**Invited Paper**

# Nuclear Forensics Awareness and Understanding

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## 1. Introduction

Nuclear forensics is a relatively new and certainly a fascinating discipline in science gaining its attractiveness from the exploration of the unknown. As stated in the Communique of the Nuclear Security Summit held 2012 in Seoul "nuclear forensics can be an effective tool in determining the origin of detected nuclear and other radioactive materials and in providing evidence for the prosecution of acts of illicit trafficking and malicious uses." It also resolved that "States are encouraged to work with one another, as well as with the IAEA, to develop and enhance nuclear forensics capabilities."

In order to respond effectively in case of a nuclear security event States should possess nuclear forensics capabilities as integral part of their national response plan. Nuclear forensic capabilities are not limited to analytical means; they include the legal and regulatory framework, technical infrastructure and human capital.

Based on a sound understanding of the opportunities offered by nuclear forensic investigations and its limitations, policy makers can establish the basis for implementing nuclear forensic capabilities at national level. Decision makers of different authorities and organizations need to cooperate in order to ensure the integration of available resources in an efficient response mechanism with appropriate technical nuclear forensics required by measurement experts and law enforcement.

## 2. Nuclear forensic capabilities

Each State should seek to acquire nuclear forensic capabilities enabling to provide competent authorities with relevant information on the nature of the nuclear security event and on the main characteristics of the interdicted material. Such capabilities are often referred to as *nuclear forensics core capabilities*. The information obtained by core capabilities has typically immediate relevance to the law enforcement investigations. They might, for instance, give answers to following basic questions: What is the material? Is it ours? Besides conducting the preliminary assessment of the material and determining if national laws have been broken, the core capabilities help in larger scale to strengthen overarching nuclear security controls, enable rapid and appropriate response, and in case advanced nuclear forensic analyses are desired, enable States to request and receive international assistance.

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*Advanced nuclear forensic capabilities*, on the other hand, help States to understand more about history of the unknown nuclear material. They might give answers to questions like, "how, when and where the nuclear material was produced" and thus helping in the determination of the origin of the material. The advanced capabilities, however require considerably more resources (e.g. instrumentation, knowledge base, subject matter expertise) than core capabilities, therefore they might not be sustainable for all countries.

Nuclear forensic capabilities consist of four elements: national frameworks, evidence management, material analysis & interpretation and human capital (Table 1). Below these four elements are discussed in more detailed.

Table 1. Nuclear forensic capabilities.

| **National Frameworks** | **Evidence Management** | **Material Analysis & Interpretation** |
|---|---|---|
| Resources | Radiological crime scene management | Categorisation |
| National response plan | Evidence sampling & collection | Basic characterisation |
| National nuclear forensics library | Transport | Comparison with domestic material |
| Collaborative agreements | Storage | Advanced characterisation |
| ITDB POC | | |
| **Human Capital** | | |
| Multidisciplinary experts; training; exercises | | |

## *2.1. National frameworks*

It is very unlikely that any State will have a dedicated nuclear forensics laboratory doing nothing else than nuclear forensics analyses. Therefore, the first thing the States are advised to do, when establishing nuclear forensic capabilities, is to make an inventory on existing **resources**. States should look into what is already available (e.g. research laboratories, universities, measurement instrumentation) and how these could be utilised in case of a nuclear security event.

In order to define the roles and responsibilities of the different organisations and competent authorities involved in nuclear security events, States should develop and implement a **national response plan**. The organisations offering national nuclear forensics capabilities should be clearly identified in this plan. Besides this, the national response plan for nuclear security events should identify the international nuclear forensics laboratories in order to facilitate international assistance if the need should arise. The possibility to receive support should be established beforehand using, for instance, **collaborative agreements** as legal basis.

The **National Point of Contact (POC) to the IAEA's Incident and Trafficking database (ITDB)** should also be a component of the national frameworks and an integral part of the national response plan. The POC needs to be provided with information pertaining to the nuclear security event promptly that he/she can notify the ITDB in a timely manner.

National frameworks include also a **national nuclear forensic library (NNFL)**. A national nuclear forensic library is a collection of information (data and/or samples) about nuclear or other radioactive material that either resides or was manufactured in the country. The information on characteristic parameters ("signatures") of radioactive materials is used in nuclear forensic investigations to distinguish one material from another assisting, therefore, in the origin determination of unknown nuclear materials.

## *2.2. Evidence management*

After a nuclear security event has been detected, measures for implementing safety and security at the incident site have to be implemented. This can be achieved using appropriate **radiological crime scene management** procedures, which should also include advice how nuclear forensic evidence, as well as traditional forensic evidence, is to be preserved. Besides this, appropriate protocols for **collection, handling and sampling** of evidence have to be in place, taking into account the rules of evidence and chain of custody considerations.

**Transport and storage** are also part of the evidence management. States should have proper containers on hand for various types of evidence (e.g. nuclear material, strong radioactive sources, traditional evidence contaminated with radioactive material) to be transported away from the crime scene. If the evidence cannot be transported directly to a laboratory for nuclear forensic analysis, an interim storage will be required. This been the case, States should have a safe and secure place with relevant permits.

## *2.3. Material analysis & interpretation*

The preliminary material analysis includes measurements, which are sufficient to provide information on the principal radiological characteristics of the interdicted or collected radioactive material. Such information would be e.g. determination of the nature of the material, identifying its bulk constituents and the potential radiological hazard associated with the material. This is referred to as **categorization** and it primarily uses non-destructive measurement techniques (e.g. hand-held radioisotope identification devices), which do not require unpacking or handling of the material. Categorization should be carried out primarily at the incident site and it is essential for supporting decisions on the subsequent steps and measures to be taken.

After the on-site categorisation and transport to an interim storage or an identified nuclear forensics laboratory, the intercepted material needs to be characterised. **Basic characterisation** of the material includes the material identification (including determination of the approximate isotopic composition of the material), the physical inspection and determination of the macroscopic morphology. This should be preferably undertaken in a controlled laboratory environment to ensure the highest integrity of the analytical data. One should also keep in mind that any analysis performed is to be executed in a manner which assures that no forensics evidence is compromised through potential contamination or mishandling.

The information obtained through these above-mentioned analyses can then be **compared with the information on the domestic material** in the national nuclear forensics library in order to find out whether the material had been produced or stored within the country.

