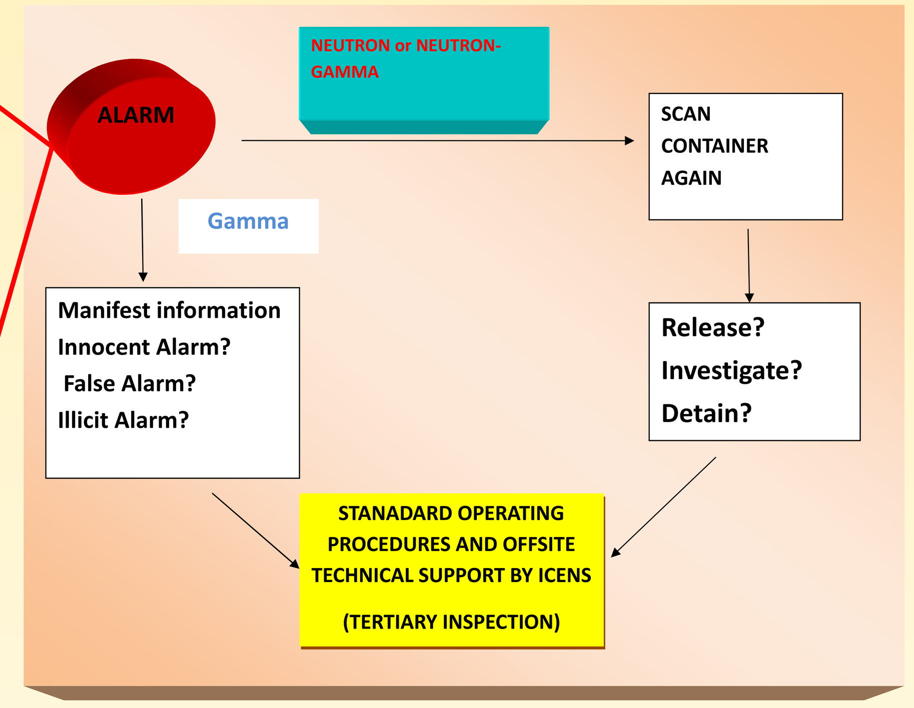
There are two (2) pairs of radiation portal monitors (RPMs) at entrance and exit check points at the port , with one straddle carrier dedicated to transshipment cargo. Each RPM consists of two (2) gamma and two (2) neutron detectors, control electronics, power supplies and occupancy sensors; a battery backup and communication equipment are also installed. The equipment passively detects radiation, however five (5) alarms can be triggered. These include alarms for neutron and gamma radiation, also tampering, high/low background readings, and internal faults.

- Gamma-Neutron Monitors at Jamaica's Ports in Kingston Jamaica (a) Entrance Check Point (b) Exit Check Point (c) Straddle carrier for transshipped cargo monitoring

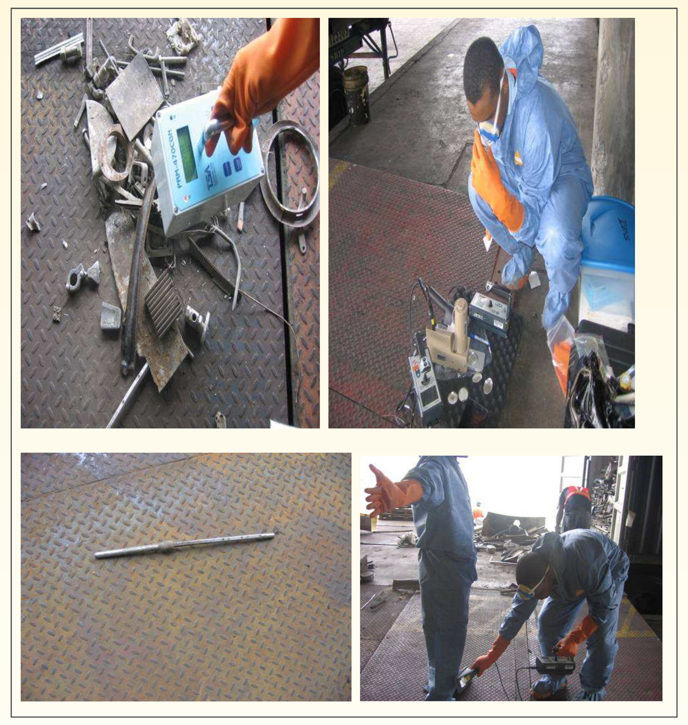
THE STANDARD PROCEDURE AND RESPONSE FRAMEWORK IN EFFECT FOR THE CATEGORIZATION AND CHARACTERIZATION PROCESS FOR NUCLEAR OR OTHER RADIOACTIVE MATERIAL INCIDENTS:



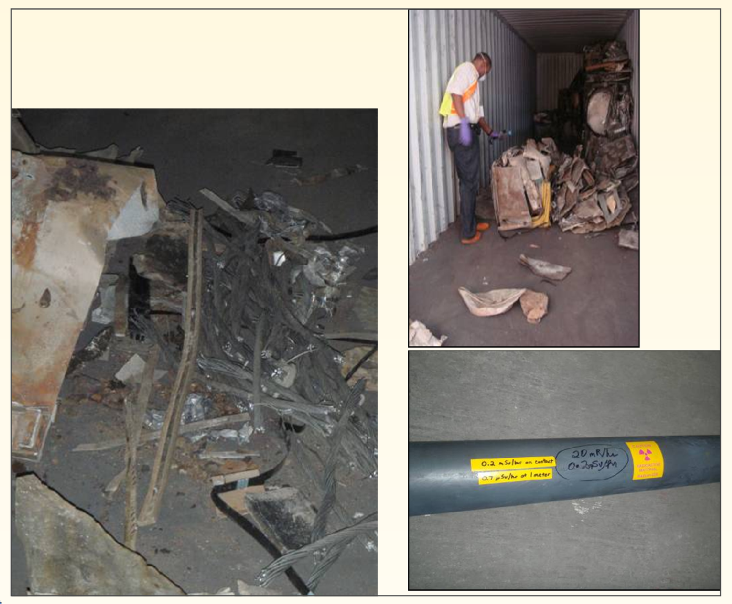
- Neutron Gamma Profile of an alarm triggered demanding an investigation



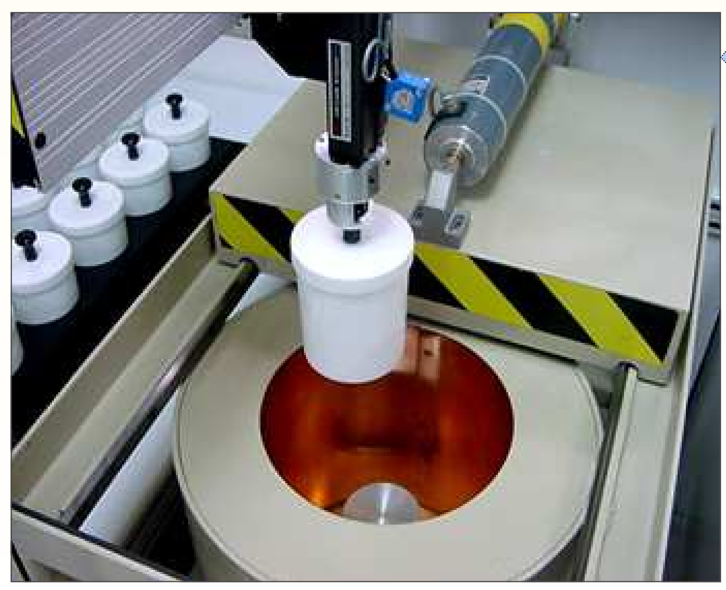
- Secondary Inspection Process Leading up to a Tertiary Inspection by Technical personnel



- Source Recovery and Inspection for a Neutron-Gamma Alarm. Surface Moisture Density Gauge with Cs-137 and Am-241,Be Sources

