SECURING RADIOACTIVE SOURCES AND MATERIALS: TIME TO HAVE AN INTERNATIONAL BINDING CONVENTION?

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Abstract

For more than a decade radiological terrorism - malicious acts involving the use of radiation sources - has been identified as one of the major threats to the international community. The present article highlights the importance of using the correct terminology in the field of nuclear law. Indeed, it is of paramount importance to understand the legal and technical meaning of terms such as *nuclear safety*, *nuclear security* or *radioactive source* in order to perceive the scope and content of the existing regime. Furthermore, after having taken radiological security as granted for decades, this regime has seen, in recent years, the multiplication of international instruments aiming at improving the security of radioactive sources in order to prevent their malicious use. However, despite national and international efforts, gaps and weaknesses remain. In this context, negotiating a Convention on Radiological Security might be an utmost solution. While such a Convention would entail numerous advantages, incertitudes and difficulties related to the nature and the negotiation of this new instrument also need to be taken into account. In spite of these doubts the outline of the provisions that could be included in the Convention can be put forward.

Disclaimer

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"Compliance is not the same as effectiveness, nor can legitimacy necessarily be equated with effectiveness"

Günther Handl [1]

Introduction

Since the attacks of 11 September 2001, chemical, biological, nuclear and radiological weapons (CBRN) have increasingly been on the forefront of the international security agenda. Despite the fact that these weapons have existed for decades, the events of the World Trade Center revealed groups with considerable organization, financial means and human resources whose objectives are to inflict enormous damage and disturb the society of some countries.

In this context, the link between terrorism and the potential use of radiation sources for malicious purposes, known as radiological terrorism, has progressively been brought to the fore of national and international authorities. Governments have been taking steps - both at national and international level - to improve the physical protection and they have been accounting measures of radioactive sources used in many legitimate areas such as science, medicine or industry.

However, despite the adoption of international standards by the International Atomic Energy Agency (IAEA), the regime - mainly based on states' voluntary implementation of non-legally binding existing standards - is fragmented. Indeed, many countries utilizing radioactive sources lack even the most basic protection and accounting standards. Furthermore, the way states apply the IAEA recommendations vary considerably, which might cause weaknesses in the existing regime that could be exploitable by terrorist groups. Although progress has been made towards the uniform application of the existing standards, the establishment of a new legally binding regime, providing states with methods to integrate the IAEA recommendations domestically and assess their application, should be considered.

This paper aims at discussing the potential need of the establishment of a Convention on Radiological Security. It will first describe the nature and the use of radiation sources. It will then examine the current international framework covering the security of such sources. Finally, it will discuss the gaps and weaknesses of the existing regime and consider the likelihood of establishing this new international convention.

Introduction to safety and security of radiation sources

The Handbook on Nuclear Law published by the IAEA underline in the preface how important and necessary it is to have a clear, consistent and accurate terminology in all areas of legislation [2]. It additionally single out the field of nuclear law as being highly technical and therefore exceptionally sensitive. International nuclear law is, due to its interdiciplinarity, not only a domain for lawyers and the principle of unambiguous terminology might have been somewhat forgotten. It is perhaps not mentioned frequently enough as it often happens in the nuclear field - that even basic terms are used improperly. There is no doubt that these misuses arise partially from linguistic differences, but also from different definitions of the same words linked to the context in which they are used. For example there is often a common lack of distinction which results in various definitions of a safety, security and radioactive source radiation source. Since these three terms are crucial in the subjects covered in the present article it is relevant to remind their meaning to the reader.

Safety and security

In the English language safety and security are distinguishable terms. In many other languages a same word covers both meaning. That is the reason why these terms are sometimes used alternatively. Even in the IAEA Safety Glossary, it is stated that "*there is not an exact distinction between general terms of safety and security. In general, security is concerned with malicious or negligent actions by humans that could cause or threaten harm to other humans; safety is concerned with the broader issue of harm to humans (or the environment) from radiation, whatever the cause. The precise interaction between security and safety*

depends on the context" [3]. This statement associates nuclear security with prevention, detection and response to possible theft, sabotage, illicit trafficking or transfer and other malicious acts of nuclear material, radioactive substances or their associated facilities. Nuclear safety on the other hand is "*the achievement of proper operating conditions, prevention of accidents or mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation hazards"* [3]. Safety is very much related to (radiation) protection which is primarily concerned with controlling exposure to radiation.

Are then safety and security of radiation sources completely detached, overlapping or is one encompassing the other? It is certainly of great interest in ensuring both safety and security. Since the physical characteristics of radiation sources cannot be changed, some of them will never be completely safe (unlikely to produce radiation harm). On the other hand, theoretically the security of all radiation sources can be assured. This means that security is a necessary, but not sufficient condition for safety. The best that can be done for these sources that cannot be considered safe, no matter how carefully handled, is to guarantee their security.