**Advanced characterisation** of the material might be necessary in case the basic characterisation and the subsequent comparison with the data in the NNFL were not adequate in finding out the origin of the material. The state of the art instrumentation as well as for nuclear forensic purposes developed specialised methods are typically required for this.

## *2.4. Human capital*

The inclusion of nuclear forensic capabilities into the national response plan requires that qualified experts in various disciplines (e.g. radiation protection, evidence collection, measurement techniques and data interpretation) are available, often in a short notice. These complementary experts should have a solid education in their respective areas (e.g. radiochemistry, nuclear physics, materials science, traditional forensics) and they should demonstrate their competences by exercising regularly. They should have also developed awareness on related fields in this **multi-disciplinary** science of nuclear forensics in order to understand better all the aspects required in nuclear forensic investigations. Therefore, **training and exercising** are an essential part of the nuclear forensic capabilities.

## 3. Programmes and projects to support the nuclear forensics awareness

Since mid-1990s the European Commission has established many support programmes and projects for various beneficiary countries in the field of nuclear forensics. Examples of such programmes are: PECO, TACIS, Instrument for Stability (IfS), Enlargement & Integration and CBRN Centres of Excellence (CoE). The form of support has varied from providing workshops and trainings up to delivery of equipment for radiation detection, radioactive material identification and characterisation. The workshops and trainings vary in degree of "hands-on" component and scientific complexity starting from awareness type of trainings (e.g. establishment of a national response plan) to trainings on specialised laboratory techniques (e.g. on electron microscopy). The comprehensive training programme developed for the capacity building in nuclear forensics at the JRC-ITU is shown below in Table 2.

Table 2. Capacity building programme related to nuclear forensics.

| Subject | Target audience | Main topics |
|---|---|---|
| National response plan | Regulatory authority, decision makers, expert institutions | MAP, RITNUM, responsibilities, communication, processes |
| Detection | Customs, border guards, police, security services | Procedures for detection, verification of alarm, securing the material & site, self-protection |
| MEST | Research institutes, environmental protection, health & safety authorities, radiation protection | Categorisation, preservation of evidence, sample taking & shipment, radiological crime scene |
| Nuclear forensics | Research institutes, measurement laboratories | Material characterisation, data interpretation, source attribution, expert opinion |
| Exercises (e.g. Table-top) | All target groups | Response processes & procedures, scenario development |

## 4. Conclusions

Every state is encouraged to establish nuclear forensic capabilities at least in "core" level in order to respond rapidly and appropriately in the case of a nuclear security event. The nuclear forensic capabilities do not comprise only technical measures (e.g. nuclear material measurements or evidence sampling), but includes also organisational aspects of different competent authorities. These should be compiled and documented in a national response plan. Human capital is a central part of nuclear forensic capabilities. Awareness and understanding of what is nuclear forensics, what are its limitations and how it can help to improve the national nuclear security is, therefore, utmost important. Increasing the awareness and understanding of nuclear forensics is a continuous international effort and the European Commission has contributed to this by multiple support programmes during the last two decades.

**Invited Paper**

# International Legal Framework for Strengthening Nuclear Security

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**Abstract.** Although nuclear security is primarily a national responsibility, the legal framework emerged and has been evolving because governments and international institutions recognize that threats to nuclear security have a global dimension. This imperative to work together gave rise to an international effort to build a nuclear-security framework to meet nuclear related threats. Its goal: a coordinated, consistent, sustainable fight against these threats. For the purpose of this paper, the legal framework for nuclear security constitutes a set of legally binding ("hard law") and nonbinding ("soft law") instruments which – in combination with other institutions and programs – strengthens nuclear security while helping the international community combat nuclear terrorism. International efforts to deter and prevent nuclear terrorism would be largely ineffective without criminalization of these crimes. States acting under these provisions define actions that threaten nuclear security as criminal offences in national law, and levy criminal or civil penalties commensurate with such serious offences. In this sense, nuclear forensics is key to successfully investigating and prosecuting such offences. The international legal framework for nuclear security provides a comprehensive umbrella under which to pursue such vitally important goals.

## 1. Introduction

The international legal framework is a product of multi-year efforts at a number of forums convened in pursuance of diverse objectives which left a legacy of inconsistencies, overlaps and duplications. Some of its major elements were developed during the Cold War period, while others subsequently emerged in the new threat environment resulting from major terrorist incidents, most dramatically the 9/11 attacks. The latter event represented a wake-up call in many respects, including the need for prompt and effective measures to remedy the most significant weaknesses in the existing legal framework – a legal framework that was not structured to address new threats coming from sub-state actors.

Another challenge in achieving further realignment and consistent implementation is that many basic terms and definitions in some of the key instruments have been revised, adjusted and expanded, with implications affecting key elements of the legal framework. For example, the term "nuclear security" as defined by the International Atomic Energy Agency in 2004 received a much wider meaning than previously understood. It is currently "the prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities." This new definition makes clear that nuclear security is focused on illegal or unauthorized acts. Its three essential functions for coping with such acts – namely, prevention, detection and response – are understood as extending beyond previous approaches that focused more narrowly on geographical, jurisdictional and procedural aspects. In addition, the new concept broadened the scope of nuclear security to cover not only materials for producing explosives, but also other radioactive materials that could be used in a radiological dispersal device (RDD). Most importantly, this shift in emphasis highlighted some previously dormant provisions, one of which is criminalization and nuclear forensics as a vehicle for successful prosecution.

## 2. A Growing Diversity of the Legal Instruments

The complexity of the legal framework was acknowledged by the IAEA Director General Yukiya Amano. As emphasized in his characterization, "the international legal framework on nuclear security has developed in a complex manner and now consists of a broad collection of legally binding and non-binding international instruments that at times may be considered as difficult to comprehend." ["The International Legal Framework for Nuclear Security," IAEA International Law Series No. 4, 2011] In recognition of these challenges, Indonesia, as a participant in the Nuclear Security Summits (NSS), volunteered to develop as a "gift basket" the National Legislation Implementation Kit on Nuclear Security designed to provide building blocks to countries intent to integrate relevant provisions of the international legal framework into their own national legislation.

Figure 1 illustrates the multi-tiered structure of the legal framework consisting of two major interactive clusters, i.e. binding "hard law" and nonbinding "soft law" with subcategories in each cluster.