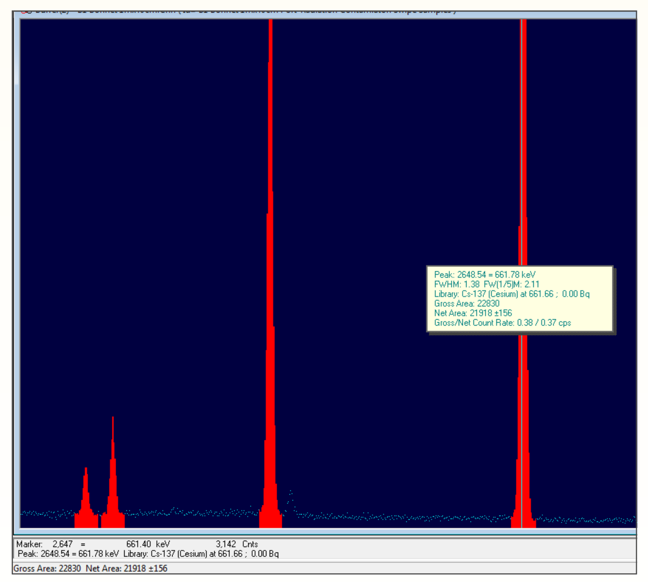


- Source Recovery and Inspection for a Gamma Alarm. Static Eliminator, a Ra– 226 lined H-Strip of Metal



Some Additional Forensics capabilities offered by ICENS:

- High Purity Germanium Detectors
- Neutron Activation Analysis
- X-ray Fluorescence Spectrometry & ICP OES



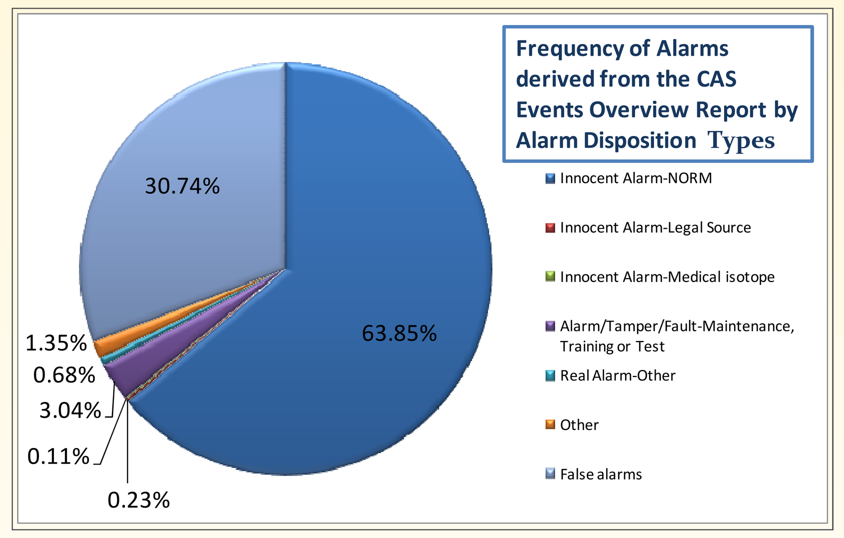
- Results and reports generated, INF's for the ITDB produced

Results

Year Log	Source of Radiation	Location	Dose Rate at Surface / (Radioactivity)	Half Life of Source/	Agency Involved	Alarm category
2008	Cs-137	Linstead, Saint Catherine	Undetermined	30.1	Retrieved by ICENS	Gamma
2009	Ra-226	KWL	Unknown	1601	Retrieved by US DOE	Gamma
2009	Ra-226	KWL	0.20mSv hr^{-1}/ (22MBq)	1601	Retrieved by ICENS	Gamma
2010	Cs-137, Am*(Be)-241	KWL	0.45mSv hr^{-1}/ (1.63GBq)	30.1, 432.2*	Retrieved by ICENS	Neutron-Gamma
2012	Cs-137 & Cs- 134	KCT	1.68µSv hr^{-1} (21.4 Bq/m^2)	30.1, 2.0652	Analysed by ICENS	Gamma

- Incident log of radiological materials discovered in Jamaica

As of May 2013 the "*Alarm Details*" section of the Jamaica Customs' Central Alarm Station (CAS) report indicated that a total of 4842 alarms were detected since August of 2009; 88 secondary inspections were further conducted on these alarms, of which, 3 alarms required tertiary inspections which identified 3 radioactive sources and 1 radioactive contamination. The statistics from the CAS overview report indicate that for approximately every 90,000 Twenty Foot Equivalent Units (TEUs), one (1) container occupying Jamaica's major import/export and transhipment Port will have a radioactive signature.



CHALLENGES HIGHLIGHTED BY THE MEGAPORTS INITIATIVE IN JAMAICA

- Capacity building deficiencies exists
- Lack of a dedicated nuclear forensics infrastructure aid by traditional forensics
- Lack of a national management strategy (a Model Action Plan) for emergencies, and safety and security relevant events involving nuclear and other radioactive sources
- National repository issues for radioactive sources out of control; for radioactive waste management
- Introduction of the "Megaports" Initiative in a developing State (Jamaica) further revealed the gaps and the implications from not having a proper regulatory framework
- Radioactive materials and sources out of regulatory control are being uncovered in scrap metal and imported trade
- Lack of a State System of Accounting and Control (SSAC) for radioactive sources exist
- A comprehensive legislative framework for safety and security of nuclear and other radioactive materials

Conclusion

The discovery of radioactive sources in scrap indicates that the management systems in place for accounting and control of nuclear and other radioactive materials are inadequate. An efficient regulatory framework is needed to minimize orphaning of sources and to maintain control over those currently in peaceful operation. With these challenges in mind and the philosophy that the responsibility of nuclear security rests entirely with each individual Member State, Jamaica has taken steps to be a part of the IAEA's illicit trafficking database and to finalize an Integrated Nuclear Security Support Plan (INSSP). We await legislation concerning nuclear and other radioactive materials in line with international legal instruments and IAEA guidelines.

Search and investigation of orphan sources in Lithuania

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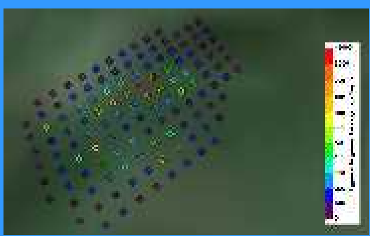
Lithuania has created national system of response in case of identification of not legal and orphan sources as well as search of such sources. Radiation Protection Centre has established laboratory, equipped with necessary technique for search, identification and further measurements of orphan sources including training on search and secure

In last years Radiation Protection Centre was launched programme for search of orphan sources in former facilities or territories used sources of ionizing radiation. During the search at soviet army military airport at place where remediation measures have been carried out 20 years ago the contamination by the radium 226 was detected



The largest part of investigated contaminated materials was discovered in metal scrap yards usually contaminated with radium or thorium as NORM. Some of sources discovered by peoples as high activity cesium source and lost smoke detectors with plutonium

Search of orphan sources and contaminated sites are performed on the asking of people as well. Inhabitants due to different reasons are asking to measure radiation at living environment. No orphan sources and radioactive contamination was found during that cases but nevertheless the search performed works for the secure life

Lithuania has established State level system for preparedness and response in nuclear or radioactive material smuggling cases also are ready to perform nuclear forensic and criminal investigation

Increasing Role of Nuclear Forensics to Support Nuclear Security Events Investigation in Indonesia

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1. Introduction

The writing purposes are to identify the existing nuclear forensic capabilities and its role in nuclear security events investigation in Indonesia. Compare them to IAEA recommendation Nuclear Security Series No.2: Technical Guide "Nuclear Forensics Support". Then analyze the gap for improvement.

This paper gives an overview of national recent capabilities, both traditional forensic and nuclear forensic, and also some recommendation on national action plan to improve the capability in nuclear forensic.

2. Method

- Identify national capability based on: existing plan and procedure, ISE (Integrated Safety Evaluation) reports to IAEA of 2013, and from the evaluation of national field exercise from 2006 – 2013;
- Literature study on requirements of nuclear forensic capability; and
- Gap analyzing in order to get some recommendation for improvement.

3. Results

3.1. Response Organization

Before conduct an investigation, the first important step is how to respond correctly to an event in order to manage the evidence to be used for law enforcement.

National Nuclear Emergency Response Organization has established in 2006 (Figure 1). At the end of 2007, this organization established their joint response guidance, developed from stakeholder's guidance, but adds some more attention to radiation risk and radiation protection.