Radiation sources

The way of talking about *radiation sources* can also be very misleading. The Code of Conduct on the Safety and Security of Radioactive Sources (hereafter referred as *the Code of Conduct*) defines it as follows: "*any radiation generator, or a radioactive source or other radioactive material outside nuclear fuel cycle of research and power reactors*" [4][3]. The Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (the BSS) has a more general definition: "*anything that may cause radiation exposure — such as by emitting ionizing radiation or by releasing radioactive material — and can be treated as a single entity for protection and safety purposes*" is a *source* (no definition of *radiation source* per se exists in the BSS text) [5]. Although the BSS title specifies that it applies to *radiation sources*, not to *sources* only, it is generally not a misconception. But yet, the biggest confusion may occur from misuse of terms which are the components of *radiation source* definition. Namely (following the BSS) a *radiation generator* is "*a device capable of generating ionizing radiation (...)*", *radioactive source* is "*a source containing radioactive material that is used as a source of radiation*"[4] and finally *radioactive material* which is "*material designated in national law or by a regulatory body as being subject to regulatory control because of its radioactivity*"[5]. In this context it is clear that depending on which definition meant to be used, the term *radioactive source* will cover a completely different group of items. This is specifically important in the medical applications of radiation where *radioactive material* can occur in unsealed form and might or might not be covered with certain definition. Additionally, the adjective *radiological* (i.e. material, emergency, etc.) is often used in relation to anything that is associated with radiation or radiation exposure. Since it does not have a specific reserved definition it should be understood in its broad concept[6].

Although in most documents the meaning of specific terms is precisely defined and usually consistent with previously existing ones, it often happens that in articles or public speeches, above mentioned terms are used as synonyms. It is however very important to distinguish these terms accordingly and specify which definition is applied while using a respective term. In this article, if not stated otherwise, the term *radioactive source* is used as defined in the BSS.

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[3] This definition comes from the 2001 version of the Code of Conduct.

[4] Compare with: "*Radioactive material that is permanently sealed in a capsule or closely bonded and in a solid form and which is not exempt from regulatory control. This also includes any radioactive material released if the radioactive source is leaking or broken, but does not include material encapsulated for disposal, or nuclear material within the nuclear fuel cycles of research and power reactors*" [4].

[5] "*This is the 'regulatory' meaning of radioactive (...) - the 'scientific' meaning of radioactive — as in radioactive substance — refers only to the presence of radioactivity, and gives no indication of the magnitude of the hazard involved*" [5].

[6] In the present article the words *radiological security* cover the security of radiation sources as defined in the 2001 edition of the Code of Conduct (excluding fissile material), which would generally make it a subgroup of the nuclear security as defined in the [3].

Fundamentals of ionizing radiation and its societal benefits

Ionizing radiation has been accompanying humans since the very beginning of human history. It is has always been in the environment. Nevertheless it is only since the end of 19th century, after the discovery of X-rays (W. Röntgen) and then natural radioactivity (H. Becquerel, M. Skłodowska-Curie and Pierre Curie) that it has been used intentionally. This does not mean that it has been, or is today, always used consciously and cautiously. However ionizing radiation's potentially harmful influence on human body has been observed soon after its discovery. Many years passed until these effects were thoroughly investigated and described. The lack of data on exposure of humans to relatively small radiation doses still makes it impossible to assess the potential risk of radiation induced disease.

Ionizing radiation, due to the energy it carries, has the ability to liberate the electrons from the atom structure, and by that, to create positively charged ions. There are many types of ionizing radiation and its interaction with matter. With respect to radiation sources as previously defined, relevant ionizing radiation types are alpha particles (or heavier ions), beta particles, neutrons, gamma and X-rays. The effects of ionizing radiation exposure are generally divided into two groups: stochastic and deterministic. A common example of stochastic effect is the induction of cancer due to non-repaired direct or indirect DNA damage leading to cell mutation. The stochastic effects of exposure are often observed after years or decades after exposure. Deterministic effects are defined as occurring due to radiation exposure that directly caused cells killing or malfunction. There are generally dose thresholds know, for certain deterministic effects, above which their severity is greater for higher dose (i.e. radiation burns). It cannot be judged which of these two types of effects is more serious, both can cause disease or death [6].

Although ionizing radiation is used in many branches of industry, science as well as in everyday life, a particularly interesting field which exploits it is medicine. It is not only relevant due to its sterilizing, diagnostic and curative utilization, but it also plays an important role in the environment, in which nuclear safety and security standards are applied. In the medical facilities exposures of all categories can occur as well as radioactive sources from all five categories can be found[7]. The majority of the medical procedures that involve radiation sources are either diagnostic imaging or radiation therapy. Most of the imaging is performed with X-rays which are generated by X-ray tubes that need power supply (can be switched off) and which are parts of bigger machinery (i.e. CT scanner, X-ray unit). A significant part of the radiation therapy is performed with linear accelerators, devices that also need power supply and are big, heavy and unlikely to be stolen. Generally very high radiation doses can be applied using these units, so they are of safety concern but due to their physical dimensions and need of power supply they are not considered unsecured. On the other hand some of the imaging and treatment utilizing ionizing radiation is done by injection of radioactive sources into human body (nuclear medicine). Used radionuclides are built in the structure of compounds or pharmaceuticals and once administered to the patient, through blood, they localize in specific organs or cellular receptors. The imaging is performed as the measurement of the radiation coming out of the patient's body. Treatment can also be performed with so called teletherapy machines (units), which utilize sealed radioactive sources as source of radiation (typically ^{60}Co). Additionally sealed radioactive sources are used in brachytherapy, which is based on their temporary or permanent implantation in the human body. The activity of radiation used in nuclear medicine is relatively small when calculated for each single procedure, but it involves work with unsealed sources that need to be divided into desired smaller doses. Mentioned radiation therapy methods involve highly radioactive sealed sources. In brachytherapy their size usually does not exceed few millimeters, whereas sources, when unshielded, used in teletherapy units are of a few centimeters [7]. These sources can become a safety and security concern because of significant radiation exposure they could cause, their size and form of occurrence.