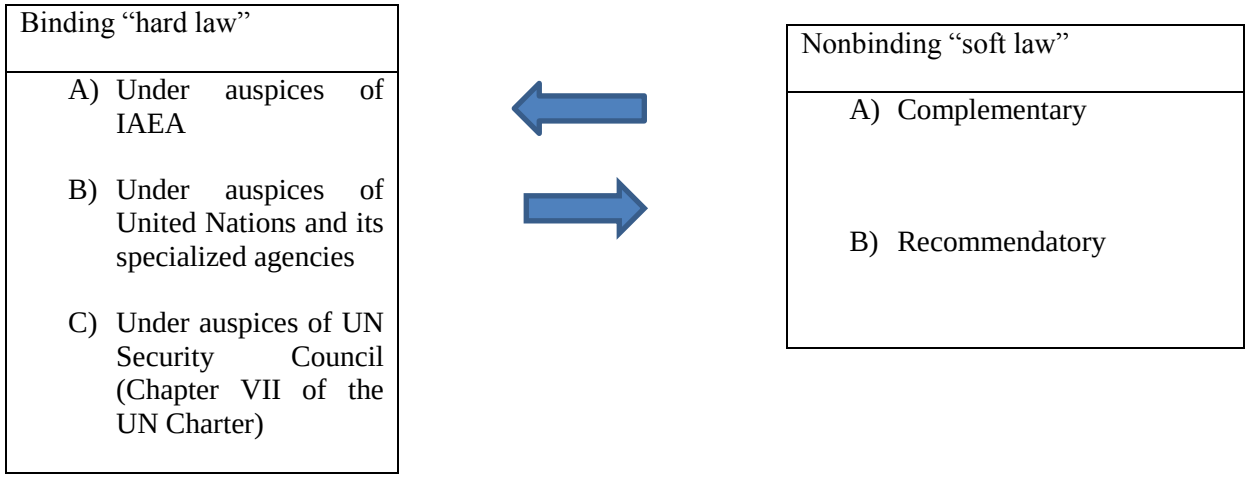


Figure 1: Multi-Tiered Structure of the Legal Framework for Nuclear Security

Instruments in the "hard law" cluster are binding and normally negotiated by states through an established diplomatic process. Obligations are typically specific and there are provisions for verification and enforcement to ensure compliance. Some instruments may involve sanctions for violations. "Soft law" elements are based on voluntary policy commitments either developed through informal consultations or proposed unilaterally. Their recommendations and guidance are typically discretionary while their verification or enforcement mechanisms are weak or nonexistent. Soft legal documents do not usually envisage specific sanctions for noncompliance but may involve review procedures.

Although "soft law," non-treaty instruments have often been developed on an ad hoc basis and in a time-constrained manner, they have the potential for evolving into binding agreements, if and when circumstances warrant such a transition. Given the urgency of taking appropriate measures to maintain nuclear security and other considerations, the "soft law" approach typically provides a more flexible means of achieving prompt progress, largely because it avoids time-consuming formal negotiations and can attract participation by more state parties.

In the rapidly evolving threat environment of nuclear terrorism, these agreements often serve as grounds for testing innovative ideas and action before they are codified into binding norms. It is important that a balance be maintained between the "soft" and "hard" elements of the legal framework. This will include, initially, working with relevant states to ensure that "soft law" guidance documents are effectively implemented in national systems. Based on experience and demonstrated need, the process of "hardening" selected non-binding agreements should be pursued in relevant international forums.

Accordingly, the distinction between "hard" and "soft" law instruments is less significant than how they are implemented in national law. If a state fails to accurately and completely incorporate the provisions of a "hard law" instrument into its domestic legal and regulating framework that instrument cannot be effectively implemented. On the other hand, if a state codifies a "soft law" document into its national laws and regulations and applies its terms in a rigorous manner, the results will be consistent with a "hard law" approach.

## 3. "Hard Law" Instruments

Binding "hard law" documents are broken down into three categories depending on the auspices under which they were developed and adopted.

A. Most important instruments under the IAEA auspices are:
*1980 Convention on Physical Protection of Nuclear Material (CPPNM)* which applies to nuclear material used for peaceful purposes while in international transport and with some exceptions also to domestic use, storage and transport. *2005 Amendment to CPPNM* (yet to be ratified) extends the scope of the CPPNM to also cover nuclear facilities and nuclear material in domestic use, storage and transport as well as sabotage. The slow rate of ratification is a common challenge to many international instruments. Although the amendment sets forth general measures for physical protection of nuclear material, specific regulating requirements and enforcement measures must be adopted and applied by domestic bodies, some of which lack the legal and technical resources for effective implementation.
*1986 Convention on Early Notification of a Nuclear Accident* applies in the event of any accident involving specific facilities or activities of a state party from which a release of radioactive material occurs or is likely to occur and which has resulted or may result in an international trans-boundary release that could be of radiological safety significance to another state. *1986 Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency* covers bilateral and multilateral assistance arrangements in connection with a nuclear accident or radiological emergency. These two instruments formally belong to the nuclear safety domain but there is a significant safety-security interface.

B. The UN framework is comprised of the 19 universal legal instruments against terrorism of which at least two have direct relevance to nuclear security and nuclear terrorism. *2005 International Convention for the Suppression of Terrorist Bombing* creates a regime of universal jurisdiction over unlawful and intentional use of explosives and other lethal devices against various public places with intent to kill or cause serious bodily injury, or with intent to cause extensive destruction of the public place, through the release, dissemination or impact of toxic chemicals, biological agents or radiation or radioactive material. *2005 International Convention for the Suppression of Acts of Nuclear Terrorism* has a broader scope than the CPPNM and its 2005 Amendment to the extent that it criminalizes acts involving "radioactive material," which includes not only nuclear material, but also other radioactive material. Several other universal anti-terrorism instruments have provisions which address nuclear security or may help address it with some of them developed within the organizational context of UN specialized agencies (e.g. International Maritime Organization, International Civil Aviation Organization) and designed to meet primarily their specific needs. Their common objective is to identify actions considered as offences, require state agencies to criminalize these offences in domestic law, require states to establish jurisdiction over offenders and to prosecute or extradite them, and provide a mechanism for international cooperation. However, most instruments have not achieved universal adherence with many states not yet parties to them. Because institutional arrangements for monitoring implementation are absent or uneven, a number of them typically lack clear and predictable measures for imposing sanctions for non-compliance. In view of these inconsistencies and weaknesses, UN member states are negotiating an additional international treaty, a draft comprehensive convention on international terrorism which would complement the existing framework of international anti-terrorism instruments and would build on their key guiding principles.