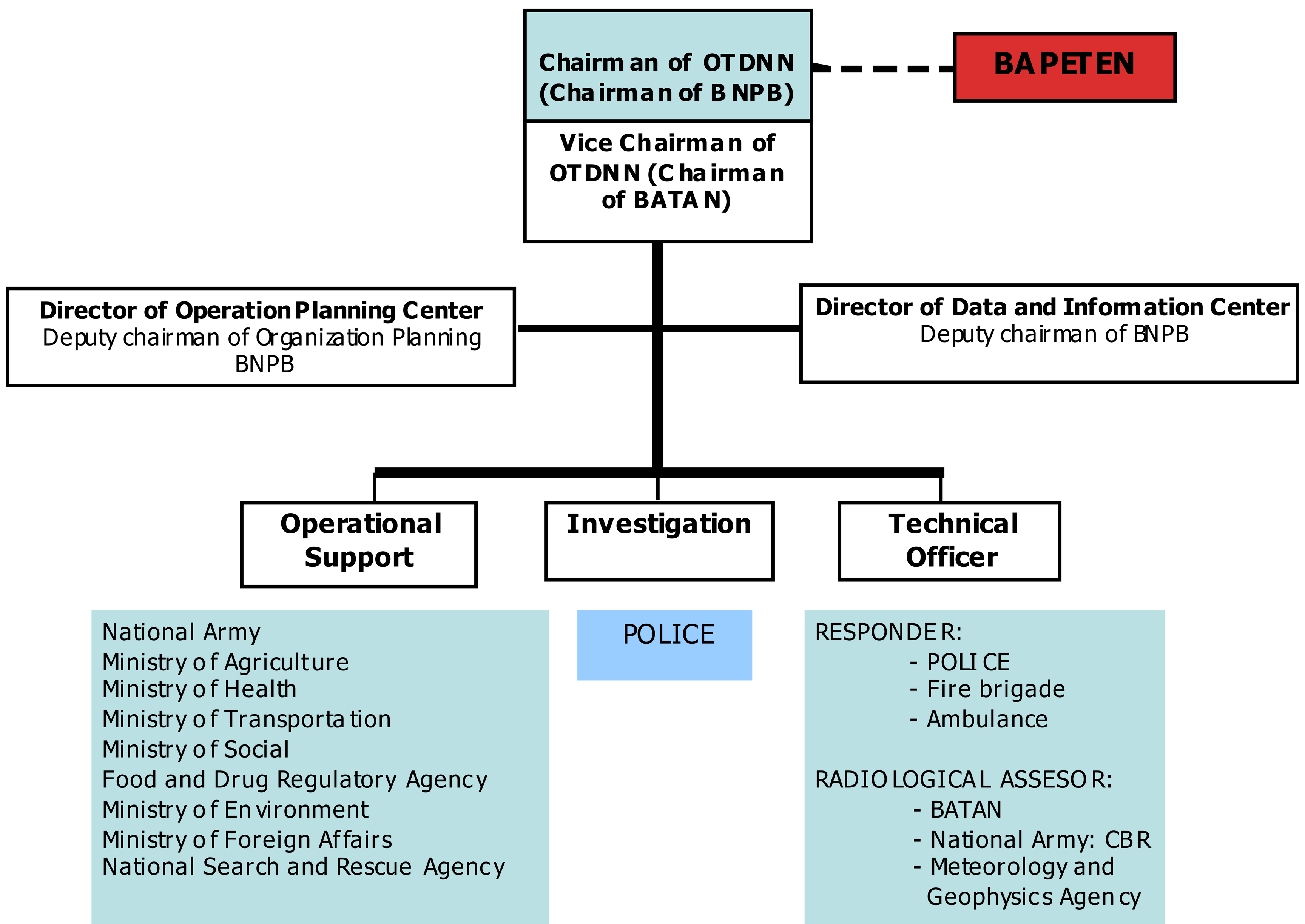

Figure 1. Structure of National Nuclear Emergency Response Organization

This is a response organization to an emergency. The response organization for a nuclear security events could also be derived from the existing organization, but need to develop by involving security agency in the operational support or technical officer, such as:

- Co-ordination Ministry of Politics, Law and Security;
- Directorate General of Customs and Excise;
- Port Operator;
- Ministry of Defence;
- Ministry of Research and Technology;
- National Counter Terrorism Agency; and
- State Intelligence Agency

The purposes of the scene response are to: minimize the radiological hazards, control nuclear/ radioactive materials, and preserve the evidence for traditional and nuclear forensics analysis.

3.2. Nuclear Forensic

BATAN as a national nuclear research agency has competent staff in handling radioactive contaminated evidence and also for current standard, but their instruments need to be reassessed according to the latest technology. BAPETEN as a regulatory body, as well as a national competent authority for nuclear security is on-going process to establish their laboratory of environment, security and safeguards.

3.3. Traditional Forensic

Police forensic laboratory has sufficient traditional forensic expertise and can be used to support nuclear forensic analysis, such as scene management by observation, analyzing and correlating the evidence. Caution should be applied when collecting the evidence in the radiological contaminated scene. Personnel involved in scene must be trained and qualified enough, also know the concept of operations and the basic concept of the radiological crime scene management and proper radiation protection.

3.4. Gap Analyzing and recommendation

Table 1. National capability in nuclear forensics

Recommendation	Current Status
1. Incident respond	
Incident investigation team;	Conducted by Police.
On-site analysis	Conducted by Police Forensic Laboratory, in coordination with BAPETEN (Mobile Expert Support Team/ Emergency Response Team) and/ or BATAN (Radiology Assessor) in the case of radiation events.
Collection of radioactive evidence	There is no arrangement yet, would be conducted by radiological expert accompany by forensic expert or vice versa.
Collection of traditional forensic evidence	Conducted by Police Forensic Laboratory.
Final survey and release of scene	Conducted by Police for bomb hazard; conduct by radiological expert (BAPETEN/ BATAN) for radiation hazard.
Evidence holding site	There is no arrangement yet.
Transportation of evidence	There is no arrangement yet.
2. Nuclear forensic laboratory	BATAN has competent researcher staff, but the instrument need to be reassessed based on current and updated technology.
3. Nuclear forensic analysis	
Characterization	BATAN already has laboratory for elemental analysis. Need to be reassessed based on current technology.
Nuclear forensic interpretation	Conducted by Police, BAPETEN, BATAN and related expert. We are lack of expert for nuclear forensic interpretation, if there is availability.
Attribution	Conducted by Police, BAPETEN, BATAN and related expert. We are lack of expert for attribution, if there is availability.
4. Traditional forensic analysis	Police forensic laboratory has sufficient expertise for traditional forensic analysis

1. Gap in incident response: investigation are conducted by Police, but for an events involving radiation, there is no interface procedure as a guide in coordination between forensic expert (Police) and radiology expert (BAPETEN/ BATAN) for conducting investigations and scene analysis; there is no arrangement yet in evidence holding site as well as for radioactive evidence transportation. Traditional evidence is stored in Police office but for radioactive evidence should be considered the radiation expose and contamination related to the availability of shielding in the Police office;
2. Gap in nuclear forensic laboratory: there is no arrangement yet which laboratory would be designated. Designation should consider the evidence chain of custody and the evidence security, but also consider easily access for further analysis. BATAN already has in place, but need to be reassessed according to recent technology in nuclear forensic; BAPETEN is on going process to establish their laboratory;
3. Gap in nuclear forensic analysis: Expert in this field is still lack, if indeed there, since we never investigate such this case;
4. Gap in traditional forensic analysis: Personnel in charge are still lack of radiation protection knowledge, concept of operations and the basic concept of the radiological crime scene management.

As we realized our weaknesses, we are now trying to improve and develop capability in nuclear forensic. We are on going process to establish Indonesia Centre of Excellent of Nuclear Security and Emergency Preparedness (I-CoNSEP). The main roles of ICONSEP are to facilitate the development of human resources, providing legal, technical and scientific support services. For nuclear forensic, it include the effort to combine the capability of traditional forensic and nuclear forensic.