Safety of radiation sources and categorization of radioactive sources

The only globally accepted set of basic safety standards is the IAEA's [5]. Its status directly stems from the Agency's Statute, which "*authorizes the IAEA to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property, and to provide for their application*" [5]. Due to an efficient preparation and review process

[7] Categorization of exposures and radioactive sources in the meaning of the BSS.

involving the IAEA Secretariat, specialized committees[8], the Commission on Safety Standards (CSS) and Member States, these standards are reflecting an international consensus on radiological safety levels. The IAEA's standards are collected in a constantly expanding set of Safety Standards Series (SSS) publications gathered in three categories: Safety Fundamentals introducing safety objectives and principles; Safety Requirements providing conditions to be reached to ensure safety fundamentals; Safety Guides giving practical tools and guidance how to respect safety requirements. SSS are meant to be a comprehensive and essential tool for Member States' regulatory bodies, other national authorities and organizations supporting the use of ionizing radiation. Indeed, they provide guidelines to create regulations of safe operation. They also are insuring safe and confident practice of radioactivity and ionizing radiation end users, protecting human life, health and the environment. In the Safety Requirements category, divided into two subgroups of General Safety Requirements and Specific Safety Requirements, one can find relevant publications ordered upon subjects of their application. The BSS has been, since its first version in 1962 (Safety Series No. 9), the cornerstone of the safety standards in planned, emergency and existing exposure situations (nomenclature in accordance with the current BSS). A revised version of the IAEA's BSS was published five years later and another one in 1982. It was cosponsored by the International Labour Organization (ILO), the OECD Nuclear Energy Agency (OECD/NEA) and the World Health Organization (WHO). A subsequent version was published by IAEA in 1996. In addition to the previous sponsors, this more recent version was supported by the Pan American Health Organization (PAHO) and the United Nations Food and Agriculture Organization (FAO). A revision of this version was requested at the IAEA General Conference in September 2005, two new potential sponsors were invited: the European Commission (EC/Euratom) and the United Nations Environment Programme (UNEP). The drafting process, taking into account the findings and recommendations of UNSCEAR[9] and ICRP[10], started in the beginning of 2007 and several meetings took place until 2009. The version 3.0 of the draft was approved by the four standards committees at the end of 2009 and was sent to member states in January 2010. Over fifteen hundred comments from 41 member states were brought back to the committees. Applied changes resulted with Draft 4.0, which after editorial changes by the IAEA, was finalized as Draft 5.0 by the BSS Secretariat and the Chairpersons of the Safety Standards Committees. This draft was approved by the CSS and published as an Interim edition in 2011. In July 2014 a joint sponsored edition of the International Basic Safety Standards was published as General Safety Requirements No. GSR Part 3: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. It supersedes the previous Interim Edition issued in 2011. According to the paragraph 2.7 of the BSS: "*if a State decides to adopt these Standards, these Standards shall come into force at the time indicated in the formal adoption by that State*". The BSS apply to the three main categories of exposure: occupational, public, medical and all their types (planned, emergency and existing exposure situations).

IAEA-TECDOC-1344 introduces a categorization of radioactive sources (also used in the BSS[11]) that "*provides a relative ranking of radioactive sources in terms of their potential to cause immediate harmful health effects if the source is not safely managed or securely protected*" [8]. The sources are grouped in 5 categories from potentially the most dangerous (category 1) to not dangerous sources (category 5). The tabulated categorization lists common practices utilizing a particular source category but also provides ranges of values of the ratio that can be calculated for unlisted practices or aggregated sources. The categorization includes 'plain language' definition with a distinction between individual source and dispersed radioactive material occurrence[12].

Although, as concluded in the TECDOC-1344, the categorization provides "*harmonized basis for risk-informed decision making, by providing a relative ranking and grouping of sources and practices, which is*

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[8] Committees for: nuclear safety (NUSSC), radiation safety (RASSC), the safety of radioactive waste (WASSC) and the safe transport of radioactive material (TRANSSC).

[9] The United Nations Scientific Committee on the Effects of Atomic Radiation

[10] International Commission on Radiological Protection

[11] Although the categorization "*focuses on sealed sources, the methodology can also be used to categorize unsealed radioactive sources*" [8].

[12] In addition to sources categorization The International Nuclear and Radiological Event Scale (INES) exists to facilitate communication and understanding between the technical community, the media and the public on the safety significance of events. The aim is to keep the public as well as nuclear authorities accurately informed on the occurrence and consequences of reported events. [9]

based on a logical and transparent methodology", the document is only based on deterministic health effects. Stochastic effects have been excluded as most likely negligible compared to deterministic ones resulting from an accident or a malicious act. Socio-economic consequences have neither been taken into account as they were considered not to be easily quantifiable. The Code of Conduct on the Safety and Security of Radioactive Sources takes this categorization into account and recognizes that "*it does not fully take into account the range of impacts that could result from accidents or malicious acts involving radioactive sources*". It does not, on the other hand, provide solutions, other than requirement for the States to "*give appropriate attention*", how to ensure safety and security of the sources having "*the potential to cause unacceptable consequences if employed for malicious purposes*" [4].