C. UN Security Council Resolutions adopted under Chapter VII of the UN Charter are therefore binding on all member states. Pursuant to article 48(2) of the UN Charter, "Such decisions shall be carried out by the Members of the United Nations directly and through their action in the appropriate international agencies of which they are members." A key resolution in this sub-category is UNSCR1540 (2004) designed to prevent weapons of mass destruction from falling into the hands of non-state actors. The rationale behind the resolution was to complement and reinforce existing legal instruments rather than replace them.

Seen in the context of previously established regimes, Resolution 1540 was meant to spur states to carry out their responsibilities under relevant instruments, enlist nongovernmental stakeholders in the fight against WMD terrorism, and widen that fight to include non-state groups. Specifically the resolution demanded from UN member states to establish domestic controls to prevent the proliferation of unconventional weapons and related materials, including measures pertaining to accounting, security, physical protection, border and law enforcement, and trade-related controls.

Critical support for efforts to meet challenges under UNSCR1540 comes from the 1540 Committee and the committee's group of experts. The committee, a subsidiary body of the UN Security Council, monitors compliance by reviewing country reports and connecting states in need of assistance. In 2011, the mandate of the committee was extended by 10 years.

Like any innovation, however, UNSCR1540 initially elicited a mixed reaction. One main reason for skepticism was that not all UN member states considered the threat of WMD terrorism and illicit trafficking in related materials to be their top priority. Some countries initially questioned the UN Security Council's role in addressing this threat, particularly the council's decision to impose binding nonproliferation and security obligations outside the traditional process of negotiations.

## 4. "Soft Law" Elements

The post September 11th imperatives to promptly respond to the new threat environment have resulted in adding a series of non-binding initiatives and documents related to nuclear security and nuclear counter-terrorism. Functionally, they can be divided into two sub-categories: complementary and recommendatory.

A. Complementary are those which are largely designed to complement the binding "hard law" category by filling in gaps in their coverage and scope or facilitate their implementation. Examples include:
*Global Initiative to Combat Nuclear Terrorism (GICNT)* was launched to develop partnership capacity to combat nuclear terrorism on a "determined and systematic basis," consistent with national legal authorities and obligations they have under relevant international legal frameworks, notably the Nuclear Terrorism Convention, CPPNM and its Amendment as well as UNSCR 1540. GICNT's 85 partner countries have a shared commitment to accomplish on a voluntary basis, among other goals, the following: improve accounting, control and physical protection systems for nuclear and other radioactive materials, enhance security of nuclear facilities, improve the ability to prevent illicit trafficking, ensure national legal and regulatory frameworks to provide for the implementation of criminal and civil liability for terrorists. These goals are outlined in the eight-point Statement of Principles accepted by partner nations upon joining the Global Initiative. The GICNT has conducted over 50 multilateral activities to enhance partner countries' capacity consistent with its mandate.
*Code of Conduct on the Safety and Security of Radioactive Sources* was originally developed under IAEA auspices to assist states in developing and maintaining high levels of safety and security for radioactive sources. Following the 11 September 2001 events, it was agreed that the Code of Conduct had to be revised to strengthen a number of security-related provisions and to address malicious and/or intentional misuse of radioactive sources. At the same time, member states agreed to develop an additional guidance on the import and export of

radioactive sources which was included as Supplementary Guidance after endorsed in 2004 by the IAEA General Conference. In response to the invitation from the IAEA Director General, member states made political commitments in which they indicated their intention to implement this non-binding Code. As of late 2013, 119 member states have made such commitments, which signaled a wide support for initiating a process for upgrading the document to the "hard law" status. In October 2013, the International Conference on the Safety and Security of Radioactive Sources held in Abu Dhabi, United Arab Emirates discussed instruments and recommended that the IAEA should convene a working group to assess the merits of this option.

*Nuclear Suppliers Group (NSG)* is yet another non-binding complementary initiative with 45 members aimed to prevent nuclear exports for commercial and peaceful purposes from being used to make nuclear weapons. The group has developed and kept updating the guidelines for nuclear transfers (INFCIRC/254, Part 1) and guidelines for transfers of nuclear-related dual-use equipment, materials and technology (INFCIRC/254 Part 2) which serve as a basis recommended for national export control regulations or laws and proscribed lists. Moreover, their provisions are used as informal guidance in the matrix prepared by 1540 experts for evaluating compliance with UNSCR1540 requirements. The group of experts developed a matrix for each state which includes about 390 fields covering activities related to operative part of the resolution. There are multiple links that enable the NSG to interact with "hard law" instruments and provide inputs in their implementation.

*Proliferation Security Initiative (PSI)* is a global effort by 70 partner states to stop WMD trafficking, their delivery systems, and related materials to and from states and non-state actors of proliferation concern by interdicting transfers to the extent of their capabilities and legal authorities. When a country joins the PSI, it endorses the PSI Statement of Interdiction Principles, which commits participants to establish a more coordinated and effective basis for such interdiction. Previous discussion to transform the PSI into a formal, legally-binding instrument identified potential difficulties at least in the near term. One reason is that some states which currently render conditional cooperation – including in interceptions within their territorial boundaries – are reluctant to join as members, given their concerns about the domestic and diplomatic consequences of being involved in all interceptions that PSI might undertake. The focus on joint training activities and limited information-sharing without binding commitment has allowed many more states to join the PSI that would otherwise have not been possible. So long as these activities build capability to enforce WMD and even dual-use related laws, many more countries would be willing to participate without formal adherence to a legally binding regime.

The above examples do not constitute an exhaustive list of "soft law" initiatives and documents. It would be appropriate to add to the list communiques and documents of the 2010, 2012 and 2014 Nuclear Security Summits, G8 Global Partnership, and several more.

B. Recommendatory sub-category of the "soft law" documents covers a wide variety of sources including UN General Assembly resolutions and non-Chapter VII resolutions of the Security Council, UN guidance documents, technical recommendations by the IAEA and UNODC and many others which upon codification or endorsement can contribute to guiding principles or standards for states or organizations to strengthen nuclear security. Examples include: *The United Nations Global Counter-Terrorism Strategy (A/RES/60/288)* was unanimously adopted in 2006 by the UN General Assembly as a comprehensive strategy to fight terrorism through strengthening the capacity of states and the role of the UN system. Nuclear security measures are addressed by provisions to prosecute or extradite perpetrators of terrorist acts, cooperate and coordinate in combatting nuclear smuggling, improve security and protection of vulnerable targets, share best practices in counter-terrorism capacity building and coordinate responses to terrorist attacks.