Based on those findings, we could make some recommendations, such as: strengthening coordination among response stakeholders as well as related expert; increasing staff competency through education as well as training programme and increasing nuclear forensic infrastructure, such as nuclear forensic library, nuclear forensic laboratory instruments, nuclear forensic standard method and etc. We also could make a timing action plan to support these recommendations, for example:

- Year 1 – 2 are development for incident response capabilities;
- Year 2 – 5 are development for national nuclear forensic library and nuclear forensic laboratory; and
- Year 5 – 10 are development for human resource on nuclear forensic analysis and interpretation.

4. Conclusion

Since the responsibility for nuclear security rests entirely on individual States, we need to develop a reliable nuclear security system from the nuclear facility to the State border. We already have in place an emergency response organization which could be derived to nuclear security response organization. The challenges of nuclear security events are now growing. Therefore, we need to develop our nuclear security system which cannot be separated from the nuclear forensic capability.

Nuclear Forensics – An Integral Part of the Philippines' National Response Plan for a Nuclear Security Event

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Since the dropping of the first atomic bombs in Hiroshima and Nagasaki on August 1945, quoting the famous phrase, "the world has lived under the shadow of nuclear threat". This was heightened by the Chernobyl nuclear accident in 1986 and magnified by the September 11, 2001 terrorist attack of the World Trade Center in the USA. Although the attack (more popularly termed as 911 attack) was not nuclear or radiological in manner, it imparted a worldwide chilling effect that such an act that is nuclear or radiological armed can be a possibility causing major damage and massive disruption. While the threat is global, nuclear security is a national responsibility. It is in this light that the Philippine Nuclear Security Plan was formulated by the Philippine Nuclear Research Institute (PNRI) specifically to address nuclear security and terrorism with nuclear forensic as an integral part of the plan.

Prior to the 911 attack, the Philippines was confronted by three (3) major internal security concerns: the local communist movement, the southern Philippines secessionist groups, and the home-grown and transnational kidnap for ransom groups such as the Abu Sayyaf Group. To deter and overcome these threats, a 'Strategy of Holistic Approach' focusing on "Winning the Peace" theme was adopted under the National Internal Security Plan. However, after the 911 attack, the word 'terrorism' drastically changed the course of global and national security. The Philippines created its own definition and perspective on terrorism with the passage of **Republic Act No. 9372 on March 6, 2007, An Act to Secure the State and Protect Our People from Terrorism, otherwise known as "The Human Security Act of 2007". Included in this law as an act of terrorism is the use of any biological and/or chemical agent, radioactive or nuclear material, explosives, firearm or other weapons, with the intent to endanger, directly or indirectly, the safety of one or more individuals or to cause great damage to property.** With this new law, the National Plan to Address Terrorism and its Consequences was developed. Unfortunately, this plan was designed to cover hostage taking, bombing, sabotage, hijacking and piracy, but did not cover biological, chemical, radiological, nuclear & cyber terrorism.

PHILIPPINE NUCLEAR SECURITY PLAN

Strategy 1 PREVENTION (1st Line of Defense)

PROGRAMS	ACTIONS	TIME LINE	Participating Organization	Lead Organization
1.1 NATIONAL THREAT ASSESSMENT	1.1.1 Initial Security Survey Inspection	2007-2016	PNRI/DOST, NICA, NSC, PNP, NBI	NICA
	1.1.2 Initial SSI	Q1 - 2008	PNRI, NICA, NSC, PNP, NBI, Licensees	NICA
	1.1.3 Periodic SSI	Annually	NICA, PNP, PNRI	NICA
	1.1.4 Design Basis Threat	2011-2016	PNRI/DOST, DOH, OTS, NICA, NSC, PNP, NBI	NICA, PNRI, PNP
	1.1.5 Periodic Assessment	Quarterly	PNRI/DOST, DOH, OTS, NICA, NSC, PNP, NBI	NICA, PNRI, PNP
1.2 NATIONAL INVENTORY	1.2.1 National Registry (RAM) using RAIS	2007-2016	PNRI	PNRI
1.3 ACCOUNTING AND PHYSICAL PROTECTION	1.3.1 State System for nuclear material accountancy and control	In-place	PNRI	PNRI
	1.3.2 Acquisition, Movement, Storage, Use and Disposal	In-place	PNRI	PNRI
	1.3.3 Physical Protection System based on IAEA guidelines	In-place	PNRI	PNRI
	1.3.4 Security Survey Inspection (SSI)	Annually	PNRI, NICA, PNP	PNRI, NICA
1.4 SECURITY TRAINING AND EDUCATION	1.4.1 Identify training needs/rationalize/ formulate training programs	2007-2016	PNRI, PNP, OTS, NICA	PNRI, NICA
	1.4.2 Formulate National Nuclear Security Training (NSTP) Program	2007-2016	PNRI, PNP, NICA, OTS	PNRI
	1.4.3 Implement NSTP	2007-2016	PNRI	PNRI
1.5 ADVOCACY	1.5.1 Identify audience/classify information	2007-2016	PNRI, NALECC, OSETC	PNRI
	1.5.2 Design Advocacy Program	2007-2016	PNRI, NALECC, OSETC	PNRI
	1.5.3 Implement Advocacy Program	2008-2016	PNRI, NALECC, OSETC	PNRI
	1.5.4 Review and Assess Program	Annually	PNRI, NALECC, OSETC	PNRI
1.6 LEGISLATION	1.6.1 Create working group to review laws & amendments	In-place	PNRI, DOJ, PNP, NBI	PNRI, DOJ
	1.6.2 Strict implementation and enforcement of RA 5207, RA 6969 and RA 9372 "Human Security Act 2007"	2008-2016	PNRI, DOJ, NBI, PNP, AFP, NICA	PNRI, DOJ
1.7 INTERNATIONAL COOPERATION	1.7.1 Strengthen and foster international cooperation	2007-2016	DFA, PNRI, DND	DFA, PNRI

Strategy 2 DETECTION (2nd Line of Defense)

PROGRAMS	ACTIONS	TIME LINE	Participating Organization	Lead Organization
2.1 BORDER CROSSING DETECTION	2.1.1 Support the Megaports Initiative	In-place	PNRI, BOC, PPA/ Port Terminals	PNRI/BOC
	2.1.2 Provide portable Scanners/sensors to border patrols	In-place	PNRI, BOC	PNRI/BOC
	2.1.3 Operation of Megaports Initiative	continuing	PNRI, BOC, PPA, Terminal Operators	PNRI/BOC
2.2 REPORTING/ NOTIFICATION SYSTEM	2.2.1 Establish EEI (essential elements of notification)	ASAP	PNRI, PNP, DILG, NICA	NICA/PNRI
	2.2.2 Interagency MOA	2007-2016	All Agencies concerned	PNRI
2.3 INVESTIGATION	2.3.1 International cooperation, domestic intelligence	2007-2016	PNP, AFP, BOC, PNRI, NICA, NBI	NICA/PNRI
2.4 TRAINING & EDUCATION	2.4.1 Training on Nuclear Security	2007-2016	PNRI, PNP, NICA,BOC, NBI	PNRI

Strategy 3 RESPONSE (3rd Line of Defense)

PROGRAMS	ACTION	TIME LINE	Participating Organization	Lead Organization
3.1 EMERGENCY RESPONSE & SEC.	3.1.1 Security drills	ASAP	PNRI, PNP, BFP, NDCC	PNRI
3.2 EMERGENCY PLANS, PROCEDURES AND EQUIPMENT	3.2.1 Revise RADPLAN	ASAP	RADPLAN Members	PNRI
	3.2.2 Acquire adequate equipment	ASAP	PNRI, NDCC	PNRI
	3.2.3 Ensure immediate response to emergencies	As needed	NDCC, PNRI, LGU, PNP, AFP	PNRI/NDCC
	3.2.4 Regular drills and dry runs	Quarterly	NDCC, PNRI	NDCC/PNRI
3.3 FORENSIC AND INVESTIGATION	3.3.1 Acquisition of required forensic equipment	As needed	NBI, PNRI, PNP, AFP	PNRI/NBI
	3.3.2 Organization of investigation unit	As needed	NBI, PNRI, PNP, AFP	NBI
3.4 ARREST AND SEIZURE	3.4.1 Arrest of violators of pertinent laws		PNP	PNP
	3.4.2 Seizure of RAM/NM		PNP, PNRI, BOC	PNP/PNRI