Malicious use of radiation sources

Risk of a malicious act is defined as its probability multiplied by its consequences [11]. Both are often considered separately and in direct relation to security and safety. In this way, for situations in which either probability or consequences are considered low, the risk is estimated as low. This misconception is even more adverse, taking into account that the consequences of radiation exposure are only based on the deterministic health effects. It leads to neglecting the threat posed by the radiation generators generally considered secure, or higher category number radioactive sources generally considered safe.

There are several ways of using radiation sources as a weapon to achieve one or more of the following effects [11]: cause harm to human health through exposure to ionizing radiation, provoke psychological effects, disrupt people's lives and livelihoods or cause economic damage by contamination or loss of trust to ionizing radiation applications (scientific, medical, industrial or others). To facilitate the latter, radiological dispersal device (RDD), radiation emission device (RED) or radiation incendiary device (RID), could be used[13]. These are the three typically considered radiological weapons, which unlike nuclear weapons, do not produce a nuclear chain reaction and hence a massive explosion. That is the reason why radiological weapons are considered to be weapons of mass disruption, rather than weapons of mass destruction.

Radiation safety and security cultures

Paragraphs 1.36 and 1.37 of the BSS explain the interferences between safety and security in details: "*1.36. Safety measures and security measures have in common the aim of protecting human life and health and the environment. In addition, safety measures and security measures must be designed and implemented in an integrated manner so that security measures do not compromise safety and safety measures do not compromise security. 1.37. Security infrastructure and safety infrastructure need to be developed, as far as possible, in a well coordinated manner. All organizations involved need to be made aware of the commonalities and the differences between safety and security so as to be able to factor both into development plans. The synergies between safety and security have to be developed so that safety and security complement and enhance one another*" [5]. Despite this distinction between safety and security, both could be used in the context of the application of ionizing radiation. Indeed, on the one hand, professionals having a deep understanding of the risks associated with the usage of radiation sources will have a highly developed safety culture. But they may often underestimate security measures due to the assumed peaceful character of their work (i.e. science or medicine). On the other hand, people without a comprehensive radiation awareness background, but aware of the possible risks, may nevertheless consider security as a priority. Hence, for them a high security level will be an important factor to decrease the probability of a malicious use. The case might also be completely opposite, all depending on human factor involved.

One has to keep in mind that the risk of a malicious act is influenced by its consequences. According to Hans Blix "*a nuclear accident anywhere is an accident everywhere*" [13]. This citation is also applicable in cases of radiological events. Due to people fear of radiation and constantly disturbed balance of their trust in nuclear technologies, direct deterministic and stochastic health effects of exposure to ionizing radiation are not the only consequences resulting from potential accidents or malicious acts. The loss of confidence in the nuclear power or medical application of ionizing radiation may influence people living thousands kilometers from a potential event and have unimaginable consequences on their health and prosperity.

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[13] RDD – the dispersal of the radioactive material in a powdered, liquid or gaseous form may be carried out by explosive, non-explosive, passive or active means [10], RED – applies to stationary or mobile radiation sources used for exposure of individuals or groups of people, RID - a device that couples fire with radioactive material [10]. Some other possible scenarios are listed in [12].

Current international radiological security framework

Historically the focus of the international community has been on preventing States from acquiring nuclear weapons. However in the aftermath of the attacks on the World Trade Center, States and international organizations broadened their strategy to prevent nuclear terrorism - malicious acts involving fissile materials or radioactive sources and materials - by enhancing the nuclear security regime.

Their efforts resulted in the establishment of the current framework towards the security of radioactive sources - a complex patchwork of international voluntary standards, legally binding documents and multilateral initiatives.

Central role of the IAEA in establishing security standards

The IAEA was established in 1957 as a result of the "*Atoms for Peace*" speech of President Eisenhower at the United Nations (UN) General Assembly on December 8, 1953 [14]. Its Statute was approved on October 23, 1956 by the Conference on the Statute of the IAEA. According to its article 2, "*the Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It shall ensure, so far as it is able, that assistance provided by it or its request or under its supervision or control is not used in such a way as to further any military purposes*"[15].

At its origin the IAEA work exclusively focused on nuclear safety as expressed in its Statute. Indeed article 3.A.6 stipulates that the Agency is authorized to "*establish or adopt (...) standards of safety for protection of health and minimization of danger to life and property (...) and to provide for the application of these standards, at the request of the parties, to operations under any bilateral or multilateral arrangements, or, at the request of a State, to any of that State's activities in the field of atomic energy*".