*IAEA publications in Nuclear Security Series (NSS)* are designed to assist states in implementing their obligations to strengthen nuclear security. The series has a four-tiered structure consisting at the top of 1) fundamentals (principles and essentials of nuclear security), followed by 2) recommendations (general approaches and application of

fundaments), 3) implementing guides (broad guides for implementation of recommendations), and 4) technical guidance (reference and training manuals for implementing guides). Examples in this series include "Objectives and Essential Elements of State's Nuclear Security Regime," which lists and explains 12 essential elements of a state's nuclear security regime as well as "Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities" (INFCIRC/225/Revision 5). The latter covers the objectives of state's physical protection regime, the elements of physical protection, the requirements for measures against unauthorized removal, and the requirements for measures against sabotage.

Unlike safety and nonproliferation, the international legal framework for nuclear security has no single treaty or convention that establishes a basic legal regime for addressing nuclear security or terrorism. Rather, it is a continuously evolving web of instruments and documents with different status and scope. The process of streamlining and rationalizing the overall legal framework will require addressing a number of challenges including continued refocusing on sub-state actors, slow ratification and lack of universality, substantive and procedural discrepancies, conflicting interpretations, insufficient monitoring and reporting, inadequate domestic implementation, and poor horizontal coordination. Much work is yet to be done to accomplish this task.

## 5. Criminalization and Nuclear Forensics

Without an effective, enforceable legal framework and relevant measures at the state level, international efforts to prevent nuclear terrorism and ensure the security of nuclear materials and facilities will be well-intentioned, but largely ineffective. It is important to continue to develop a wide range of both criminal and civil instruments that would deter the perpetrators of acts threatening nuclear security. One of the principal concerns surrounding the need for the accelerated use of criminal prosecution against nuclear smugglers and security violators is its apparent ineffectiveness. Successful prosecution and convictions, in most cases, require extensive investigative work, high burden of proof, the establishment of criminal intent and effective presentation of the above in court. Sometimes consideration of secrecy prevents a successful investigation while the involvement of individuals from several countries, unresolved cross-border issues, unclear jurisdiction and the reluctance to share the information necessary for prosecution lead to ineffective penalties and failed convictions.

The existing legal framework in its entirety has provisions whereby state parties should identify actions threatening nuclear security and establish them as criminal offences in national law, with appropriate criminal or civil penalties commensurate with the serious nature of these offences. These provisions are found in several "hard law" instruments including CPPNM (article 7); CPPNM 2005 Amendment (new article 7); Nuclear Terrorism Convention (articles 2 and 5), UNSCR1373 (para 2c) and UNSCR 1540 (para 3d). In addition, under GICNT principle 6, partner states are committed to ensure adequate national legal and regulatory framework sufficient to provide for the implementation of appropriate criminal and, if applicable, civil liability for terrorists and those who facilitate acts of nuclear terrorism. Likewise, the Communique of the 2014 Nuclear Security Summit in The Hague underscores the need for legislative measures to enable national prosecutions in the context of illegal trafficking. Other "soft law" documents have similar provisions and provide sufficient flexibility for governments to collaborate and exchange information in a manner consistent with their legislation.

In this sense, nuclear forensics represents the principal method for analyzing materials used to commit crimes and tracking these materials to the culprit. As evidentiary procedure it is the examination of nuclear and other radioactive material, or other evidence that is contaminated by radioactive material, in the context of legal proceedings under international or national law related to nuclear security. Prevention, detection, and response are the three main steps in maintaining nuclear security and combatting nuclear terrorism. Nuclear forensics helps keep nuclear materials under control by providing clues into their history. It thus contributes to effective measures for preventing the loss of nuclear material from the same source. Forensics can also deter. If investigators undertake collaborative forensics projects under the international legal framework, they can drive up risks for potential perpetrators. Greater prospects of being detected and punished translate into deterrence.

## 6. Conclusion

The diversity and multi-functionality of the international legal framework make it possible to successfully prosecute those who are involved in a theft, diversion and use of nuclear material for acts of terrorism. There are at least three preconditions for accomplishing this mission, i.e. recognition by governments that nuclear terrorism is a global menace, the government's commitment to collaborate and provide assistance including nuclear forensics and the establishment of an effective national legal mechanism. Once these elements are in place, the international legal framework can provide an umbrella under which to pursue vitally important goals of protection, enforcement, criminalization and prosecution.

## REFERENCES

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Application of Nuclear Forensics in Combating Illicit Trafficking of Nuclear and Other Radioactive Material, TECDOC No 1730, IAEA, Vienna, (2014).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Objectives and Essential Elements of a State's Nuclear Security Regime, IAEA Nuclear Security Series No 20, IAEA, Vienna, (2013).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, The International Legal Framework for Nuclear Security, IAEA International Law Series No 4, IAEA, Vienna, (2011).

[4] STOIBER et al., Handbook on Nuclear Law, Implementing Legislation, Vol II, IAEA, Vienna, (2010).

[5] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Forensics Support, IAEA Nuclear Security Series No 2, IAEA, Vienna, (2006).

[6] UNITED NATIONS OFFICE ON DRUGS AND CRIME, Preventing Terrorist Acts: A Criminal Justice Strategy Integrating Rule of Law Standards in Implementation of United Nations Anti-Terrorism Instruments, UNODC, (2006).

# Nuclear Security Legislation in Hungary - Overview of the National Response Plan to Events with Nuclear and Other Radioactive Material Out Of Regulatory Control

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**Abstract.** A governmental decree entitled 'Physical protection of nuclear facilities, nuclear material, radioactive sources and radioactive waste and the related licensing and control system' came into force on 4th of October 2011 regulating the process of developing physical protection systems of a nuclear facility, physical protection of nuclear and other radioactive materials during storage, application and transport, as well as the preparation of the physical protection plan.

The aim of the physical protection of nuclear facilities and nuclear materials, radioactive sources and the radioactive waste in Hungary is to deter, detect and respond to

- the sabotage resulting unacceptable radiological consequences;
- unauthorized removal of the nuclear material, radioactive sources and radioactive waste;
- the unauthorized acquisition of classified data and information

in the nuclear facilities and during the use, storage and transport of nuclear materials, radioactive sources and radioactive waste.