NATIONAL NUCLEAR SECURITY PLAN (2010 – 2016)

A. Legislative and Regulatory Framework

Program	Action	Timeline	Responsible Entity
1. Proposal to create an Independent regulatory body	a. Create a technical working group to draft the comprehensive nuclear law b. Submit the bill on the proposed "Comprehensive Nuclear and Radiation Regulatory Act"	2010 2011	PNRI
2. Development of regulations relating to nuclear security.	a. Adopt IAEA nuclear security recommendations & guides b. Amend or develop additional regulations in areas relevant to nuclear security c. Request expert assistance in reviewing/drafting nuclear securityregulations	2011 - 2016	PNRI
3. Adherence to implement Relevant international instruments for Strengthening Nuclear Security	a. Convention on the Physical Protection of Nuclear Material (CPPNM) b. Additional Protocol to Safeguards Agreement c. 2005 Amendment to the CPPNM d. International Convention for the Suppression of Acts of Nuclear Terrorism e. Submit report to UNSC 1540	In-force Feb. 1987 In-force 26 Feb. 2010 Signed Sep.2005	DFA, PNRI & other relevant organizations

B. PREVENTION

Program	Action	Timeline	Responsible Entity
1. Defining Design Basis Threat (DBT)	a. Organize and implement national workshop on threat assessment b. Implement national DBT	2011- 2012	PNRI, NICA, PNP
2. Review level of security arrangements for category 1 and 2 radioactive sources with relevant facilities	a. Implement security upgrades in 12 facilities with high risk radioactivesources b. Implement security upgrades in PNRI's Radwaste facility, Multi-purpose Irradiation Facility and Secondary Standard Dosimetry. c. Implement facilities'security plan d. Review security measures for Category 2 sources e. Implement transport security plan forCat.1 sources vis-à-vis safe transport regulation	Completed Completed 2011 2011-2012 2011-2012	PNRI
3. Phil. system for nuclear material accountancy & control	a. Implement system of accounting for and control of all the Country's nuclear materials b. Acquisition, movement, storage, use and disposal	In-place	PNRI
4. Establishment of national registry of radioactive sources	a. Implement IAEA Regulatory Authority Information System (RAIS) b. Complete inventory of all radioactive sources in the country using RAIS	2010 – 2011 2011 - 2013	PNRI
5. Development of orphan source search capabilities	a. Conduct study on national strategy for regaining control of orphan sources b. Establish plan for searching orphan sources c. Locate and secure orphan sources	2010 - 2012	PNRI, PNP
6. Security Survey & Inspection	a. Conduct SSI to critical facilities semi-annually	2011 -2016	NICA, PNP
7. Strengthening intl. cooperation	a. Continuing cooperation with IAEA, US DOE, ANSTO & EU	On-going	PNRI, DFA
8. Security training & education	a. Formulate National Nuclear Security Training Program (NSTP)	2010 - 2016	PNRI, PNP, NICA

C. DETECTION

Program	Action	Timeline	Responsible Entity
1. Development of national detection strategy for detection of illicit trafficking in nuclear/radioactive sources	a. Evaluate types and locations of border monitoring equipment in thePhils. b. Installation of Radiation Portal Monitors at Port of Manila. c. Support the US Megaports Initiative and its operation d. Creation of Mobile Expert Support Team (MEST)	2010 – 2016 1st Q 2011 On-going	PNRI/Terminal operators (ATI & MICT) PNRI, BOC & PPA
2.Reporting Notification System	a. Develop procedures in the detection of alarms b. Assessment and evaluation of alarms c. Identification of stakeholders and defining responsibilities d. Intelligence and investigation	On-going	Interagency MOA Interagency MOA NICA, PNP
3.Maintenance of radiation detection equipment	a. Provide arrangement to maintain periodically calibrate handheld detection equipment to ensure, reliable and accurate operation	On-going	PNRI
4. Identification of training needs	a. Front line officers on measures related to detection of radiation b. Other trainings to be included in the training program	2010-2016	PNRI

D. Response

Program	Action	Timeline	Responsible Entity
1. Development of plan and procedures to respond to incidents involving nuclear and other radioactive material including seizure of such material by law enforcement authorities	a. **Prepared response plan should cover :** Detection and response, Verification of presence of nuclear and radioactive material, Communication between involved organization including emergencyresponders, **Obtaining nuclear forensics support,** Transporting of nuclear and other radioactive material, Storage of nuclear/radioactive material b. **Integration of response plan with national emergency response plan** c. Expert assistance to review response plan to be requested to IAEA	2010-2016 2011-2012	PNRI, PNP & other relevant organizations PNRI
2. Establish forensic and Investigation Unit	a. **Create an organization of nuclear forensic and investigation unit** b. Strengthen intelligence and investigation c. Seek assistance to IAEA, US DOE and Japan	2011-2016	NBI, PNP, PNRI PNRI
3. Establishment of reporting and notification system	a. Participation to the IAEA's Illicit Trafficking Database (ITDB) b. Promote advocacy and awareness	In-place	PNRI

E. Human Resource Development

Program	Action	Timeline	Responsible Entity
1. Implementation of a National Nuclear Security Training Programme	a. Identify necessary resources to implement the training programme b. Identify personnel to be trained and classification of required training c. Identification of priority areas: legal framework, radiation awareness, physical protection, security culture, threat assessment and other areas identified in the program. d. **Implement training programme taking existing IAEA offers and other organizations.**	2010-2016	PNRI

As such, the Philippine Nuclear Security Plan (PNSP) was developed covering three (3) strategy components of prevention, detection and response. Under response strategy, a program to establish a forensic and investigation unit is included, as well as the development of plan and procedures to respond to incidents involving nuclear and radioactive material, including seizure of such material by law enforcement authorities. The Nuclear Materials Research Section (NMRS) of PNRI was thus given the added function to "develop nuclear forensic analysis capabilities in support of nuclear material protection process so that in the event of an interdiction by Philippine law enforcement agencies involving illegal use or movement of radioactive material this capability may be used to develop and build a legal case against the perpetrators". To date, several NMRS staff has undergone training on nuclear forensics taking advantage of offers from the International Atomic Energy Agency and other international organizations as part of the human resource development program of PNSP.

Meanwhile, in 2003, the Megaports Initiative was established by the United State Government through the United State's Department of Energy / National Nuclear Security Administration – Office of Second Line of Defense (USDOE/NNSA-SLD). The purpose of which is to screen container-cargoes for nuclear and other radiological materials being transported through the global maritime shipping network. In the Philippines, with financial and technical support from the USDOE/NNSA-SLD, radiation portal monitoring systems were installed at the Port of Manila, specifically at the South Harbor and Manila International Container Terminal. This will reduce the risk of illicit trafficking and thus preventing the acquisition and malevolent use of these nuclear and other radiological materials by terrorists.

Megaports Initiative Projects

Under a Memorandum of Intent signed by U.S. (Dept. of Energy-National Nuclear Security Administration)and Philippines, PNRI in coordination with Bureau of Customs & Phil. Ports Authority continued their active participation in the Megaports Initiative Project. The project involved the detection of illicit shipment of nuclear and radioactive materials through Radiation Portal Monitors installed at the Port of Manila.

Radiation Portal Monitor

Inquirer Headlines / Nation

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WikiLeaks bares uranium smuggling in PH

By Jerry E. Esplanada
Philippine Daily Inquirer
First Posted 06:08:00 02/03/2011

Filed Under: WikiLeaks, Smuggling, Diplomacy, Foreign affairs & international relations, Nuclear power

MANILA, Philippines?An alleged smuggling incident involving uranium?a radioactive metal used in the production of nuclear power?took place in the Philippines in 2007, according to a cable from the US Embassy in London that was released by the WikiLeaks

Quoting an unidentified source, the unclassified embassy memo said the uranium ?formerly belonged to the US.?

The same embassy source had allegedly ?worked with divers in the Philippines previously and was recently contacted by them with information that they had found five to six uranium bricks at an underwater wreck.?

In the Nov. 21, 2007 cable to the US State Department, then US Ambassador to the United Kingdom Robert H. Tuttle did not disclose the location of the wreck.

But Tuttle said the informant?s contacts had ?expressed a desire to sell the bricks for profit.?