Surprisingly neither the word *nuclear security* nor *security* can be found in the IAEA Statute (including in its amended version of February 23, 1989). This absence is regularly overused by states reluctant to support the Agency's growing responsibilities in the field of nuclear security. However, despite this omission in the Statute, it is generally understood that the IAEA mandate in nuclear security derives from both non-binding and binding instruments. In fact its nuclear security mandate is integrated into its statutory functions of establishing standards on nuclear safety and safeguards [16]. Thus it is common to find provisions of nuclear security in texts devoted to safety and safeguards. Although *nuclear security* and *security* are not explicitly mentioned in its Statute, the Agency has competences and responsibilities in this area.

For Member States still arguing that nuclear security is not within the IAEA competences, the recent elevation of the Office of Nuclear Security to a Division has shown the growing importance of nuclear security. It has helped to increase the amount of funding from the regular budget for administering the nuclear security part of the IAEA mandate. Even if the current projects undertaken by the Division, in terms of assisting, advising and guiding States, still come from the Nuclear Security Fund and Technical Cooperation Program, this upgrade is a helpful development as it increases the bureaucratic influence and standing of nuclear security and embeds it firmly in the IAEA's priorities.

From safety to security: a recent (r)evolution

In the 1950s the security of radioactive sources was taken as granted by all existing international recommendations and standards. No specific nuclear security issues and prevention or response mechanisms in case of a security emergency were discussed. The focus was on establishing standards on nuclear safety in order to protect human health and the environment. This approach lasted in the period between the 1950s and 1990s during which nuclear security provisions did not appear in official documents.

The 1996 IAEA International Basic Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (IAEA Nuclear Safety Series n°115), or the BSS, was the first international standard addressing both safety and security of radioactive sources. Despite the fact that the BSS did not explicitly mention the security of radioactive sources, several of its provisions contained measures to

improve the physical protection of *radioactive substances*[14]. Following this core publication a series of conferences were held to address increasingly issues related to the security of radioactive sources.

Indeed, the first international meeting took place in 1998 with the Dijon Conference on the Safety of Radiation Sources and Security of Radioactive Materials [17]. Along with discussions related to safety issues, participants called upon the adoption, expansion and application throughout the world of basic principles governing radiological security. The possible role of the IAEA on this matter was in the middle of the debates, due to its extensive experience in drafting international standards, its international legitimacy and expertise in related matters such as the detection of illicit nuclear trafficking[15]. The Agency was already singled out to provide future important inputs and advice on ways to enhance the security of radioactive sources.

The second conference was held in Buenos Aires in 2000 and gathered national regulatory authorities with competences in the safety of radiation sources and the security of radioactive materials [18]. Various topics related to the security of radioactive sources were discussed. Experts called upon States to follow the provisions of the first edition of the IAEA Code of Conduct on the Safety and Security of Radioactive Sources - adopted in the wake of the Dijon Conference - and the IAEA radioactive sources categorization system which was under development[16].

As previously mentioned for more than four decades, nuclear security was considered secondary to nuclear safety. Following the attacks of 9/11 it was prioritized on the international security agenda. Multilateral efforts were intensified to further prevent nuclear terrorism by ensuring a robust nuclear security regime at both domestic and international level. In this context the IAEA published numerous standards and updated the existing ones. Experts naturally continued to convene conferences with a new focus: securing dangerous materials and sources from illicit purposes.

Hence the International Conference on the Security of Radioactive Sources took place in Vienna in 2003 and extensively discussed measures to improve radiological security and ways to prevent radiological terrorism and its consequences [19]. Talks were also broadened to several related topics such as the characteristics of the threat (theft, radiological emission and dispersal devices, sabotage, etc.) or the problem of sources falling outside the regulatory system (*orphan sources*). Similarly to the Buenos Aires Conference participants insisted on the paramount importance of a comprehensive implementation of the principles contained in the Code of Conduct. At the end of the Conference participants decided to develop two international initiatives: on one hand, a multilateral effort to locate and recover orphan sources and, on the other, a global momentum to convince States to improve security at their national facilities containing radioactive sources.

At the 2005 Bordeaux Conference on the Safety and Security of Radioactive Sources the emphasis was put on improving the security of sources throughout their entire lifecycle, from their production to their disposal [20]. While calling for further international cooperation in the field of radiological security, participants committed themselves to support the newly adopted Guidance on the Import and Export of Radioactive Sources (2005) as well as the development of radioactive sources and materials illicit trafficking detection capabilities.

The 2009 Tarragona International Conference specifically focused on an issue that had not yet been targeted in the conference cycle: the management and control of radioactive materials in scrap metal. Experts were unanimous on the fact that the transborder issue of metal scrap containing radioactive materials requires a global approach through the promotion of international cooperation and, as a long term goal, the development of legally binding standards [21].

The last conference to date was held in Abu Dhabi in 2013. This International Conference on the Safety and Security of Radioactive Sources had the objective to review the main achievements and the existing regime ten years after the adoption of the Code of Conduct. Three main issues were discussed during the

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[14] C.f. footnote 5

[15] The IAEA established in 1995 the International Incident and Trafficking Database (ITDB) which is an information system on events involving nuclear and radioactive materials trafficking and other unauthorized activities.

[16] The final version of the categorization was adopted in 2003 in [7]

conference. Firstly, the long term management of orphan and disused sources and the various options available to States to secure them. Secondly, the importance of discussing an interface between nuclear safety and security as they both contribute to the protection of people and the environment against potential harmful effects of radiation. Thirdly, whilst recognizing the numerous achievements of the Code of Conduct and the Guidance on Import of Export, participants discussed the potential merits that could bring an international legally binding instrument and the ways the latter could fill the existing gaps. They suggested that the IAEA should set up a group of experts on that matter [22].