The governmental decree described above is based on the recommendation of Nuclear Security Series No. 13 and No. 14. Additionally, the National Response Plan to event with nuclear and other radioactive material out of regulatory control has been reviewed according to the Nuclear Security Series No. 15. The new regulation is to be issued in 2014 as a governmental decree. The regulation applies a "graded approach" through the application of diferent levels of response to a nuclear security event.

In this paper the relevant features of the Hungarian nuclear security regulatory framework, the details of the relevant legislation and the role of nuclear forensics will be discussed including the experiences collected during the licensing period from 4th of October 2011. Special attention will be paid to the introduction of the details of the National Response Plan to an illicit trafficking event regulated by the new draft governmental decree.

## 1. Introduction (Hungary's commitments)

Hungary signed and ratified every relevant legal instrument in the field of nuclear safety, security and non-proliferation.

The internationally accepted basis of physical protection of nuclear facilities in Hungary is the Law-Decree 8 of 1987, which promulgated the Convention on Physical Protection of Nuclear Materials approved by the IAEA in 1979 and the Act LXII of 2008, which promulgated the Modification of the Convention signed on 8 July 2005 in a diplomatic conference organized by the IAEA. Hungary also ratified the International Convention for the Suppression of Acts of Nuclear Terrorism by Act XX of 2007. Hungary complies with the stipulation of UN Security Council resolution 1540 and submits the required national reports to the 1540 Committee.

Hungary, as a member state of the European Union, adapts its acqui communautaire. The Council Directive 2003/122/EURATOM on the control of high-activity sealed radioactive sources and orphan sources requiring the establishment and maintenance of a national register of high activity sealed sources (almost identical with Category 1-3 sources according to the IAEA) is adapted into the national legislation. The Council Regulation (Euratom) No 1493/93 of 8 June 1993 on shipments of radioactive substances between Member States that regulates the intercommunity transport of radioactive sources and wastes shall be directly applicable in Hungary. The Hungarian Atomic Energy Auhtority (HAEA) plays the role of the competent authority for both instruments.

Hungary is also party to each mode-specific international transport agreement. Hungary supports both the IAEA Code of Conduct on the Safety and Security of Radioactive Sources and the IAEA Guidance on Export and Import. The import and export related provisions of the IAEA Code of Conduct on the Safety and Security of Radioactive Sources are implemented in the national legislation, typically as binding regulations. Nevertheless, the explicit enforcement provisions for individual shipments are missing from the specific legislation; however they are covered by the act on regulatory procedures. The provisions of the IAEA Guidance are applied to Category 1&2 sources.

Due to the international obligations and commitments, the revision of the regulatory system for nuclear security in Hungary was necessary, which started in 2008 and resulted in new national legal instruments that entered into force by the end of 2011. In the following sections the peaceful use of atomic energy and the corresponding new physical protection requirements will be introduced and the regulatory experinces in the new licensing procedures discussed.

## 2. Act on atomic energy

The uppermost level of domestic application of the obligations undertaken in the international convention is represented by the Act CXVI of 1996 on Atomic Energy (hereinafter referred to as: Atomic Act) [1]. The Atomic Act contains the basic concepts of nuclear security and establishes the basis for detailed regulation of physical protection.

According to the definition of the Atomic Act the use of atomic energy means such activities that correspond to nuclear or other radioactive materials, to such facilities which serve for the use of nuclear or other radioactive materials, and equipment which generate ionizing radiation without a radioactive source. The basic objective of regulatory oversight is that the use of atomic energy, thus the ionizing radiation generated during the use, shall not cause any harm to the people and to the environment in any way, while the regulatory activity does not unjustifiably limit the operation of the facilities or equipment or the pursued activity causing the threat. Moreover, it is a basic interest and obligation of the states operating nuclear facilities and using radioactive materials that the integrity and safe use of nuclear facilities operated and of the nuclear and other radioactive materials used, stored or transported within their territory is protected by due physical protection systems.

Pursuant to the effective provisions of the Atomic Act the nuclear security provides:

- prevention of the unauthorized removal of nuclear and other radioactive materials, unauthorized use (misuse) of radioactive materials, sabotage, malevolent acts and damage to the environment committed with nuclear or other radioactive materials;

- physical protection, based on the current level of threat, against unauthorized removal of nuclear and other radioactive materials in use, storage or transport, as well as against sabotage;

- detection of malevolent acts, damage to environment committed with nuclear and other radioactive materials, as well as of misuse of radioactive materials;

- implementation of urgent and comprehensive measures for the identification of the location of a missing or thieved nuclear or other radioactive material, and if appropriate for regaining the regulatory control;

- mitigation or minimization of the consequences of a sabotage, as well as of malevolent acts, damage to environment committed with nuclear or other radioactive materials.

The physical protection is the complex set of those internal regulations, technical equipment and live response forces, which are applied as part of nuclear security for prevention, deterrence, detection and delay of and response to unauthorized removal and sabotage or other crime committed against nuclear facilities, nuclear and other radioactive materials or against such equipment that generates ionizing radiation but does not contain radioactive materials.

The Atomic Act introduces three basic principles in relation to physical protection:

1. According to the principle of graded approach the threat against the particular material, equipment or nuclear material shall be taken as basis to design and construction of the physical protection system. In order to determine the particular threat and so the respective requirements the attractiveness and potential applicability of the material shall be taken into account.

2. The protection-in-depth concept requires the application of a complex system of principles, administrative measures and technical solution built onto each other to ensure physical protection, where the system guarantees for the realization of the required level of protection by a combination of various independent protection levels applied in a specific sequence.

3. The concept of equal protection means that the physical protection system shall provide approximately equivalent protection against each potential intrusion routes and tactics under any (i.e. environmental, meteorological, lighting) conditions.

The Act also stipulates that the operation of the physical protection system of a nuclear facility, the use, store and transport of nuclear and other radioactive materials, as well as the particular implementation of the deterrence, detection, delay and response physical protection functions shall be described in a physical protection plan.