The same embassy source had earlier informed the US Central Intelligence Agency about the ?possible nuclear smuggling incident,? but ?as yet had not received a response,? said Tuttle.

In the cable, the envoy described as ?unknown? the supplier, transport status and the intended destination of the alleged nuclear materials.

On the mission?s assessment of the likelihood that appropriate authorities would secure the materials, Tuttle said ?UK and Philippine authorities have not yet been notified.?

Tuttle attached ?nine photos of the substance in question? to the embassy cable.

In late 2011, PNRI staffs were instructed to inspect a suspected radioactive material that was seized during an operation by a government investigative agency since there had been reported news of smuggling incidents involving uranium in the Philippines as early as 2007. It was unfortunate however, that the suspected material was brought to the room where the PNRI staffs were planning on how to go through with the inspection at the crime scene. Fortunately, the yellowish metallic box bearing a U235 marking registered very low radioactivity. Evidently, there is a need for strengthening and reorientation of persons that will be involved in radiological crime scene investigations on the unique characteristics and required safety measures in handling radioactive materials, and more importantly, by equipping PNRI with basic instrumentation and skills in building the nuclear forensics capabilities of the Country.

Defence Research and Development Canada | Recherche et développement pour la défense Canada

Overview of the Canadian National Nuclear Forensics Capability Project

AUTHORS: **E. Inrig**, N. Yanofsky, *Defence Research and Development Canada;* A. El-Jaby, T. Hinton, *Canadian Nuclear Safety Commission;* F. Dimayuga, J. Whitlock, *Atomic Energy of Canada Limited*

BACKGROUND

The following statement is from the Canada's National Progress Report, presented at the 2012 Nuclear Security Summit in Seoul, Republic of Korea:

> *"Canada is finalizing a strategy to enhance its domestic nuclear forensics capabilities, which will include efforts to improve the Canadian nuclear forensics laboratory network, creating a national library of nuclear and radiological signatures, and enhancing Canada's capacity to forensically process radiologically-contaminated evidence."*

The Canadian National Nuclear Forensics Capability project, a Targeted Investment Project under the Canadian Safety and Security Program (CSSP), was initiated with the goal of providing these enhanced capabilities.

The project involves partners from eight federal departments and agencies: the Department of National Defence (Defence Research and Development Canada, Royal Military College of Canada, CANSOFCOM), the Royal Canadian Mounted Police (Operations and Forensics), Atomic Energy of Canada Limited, Canadian Nuclear Safety Commission, Health Canada, National Research Council, Public Safety, and Foreign Affairs, Trade and Development.

Figure 1. Project partners

Canadian Safety and Security Program — A program led by Defence Research and Development Canada, in partnership with Public Safety Canada.

DRDC | RDDC technologysciencetechnologie; Public Safety Canada / Sécurité publique Canada; AECL EACL; RMC CMR; CNSC CCSN; NRC·CNRC; Health Canada / Santé Canada; Foreign Affairs, Trade and Development Canada / Affaires étrangères, Commerce et Développement Canada

MAIN OBJECTIVES

- To develop a coordinated, comprehensive, and timely national Nuclear Forensics Capability within Canada.
- ***Stream 1:*** Establishment of a **National Laboratory Network** for comprehensive NF analysis, including a capability to perform classical forensic analysis on evidence contaminated with radioactive material.
- ***Stream 2:*** Development of a **National Nuclear Forensics Library** (NNFL) cataloguing characteristics and signatures of RN materials under Canadian regulatory control.

METHODOLOGY

Stream 1 – National Laboratory Network

By mobilizing several government agencies with RN expertise and resources, the project will create a formal laboratory network. Led by AECL, the network will draw on existing knowledge, expertise, and facilities, taking advantage of the complementary capabilities of partner labs.

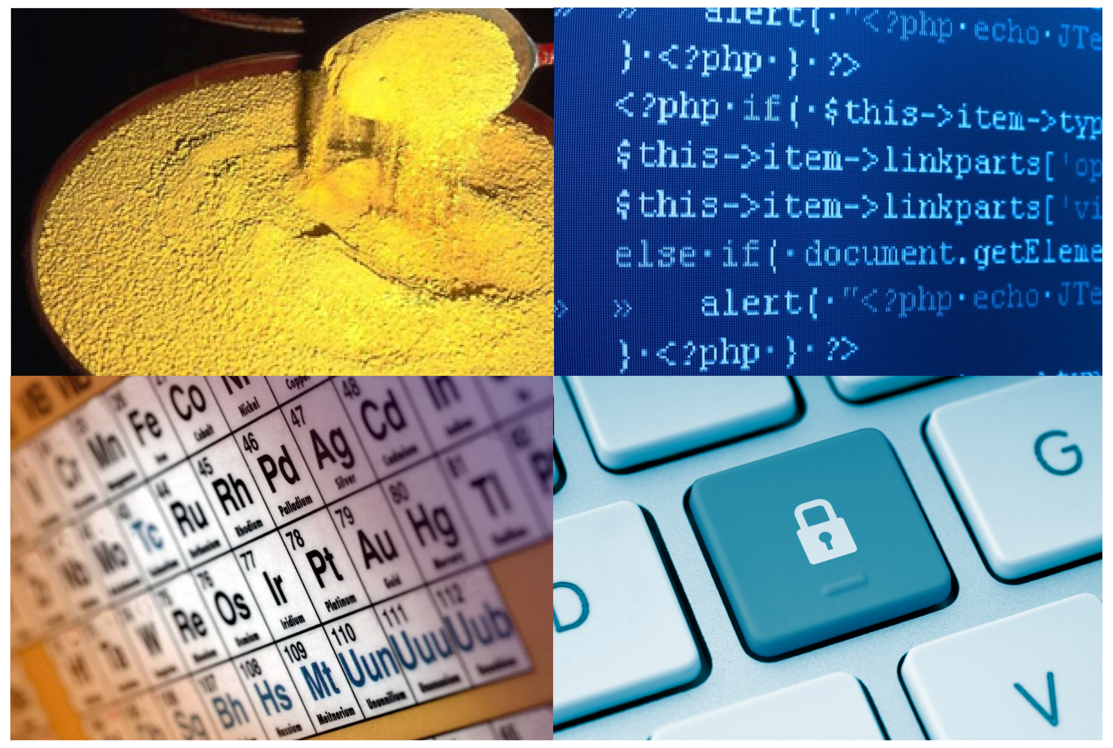
To ensure that the outputs are consistent with the requirements and expectations of the user community, law enforcement agencies and other federal departments are being engaged as partners, providing advice and guidance.

Key tasks:

- Establish requirements for nuclear forensics labs and facilities handling evidence contaminated with radioactive material
- Catalog current capabilities
- Identify gaps in current knowledge and capabilities and determine and implement actions to close gaps (e.g. protocol development, equipment upgrades)
- Develop and implement training plan for nuclear and classical forensics specialists
- Develop protocols for
  - Collection, packaging, and domestic transportation of RN materials to the labs
  - Handling of evidence at the labs
- Plan and execute operational exercise geared towards lab network implementation

Table 1. Capability inventory and gap analysis

Desired capabilities	Lab 1	Lab 2	Lab 3	Lab 4
Incident scene attendance				
Capability 1		–		
Capability 2	–		–	–
....				
Imaging				
Capability 1	–			–
Capability 2	–	–	–	–
....				
Portable detection and ID				
....				
....				
Contaminated evidence analysis				
Capability 1		–	–	–
....				