Taking into account the above mentioned elements, the approach to the security of radioactive sources has greatly evolved for more than twenty years. Considered as granted in the early international standards, nuclear security is now extensively discussed at the international level. After a long period without debating an interface to link permanently safety and security, experts have put emphasis, since the Vienna Convention 2003, on the importance of establishing a platform between these two interlinked notions. More than ten years after the adoption of the Code of Conduct gaps in the radiological security regime still remain. In order to ensure a sustainable and effective regime that would prevent malicious use of radioactive sources, more and more voices call upon States to consider the possibility of harmonizing and strengthening the current regime through the establishment of a convention on radiological security.

IAEA Code of Conduct on the Safety and Security of Radioactive Sources

The premises of the Code of Conduct can be found at the Dijon Conference in 1998 which was a turning point for the following reason: experts recognized the strong interaction between the safety and security of radioactive sources and called for the adoption of principles improving radiological security. For the first time, it was officially acknowledged that both security and safety should be discussed in a joint manner.

In this context the IAEA General Conference of September 1998 encouraged, in Resolution GC(42)/RES/12, States to "*join in international cooperative efforts towards strengthening the safety of radiation sources and the security of radioactive materials*" and "*to take steps to ensure the existence within their territories of effective national systems of control for ensuring the safety of radiation sources and the security of radioactive materials*". The General Conference also requested the Secretariat "*to prepare for the consideration of the Board of Governors a report on (i) how national systems for ensuring the safety of radiation sources and the security of radiative materials can be operated at a high level of effectiveness and (ii) whether international undertakings concerned with the effective operation of such systems and attracting broad adherence could be formulated*" [23].

In 1999 the Board of Governors approved the Action Plan submitted by the Secretariat in accordance with Resolution GC(42)/RES/12 [24]. It called the Secretariat to further develop and implement, by promoting international cooperation, activities to assist Member States in maintaining and, if necessary, improving radiological security. More importantly, the Action Plan provided a structure for national experts to discuss international undertaking in the area of safety and security of radioactive sources [25]. The outcomes of these meetings of experts led to the establishment of the Code of Conduct. The Board of Governors took note of the Code in September 2000 and the General Conference invited Member States, through Resolution GC(44)/RES/11, to consider means of ensuring the wide application of the provisions of the Code [4].

While participants of the Buenos Aires Conference called upon all States to comprehensively apply and implement the provisions of the Code, the findings of the Conference also suggested revising its content. A new version of the Code was approved by the Board of Governors on September 10, 2001 and endowed promptly by the General Conference. National experts were extensively consulted by the Secretariat in order to share their experience in the implementation process of the Code of Conduct.

At the Vienna Conference experts recommended the States to make concerted efforts to follow the principles contained in the Code of Conduct, which was in the process of being revised after the events of 9/11. At the technical meeting held in July 2003 a consensus was reached on the scope of the revised Code. The Board of Governors approved the final version of the Code on September 8, 2003 and the General Conference endorsed it, in its current version, shortly thereafter [26]. At the same General Conference States called for an enhanced support to all instruments aiming at improving nuclear and radiological security and preventing radiological terrorism [27].

The Code of Conduct is a non-binding instrument containing provisions voluntarily implemented by States. Its scope is very specific: only Categories 1, 2 and 3 of radioactive sources, which are identified in annex 1, are covered. In addition States should "*give appropriate attention to radioactive sources considered by them to have potential to cause unacceptable consequences, if employed for malicious purposes, and to aggregations of lower activity sources (as defined by TECDOC 1344 [8]) which require management under the principles of this Code*". The provisions of the Code are not applicable to unsealed radioactive materials, radioactive sources used for military purposes and nuclear material as defined in the Convention on the Physical Protection of Nuclear Material (CPPNM).

The objectives of the Code of Conduct are the following: help states to reach and maintain a high-level of safety and security of radioactive sources including the end of their useful lives; prevent unauthorized access, damage, theft or unauthorized transfer of radioactive sources; prevent malicious use of radioactive sources; mitigate and minimize the consequences of any accident or malevolent act involving radioactive sources; support states in establishing national legislative and regulatory system of control.

Since 2006 States have been encouraged to report their national progress in implementing the provisions of the Code. This mechanism allows to assess of the implementation process, to identify further needs and provide a way for States to show their commitment in the security of radioactive sources. Lastly, triennial meetings are held in order to promote a continuous assessment of the Code.

The Code of Conduct on the Safety and Security of Radioactive Sources is a primary instrument aiming at enhancing the security of radioactive sources. A numerous amounts of national regulatory structures have been established and strengthened following its provisions.

Guidance on the Import and Export of Radioactive Sources

When the revised version of the Code of Conduct was officially approved by the Board of Governors in 2003, its Chairperson already expressed the serious concern regarding the import and export of radioactive sources and called for further exploration of this matter [28]. In a reactive manner the Secretariat convened working groups composed of legal and technical experts to discuss ways to strengthen the security of radioactive sources while being transported. Experts rapidly reached a consensus on the text that became the Guidance on the Import and Export of Radioactive Sources after its approval by the Board of Governors and endorsement by the General Conference in September 2004 [28].