### *2.1. Govt. decree on physical protection*

The Govt. Decree 190/2011. (IX. 19.) Korm. on physical protection requirements for various applications of atomic energy and the corresponding system of licensing, reporting and inspection entered into force on 4 October 2011 based on Paragraphs q) and r) of Section 67 of the Atomic Act. According to Section 31 of the Govt. Decree the HAEA is responsible for licensing and inspection of construction, operation and modification of the physical protection system of nuclear facilities, interim storage or final repository of radioactive wastes and nuclear materials, radiation sources and radioactive wastes with the involvement of the National Police Headquarters as special authority [2].

The Govt. Decree describes a performance based requirement system for nuclear facilities (with the exemption of the training reactor) and a prescriptive system for all other users. The minimum compulsory security requirements depend on the category of the nuclear material and the ratio of the isotope specific activities to the D values of radioactive materials. Four physical protection levels are established and the physical protection requirements are prescribed according to these four levels (e.g. Level A is the most stringent and it applies to the use, storage and transport of nuclear materials in Category I).

The physical protection system for the use, storage and transport of nuclear material, radioactive sources and radioactive waste must ensure: (i) the prevention of sabotage and unauthorized removal (A-level), (ii) reducing the opportunity of sabotage and unauthorized removal (B level), (iii) reducing the opportunity of unauthorized removal (C-level) or (iv) application of basic protection measures, i.e. prudent management, (D-level). The physical protection system must ensure the effective combination of deterrence, detection, delay and response as physical protection functions. The detailed requirements for implementing deterrence, detection, delay measures according to the security levels (A, B, C, D) are prescribed in the Govt Decree. The required physical protection levels (i.e. A, B, C

and D) are related to categories of nuclear and other radioactive materials. The materials are categorized according to CPPNM and Code of Conduct on the Safety and Security of Radioactive Sources.

The scope of the Govt. Decree also covers the fix and mobile equipment that generate ionizing radiation but does not contain radioactive material. The capabilities corresponding to such equipment is limited, but the provision of a due protection is required also in this case, and accordingly, the respective requirements should be determined. The concept of a graded approach does not justify the obligation of the concerned licensees to develop a physical protection plan.

*Table I. Security levels for nuclear and other radioactive materials*

| **Material category** | | **Security level** |
|---|---|---|
| **Cat 4, 5 radioactive source** | ***(use, storage and transport )*** | **D** |
| **Cat 4 radioactive waste** | **(*processing, storage and transport)*** | |
| **Non-categorized nuclear material** | ***(use, storage and transport )*** | |
| **Cat 2, 3 radioactive source** | ***(use, storage and transport )*** | **C** |
| **Cat 2, 3 radioactive waste** | **(*processing, storage and transport)*** | |
| **Cat III nuclear material** | ***(use, storage )*** | |
| **Cat 1 radioactive source** | ***(use, storage and transport )*** | **B** |
| **Cat 1 radioactive waste** | ***(processing, storage and transport)*** | |
| **Cat II nuclear material** | ***(use, storage and transport )*** | |
| **Cat III nuclear material** | ***(transport )*** | |
| **Cat I nuclear material** | ***(use, storage and transport )*** | **A** |

## *2.2. Ministerial decree on police tasks in relation to the application of atomic energy*

The Ministerial decree 47/2012. (X.4.) BM on the police tasks in relation to the application of atomic energy established those aspects that are to be considered by the Police Headquarters during the licensing of physical protection plans, as well as during the inspection of licensees. The Ministerial decree also determines the police tasks in relation to transport of nuclear materials.

## *2.3. New regulation of nuclear and other radioactive material out of regulatory control*

The response measures regarding found and seized radioactive and nuclear materials are regulated in Hungary by the Gov. decree 17/1996. (I.31.) Korm. on "Measures Related to Found or Seized Radioactive or Nuclear Materials". This decree prescribes the tasks and duties of the different organizations involved from the reporting of detection through the accurate identification, until the storage of the subject nuclear and radioactive materials. In 2008 an illicit trafficking exercise was organized, which was a step of a comprehensive national review of the Hungarian nuclear and radiological non-proliferation provisions [3]. As a field exercise it focused on the response actions to be made. The one day exercise took place on the site of the Budapest Research Reactor on the 15th of May, 2008. The exercise simulated the case of an abandoned foreign plated car found in a forest near Budapest by a passer-by. There two packages left in the boot and the front seat of the car. In the boot there was a radioactive source of 11,8 GBq 60Co placed into a depleted uranium container with a radioactive sign. The other package on the front seat was a glass jar in which low enriched (2,6 %) uranium pellets.

In the exercise several national authorities participated. The scenario of the exercise followed the provisions of the Government Decree, complemented with some elements of the Draft model action plan for seized/found radioactive or nuclear material of the Nuclear Smuggling International Technical Working Group. The evaluation of the exercise highlighted some week points of National Response Plan, which initiated its revision.

The revision of the National Response Plan to event with nuclear and other radioactive material out of regulatory control started in 2012. A draft of the new regulation has been prepared and the negotiation process has been started involving all competent authorities. In this section the main feature of the new regulation is discussed, which is planned to be issued in 2014 as a governmental decree.

During the revision of the National Response Plan several non-compliance to the international guidelines (e.g. Nuclear Security Series No. 15, „graded approach") and two-fold competencies in case of on-site response and secure storage of the materials were identified. Moreover, in case of an incident within the territory of a site the responsibility was not regulated clearly.

The new regulation applies the recommendation of "graded approach" through the application of three levels of response to a nuclear security event, as follows:

- Strategic level: In case of radiological emergency the response is determined in the National Emergency Preparedness Plan (NEPP), which defines the role and responsibility of all competent authorities.Tactical level: If the incident doesn't fall under the scope of the NEPP, the response is defined in the new governmental decree.Operational level: In case of an incident within the territory of a site the response is the responsibility of the licensee, to which – upon request – the competent authority provides support.

Moreover, the response to an event with nuclear and other radioactive material out of regulatory control may differ based on the type of incident e.g.

- Missing: incidents involving the disappearance of material including theft or loss.
- Discovery: incidents involving discovery/detection of any type or quantity of material which is out of regulatory control (uncontrolled, e.g. orphan source) inside or outside of a site.
- Seizure: as a last step of discovery, the material can be seized by the competent authority.
- Confiscation: in case of unauthorized possession the material can be confiscated by the competent authority.

According to the revised National Response Plan in case of "Discovery", "Seizure" and "Confiscation" the nuclear and other radioactive material is transported to a dedicated nuclear forensics laboratory operated by the Hungarian Academy of Sciences Centre for Energy Research (HAS CER). The HAS CER is responsible not only for the secure storage of the material but also for carrying out a detailed nuclear security investigation if it is requested by a competent authority. In contrast to the past the experts of the Ministry of Health are involved into the process only if unacceptable radiological exposure can not be excluded.