Stream 2 – National Nuclear Forensics Library

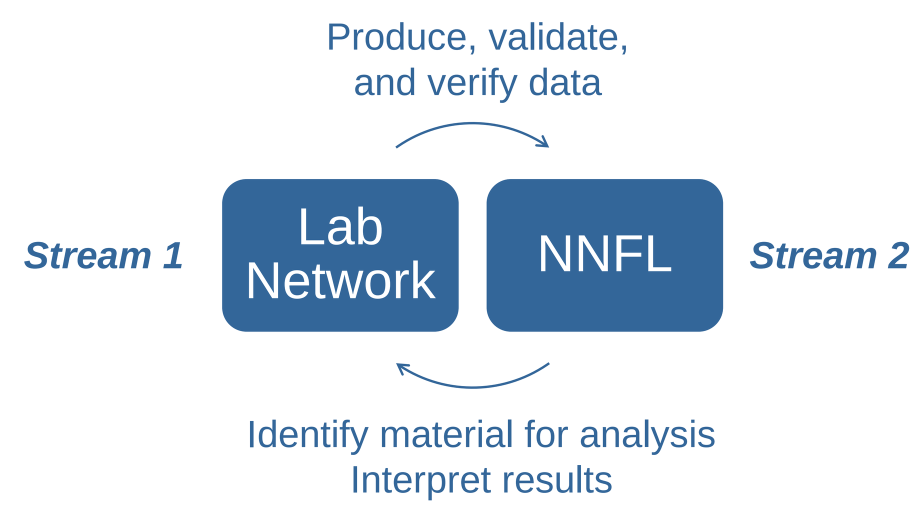
The NNFL has been identified as a critical component of Canada's NF capability. CNSC is leading development of the NNFL, which will consolidate information on all radiological and nuclear material under Canadian regulatory control in a manner that allows for sample/specimen attribution.

The NNFL will

- Consist of a database and a separate analysis utility, which will not be able to modify the database (to ensure data integrity)
- Be a tool to determine whether or not RN material found out of regulatory control is consistent with Canadian RN material holdings
- Be used in concert with current regulatory RN material databases and accounting systems
- Be structured to provide necessary assurances to CNSC licensees for the protection of commercially sensitive information

Uranium ore concentrate (UOC) has been selected as the material group to be used for database development purposes. Other material groups will be added following the development phase.

Figure 2. Interaction of project streams



SUMMARY

- Canada has initiated the National Nuclear Forensics Capability Project, taking a two-stream approach to develop a formalized lab network and a National Nuclear Forensics Library.
- The Lab Network as a whole will be capable of comprehensive NF analysis, including a capability to perform classical forensic analysis on evidence contaminated with radioactive material.
- The NNFL will be held, operated, and maintained by CNSC, and populated with the support of licensees and labs in the national network.
- The involvement of law enforcement will ensure that Canada is capable of analyzing both seized materials and contaminated evidence in a manner that supports the successful prosecution of crimes involving the misappropriation or misuse of RN materials.
- The project requires multi-departmental coordination of complementary S&T capabilities, and will establish strong collaboration among nuclear scientists, forensic experts, law enforcement, policy makers, and operational support specialists.

Figure 3. Evidence collection in a contaminated scene

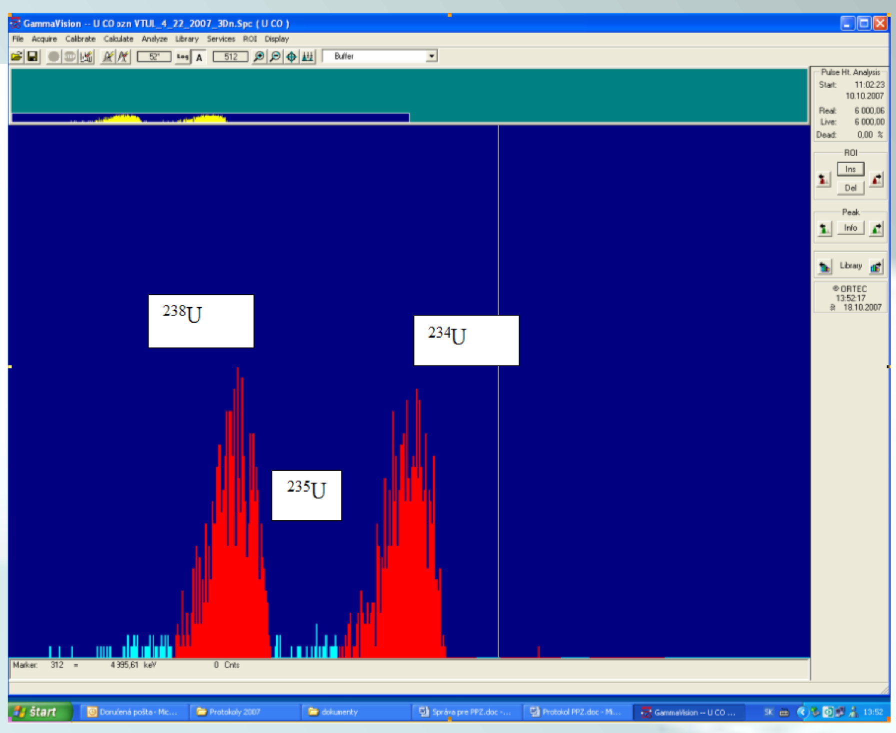
Nuclear Forensics Activities in the Slovak Republic

International Conference on Advances in Nuclear Forensics:
Countering the Evolving Threat of Nuclear and Other Radioactive Material out of Regulatory Control
Vienna, Austria, 7–10 July 2014

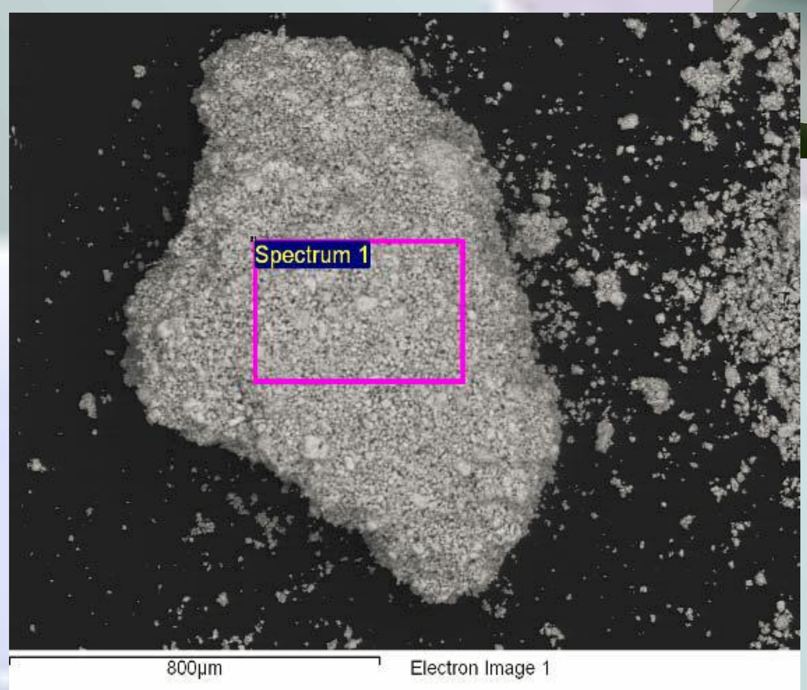
After political change in 1989 we have been facing a new type of criminal activity – smuggling of nuclear materials. The territory of Slovakia became one of possible routes for criminals, smuggling nuclear materials from former USSR countries to the western countries. Slovak Republic was established on 1st January 1993. By the Act Nr. 2/1993 the Nuclear Regulatory Authority of the Slovak Republic (UJD) was grounded.