The Guidance is supplementary to the para. 23 to 29 of the Code of Conduct. It applies to Category 1 and 2 sources within the scope of the import and export provisions of the Code. The Guidance does not cover sources that are not falling within the scope of the Code of Conduct.

Interestingly para. 20 of the Guidance creates a mechanism that could lead to its revision every five years. In this regard the IAEA Secretariat convened an open-ended meeting in 2010 to share information on the implementation process of the Code and Guidance and discuss a possible update of the latter. A consensus on the draft of the revised text of the Guidance was reached in 2011 and the new version was subsequently approved by the Board of Governors and endorsed by the General Conference in September 2011.

Nuclear Security Series

The IAEA Nuclear Security Series (NSS) is a compilation of non-binding documents containing voluntary standards aiming at increasing the level of prevention and detection of acts related to nuclear terrorism and to issues such as illicit trafficking, theft of nuclear materials and other radioactive substances or sabotage of their associated facilities. This series of publications aims at complementing international binding and non-binding nuclear security instruments such as the CPPNM and its amendment, the Code of Conduct or the Guidance on Import and Export. They are prepared by experts from the IAEA Secretariat, Member States and the Nuclear Security Guidance Committee, a standing body of senior representatives making recommendations to the Agency.

The NSS is divided into four types of documents: Nuclear Security Fundamentals, containing objectives, definitions and general principles of nuclear security that will provide a basis for other security recommendations; Recommendations, compiling best practices that should be implemented by Member

States; Implementing Guides, intending to elaborate more recommendations and suggest ways to implement them; Technical Guides, detailing reference manuals, training specifications and service guidelines to properly use the Nuclear Security Series documents.

The NSS covers both the security of fissile materials and radioactive sources. Concerning the latter, several NSS are particularly relevant, including:

- The NSS N°5 Identification of Radioactive Sources and Devices assists States in the recognition and identification of objects likely to be radioactive sources, devices and transport packages.

- The NSS N°6 Combating Illicit Trafficking in Nuclear and other Radioactive Material provides advice to individuals or organizations that have to deal with the detection and response to unauthorized acts involving the transport of nuclear or other radioactive material.

- The NSS N°9 Security in the Transport of Radioactive Materials gives States and competent authorities elements to implement, maintain or enhance the nuclear security regime to protect transported radioactive materials against theft, sabotage or other malicious acts that could have serious radiological consequences.

- The NSS N°11 Security of Radioactive Sources provides guidance and recommendations on the prevention, detection and response to malicious acts involving radioactive sources. It covers the entire lifecycle of sources and recommends security measures to be applied on a graded basis depending on several factors (incl. current evaluation of the threat, relative attractiveness of the sources and potential consequences resulting from malicious use).

- The NSS N°14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities gives guidance to States and other national authorities on the development, enhancement, implementation and maintenance of a high level nuclear security regime specifically for radioactive materials, associated facilities and any associate activity. It also provides recommendations to ensure a sufficient and sustainable level of security and guarantee a comprehensive balance between the secure use of radioactive materials and the commercial use of radioactive materials for societal benefits.

- The NSS N°15 Nuclear Security Recommendations on Nuclear and Other Radioactive Material Out of Regulatory Control has two objectives: provide information to States and their competent authorities on ways to carry out effective strategies to deter, detect and respond to malicious or unauthorized acts, involving nuclear or other radioactive material out of regulatory control; and, encourage States to support international cooperation in order to ensure that any nuclear or other radioactive material out of regulatory control, whether originating from the State or from outside that State, is placed under regulatory control and the alleged offenders are, as appropriate, prosecuted and extradited.

Legally binding instruments

United Nations Security Council Resolution 1540 (2004)

Adopted in April 2004 under Chapter VII of the UN Charter, the Security Council Resolution 1540 (UNSCR1540) aims at fighting the risks associated with the proliferation and acquisition of nuclear, chemical and biological weapons and their delivery systems by non-State actors. It requires States to set up on adequate national legislation and regulatory controls to prevent, detect and punish proliferation related activities.

The Resolution mentions only nuclear, chemical and biological weapons. It does not explicitly address the potential use of radioactive sources. However it is generally accepted that the latter are indirectly covered by its provisions. Indeed States can undertake any revision of their national legislation needed to improve radiological security [11]. Moreover, the Resolution emphasizes the importance of adopting effective measures to detect illicit trafficking and that those should be improved in order to limit any kind of illegal transfer or transit of radioactive substances.

The Resolution established the '1540 Committee' - which has seen its mandate extended until 2021 under Resolution 1977 (2011) - and is responsible for monitoring the implementation of its provisions. The Committee aims also at raising awareness, sharing information and assisting States in their implementing process.

Through Resolution 1540 and its follow-up Resolution 1977 (2011), States have the obligation to submit an initial report which explains the national steps they have taken to implement the Resolution and to submit this report to the Committee. Additionally States are highly encouraged to provide complementary information on their implementation process as well as a national implementation plan setting their priorities in the execution of the key provisions of the Resolution. As of May 2014, 171 States submitted their initial report, 28 States have provided the Committee with a complementary report and 8 States have sent their national implementation plan.