## *2.4. Regulatory guidelines*

The methods how the requirements determined in the laws should be complied with are described in the guidelines that constitute the next level of the regulatory system. The guidelines are issued by the director general of the HAEA, and they are regularly reviewed and reissued based on the accumulated experience. So as to proceed smoothly and duly the authority encourages the licensees to take into account the recommendations of the guidelines to the extent possible. The following guidelines are available at the website of the HAEA:

PP-1 Categorization of nuclear materials, radioactive sources and radioactive wastes

PP-2 Detailed requirement levels for the systems, structures and components of the deterrence physical protection function

PP-3 Detailed requirement levels for the systems, structures and components of the detection physical protection function

PP-4 Detailed requirement levels for the systems, structures and components of the delay physical protection function
PP-5 Determination of physical protection zones
PP-6 Security culture
PP-7 Design of the physical protection system of nuclear materials, radioactive sources and radioactive wastes in use or store against unauthorized removal and sabotage
PP-8 Design of the physical protection system of nuclear facilities (with the exemption of those operating with a reactor having less than 1 MW thermal power) and radioactive waste temporary storage and final disposal facilities
PP-9 Evaluation of the effectiveness of the physical protection system of nuclear facilities (with the exemption of those operating reactor having less than 1 MW thermal power), and radioactive waste temporary storage and final disposal facilities
*PP-10 Development of the DBT (not public - provided to the relevant organizations only)*
PP-11 Preparation and submittal of physical protection license applications
PP-12 Physical protection related reporting system
PP-13 Protection against insiders
PP-14 Operation, maintenance and testing of physical protection systems and components
PP-15 Preparation of the physical protection plan required for the transport of nuclear and other radioactive materials 18
PP-16 Detailed requirement levels for the realization of the response physical protection function
PP-17 Physical protection requirements for new NPP units (draft, under issuance)
PP-18 Protection of IT and ITC systems (draft, under preparation)

## 3. Regulatory experiences

The HAEA and the National Police Headquarters are responsible for licensing of physical protection plans and inspecting their implementation. The license holders are responsible for the implementation of the system described in their approved physical protection plans.

The inspections are based on a risk informed approach: their frequency is adapted with the category of the materials and the number of security related events. The frequency of inspections is laid down in the inspection plan, which is established in each quarter on the basis of risk-informed considerations. Inspections are either announced or unannounced or conducted as a follow-up action in case of a suspicious situation. The investigation and assessment of any events affecting security that have occurred during operation and the identification of the causes and the taking of corrective actions and measures in order to prevent their occurrence is primarily the task of the licensee.

Until the end of 2013 375 physical protection licenses were issued for use and storage and 155 for transport (including 5 lincenses for both applications) by the Hungarian Atomic Energy Authority. The license document includes the approved physical protection plan. The physical protection plan is valid for 5 years, with the exemption of the transport of Category 1-2 sources, where it is valid for the specific transport only.

To facilitate the introduction of the new nuclear security reguratory system and to explain the new requirements, HAEA in cooperation with the National Police Headquarters organised several seminars for the material holders on the development of the physical protection plan. There was a huge interest whereby around 80% of the total licensees participated in one of these seminars. As a result only 2 % of the material holders failed to apply for physical protection license on time. In these cases HAEA initiated administrative procedures, which resulted in all cases in the promt application for the license. There was only one case, where the associated risk justified the fining the material holder by the HAEA for failing to apply for license on time.

Based on the annual inspection plan 150 physical protection systems were inspected annually. Additionaly, in 10 and 19 cases targeted inspections were carried out in 2012 and 2013, respectively. Based on the experiences of physical protection inspections some typical shortcomings were identified and corrective actions initiated.

## 4. Conclusion

The main pillar of the new nuclear security regulatory framework in Hungary is the Govt. Decree 190/2011. (IX. 19.) Korm. on physical protection requirements for various applications of atomic energy and the corresponding system of licensing, reporting and inspection, which entered into force on 4 October 2011.

The Govt. Decree describes a performance based requirement system for nuclear facilities and a prescriptive system for all other users. The uniqness of this new regulation is the consolidated minimum security requirements specified for each of the four security levels. The required security level depends on the category of the nuclear material and/or the categorization of the radioactive materials and/or the radioactive waste.

To facilitate the new licensing procedures, HAEA in cooperation with the National Police Headquarters organised several seminars for the material holders on the development of the appropriate physical protection plan. Due to the success of these seminars, only 2 % of the material holders failed to apply for physical protection license on time. This was a great achievments in raising nuclear security awareness.

HAEA in cooperation with the National Police Headquaters, carried out 329 physical protection inspections in 2012-2013, whereby minor non-compliances could be detected and corrective actions enforced.

However, continuous efforts are needed to sustain the appropriate level of nuclear security especially in the field of the security of radioactive materials, where some of the users are less confident that higher level of physical protection of their materials is indeed necessary. For this reason HAEA is planning to establish a national nuclear security centre by 2014-2015 which could provide the licensees and the staff of the compenent authorities with training, scientific and technical assistance.

The revised regulation of nuclear and other radioactive material out of regulatory control correct and simplify several point of the previous National Response Plan, e.g. non-compliancies to the international guidelines, two-fold competencies in case of on-site response and secure storage of the materials. Moreover, the responsibility of the nuclear forensic investigation is also regulated.

## REFERENCES

[1] Act CXVI of 1996 on Atomic Energy (for unofficial English translation visit: http://www.oah.hu/web//v2/portal.nsf/att_files/jogszabalyok/$File/atomtv_en.pdf

[2] Decree 190/2011. (IX. 19.) Korm. on physical protection requirements for various applications of atomic energy and the corresponding system of licensing, reporting and inspection (for unofficial English translation visit: http://www.oah.hu/web//v2/portal.nsf/att_files/jogszabalyok/$File/gd190.pdf

[3] VINCZE et al., Detection and Response to Malicious Use of Nuclear and other Radioactive Materials: Illicit Trafficking Exercise in Hungary, NATO Advanced Research Workshop (ARW), “Threat Detection, Response and Consequence Management associated with Nuclear and Radiological Terrorism” November 17–20, 2008, Brussels