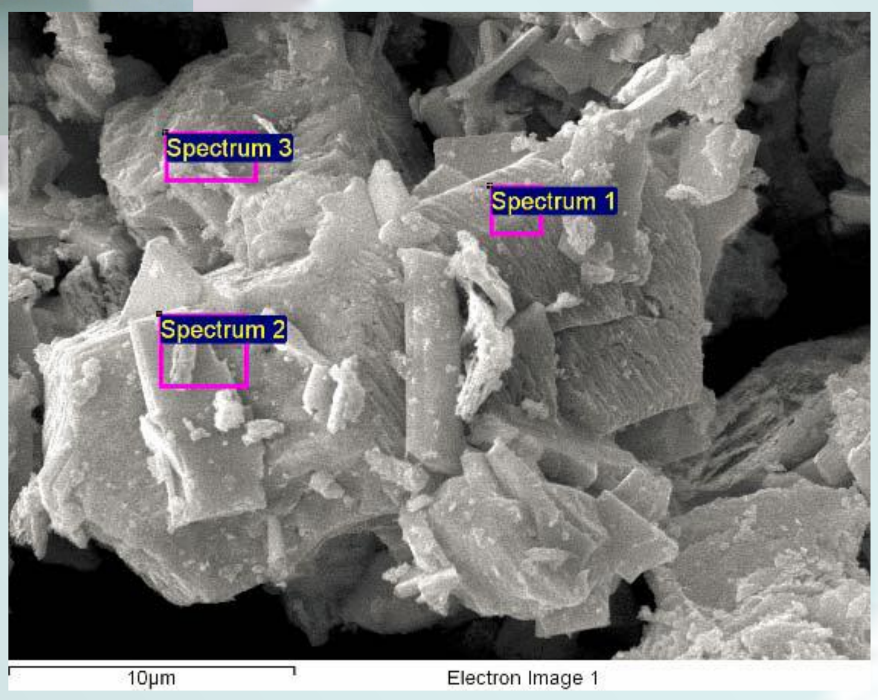
History

Since 1993 all relevant ministries and regulatory bodies paid attention to the creation of an effective system to combat illicit trafficking in nuclear and other radioactive materials. In nineties, when the most cases of illicit trafficking of nuclear materials occurred, the nuclear forensics tasks were performed by the Department of Nuclear Chemistry of Comenius University in Bratislava. Nuclear materials seized on Slovakian territory were analyzed by using alpha and gamma spectrometry. We also trained customs and police officers, installed portal monitors and all involved state bodies signed a common guideline on how to proceed and cooperate in the case of a seizure of nuclear or radioactive materials.



Pribenik case analysis



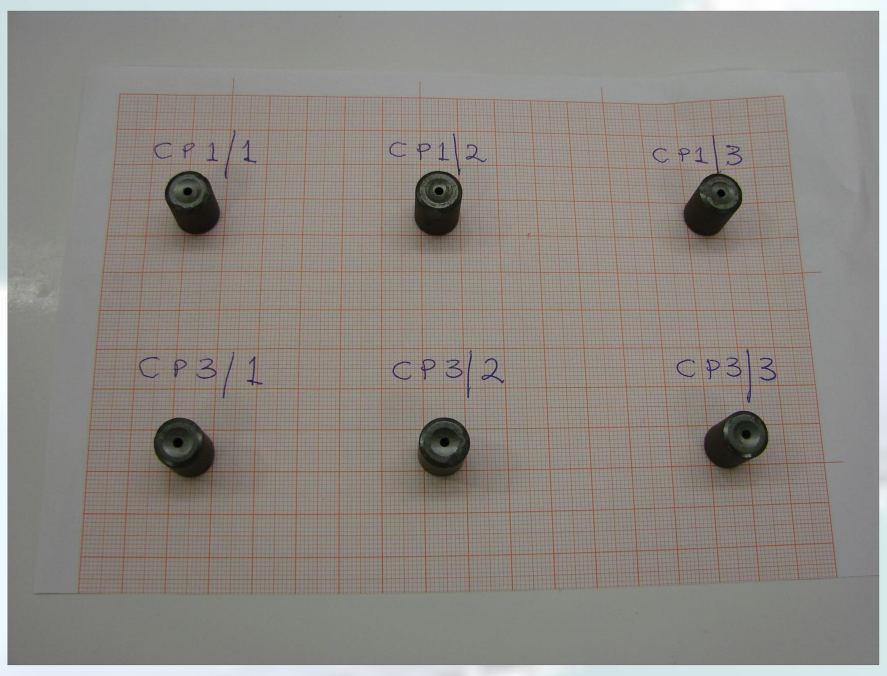


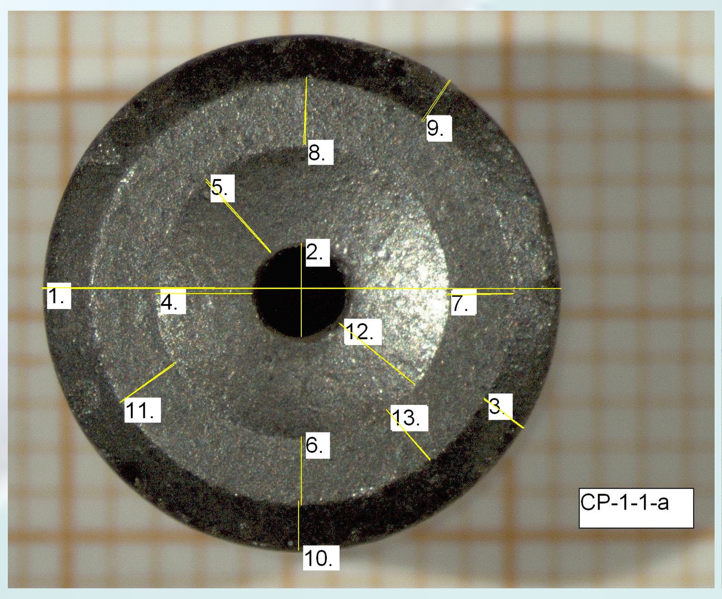
Qualitative change occurred in 2001, when the chairmen of UJD and Joint Research Centre – Institute for Transuranium Elements (ITU) signed an agreement of future cooperation in the field of combatting illicit trafficking of nuclear materials. This agreement started new era of cooperation. Regular participation of Slovakian representatives in The Nuclear Forensics International Technical Working Group (ITWG) was supported by the ITU, and, according to the agreement, we used the capabilities of ITU for nuclear forensics analyses of seized nuclear materials.

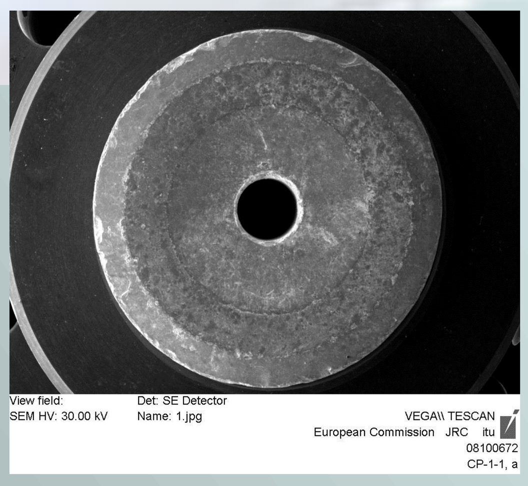
In November 2007 our Police Corps finished an undercover investigation by seizure of suspicious radioactive material. First analyses made by the Civil Protection laboratory and Department of Nuclear Chemistry showed, that suspicious material contains natural uranium. We asked the ITU to perform forensic analysis of that material. In March 2008 we sent a sample of the seizure to ITU. The forensic analysis confirmed the seized material was natural uranium. The results were used as evidence during the trial. One sample of this material was sent also to Lawrence Livermore National Laboratory, USA in 2011.

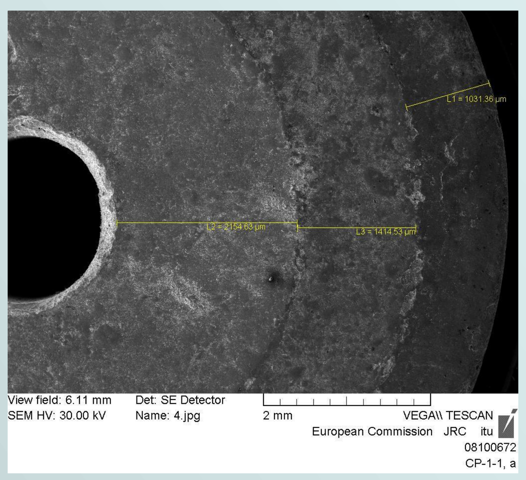
Fuel pellets analysis

Another example of cooperation between ITU and UJD represents the joint analysis of uranium pellets coming from the seizures in nineties. The UJD sent two sets each of tree pellets to ITU and in October 2008 two experts from Slovakia partially participated in analyses of those pellets in ITU headquarter in Karlsruhe, Germany. The results of the analyses were made available in April 2009. The outcomes showed that uranium pellets most probably came from the fuel assembly stolen in Lithuania in the beginning of nineties.









Slovakian experts are fully aware of the importance of having, even limited, nuclear forensics capabilities. We are still trying to improve our laboratories with new devices and methodologies in order to be able to provide fundamental analyses of seized nuclear or radioactive materials. However, taking into account limited financial and personal sources, it seems to be more useful to continue the cooperation with ITU.

Juraj Václav, Nuclear Regulatory Authority of the Slovak Republic