As it was adopted under Chapter VII to address threats to international peace and security, Resolution 1540 is to date the only international legal document addressing the threat of CBRN terrorism which is mandatory for all UN Member States.

International Convention for the Suppression of Acts of Nuclear Terrorism

Negotiated within the UN General Assembly, the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT) was opened for signature on September 12, 2005 and entered into force on July 7, 2007. As of August 5, 2014, 115 States have signed and 94 have ratified the Convention.

The ICSANT is based on the idea that the existing multilateral legal provisions back in the aftermath of 9/11 did not adequately address acts of nuclear terrorism. Therefore, the Convention calls upon States to adopt legal measures to prosecute, sentence and/or extradite individuals who commit criminal acts involving radioactive materials, which are listed in art. 2. According to art. 1(1) of the Convention, "*radioactive materials*" must be understood as "*(...) nuclear material and other radioactive substances which contain nuclides which undergo spontaneous disintegration (...) and which may, owing to their radiological or fissile material properties, cause death, serious bodily injury or substantial damage to property of the environment*".

With regard to the scope of the Convention, art. 3 specifies that its provisions are limited to offense with an international dimension, i.e. an act which concerns at least two States. Thus the ICSANT does not apply if criminal acts are committed within a single State; when the alleged offender and the victims are nationals of that State; when the alleged offender is in the territory of that State; and when no other State has a legal basis to exercise its jurisdiction [29]. In this context keys elements of the Convention consist of extradition provisions than can be found in art. 10 to 17.

Taking into account the above mentioned elements the ICSANT is primarily an international criminal law instrument. It does not provide measures or guidance to improve radiological security.

International partnerships

Nuclear Security Summit

Launched under the leadership of the Obama administration in 2010, the biannual Nuclear Security Summit aims at combating the threat of nuclear terrorism by raising the awareness of the international community on the necessity to enhance the nuclear security regime.

At the first two summits which took place in Washington (2010) and Seoul (2012) the initial focus was on the security of fissile materials, and more particularly on high enriched uranium and plutonium. Through unilateral and multilateral voluntary commitments, States agreed to take concrete steps to secure their civilian nuclear facilities and the fissile materials used in these facilities.

For four years the security of radioactive sources was regarded as a secondary topic. In Washington efforts were primarily focused on promoting the universalization of existing international instruments such as the CPPNM and its amendment or the ICSANT. In Seoul States extended the scope of the discussions and

timidly addressed the threat of malicious use of radioactive sources. In the *communiqué* - the non-binding political declaration, negotiated by a consensus adopted at the end of the summits - they called upon States to adhere to the principles contained in the Code of Conduct, the Guidance on Import and Export and other IAEA standards. A multilateral declaration was made by 24 States which committed themselves to improve the security of radioactive sources by supporting existing international documents and promote international cooperation in that matter [30].

Radiological security became a priority at the third summit which was held on March 24-25, 2014 in the Dutch city of The Hague and gathered 53 world leaders and 4 heads of international organizations. Aware of the urgency to address the security of radioactive sources in a comprehensive manner, States committed themselves to take actions going beyond many expectations of the experts. Firstly a section on "*radioactive sources and materials*" was added in the *communiqué*. Similarly to the Seoul *communiqué*, this new section reminds the importance of implementing the Code of Conduct, the Guidance and other standards contained in the Nuclear Security Series. Secondly 23 participating States signed a multilateral commitment on "*enhancing radiological security*" which is going beyond the scope of the 2012 one. Indeed it calls upon States to adopt concrete basic steps to improve radiological security such as reviewing the reliability of people having access to radioactive sources or developing effective response plans based on a thorough and comprehensive approach of the threat [31]. This commitment also envisaged the adoption of additional measures that States could voluntarily endorse such as the installation of video surveillance or the adoption of a comprehensive regulatory framework covering the entire lifecycle of radioactive sources (production, transport, possession/use and disposal).

The process of the Nuclear Security Summit has the merit of having raised the awareness of the international community on the various forms and seriousness of the threat of nuclear terrorism. It provides a unique platform for States to discuss ways to improve nuclear security both at the national and the international level by adopting domestic measures and increasing multilateral cooperation in that matter. Through various voluntary unilateral and multilateral commitments, States reaffirmed their willingness to work towards the establishment of a comprehensive regime covering the security of fissile materials, and more recently, radioactive sources. This momentum will be kept as the fourth summit will take place in the United States in 2016.

G8 Global Partnership Against the Spread of Weapons and Materials of Mass Destruction

The Global Partnership is a multilateral and non-binding non-proliferation initiative launched on June 27, 2002 by the G8 countries at the Kananaskis Summit (Canada) [32]. The objectives of the Partnership include: the promotion of multilateral treaties and international instruments preventing the proliferation of nuclear, chemical, radiological and biological weapons; the development of CBRN counterterrorism through international cooperation; the improvement and the promotion of physical measures protecting nuclear materials and radioactive sources; the support to the reduction of weapons of mass destruction stockpiles. The Partnership currently gathers 27 partner States.

From the beginning, participating States have made radiological security and the threat of RDD one of their top priorities. Indeed at the Evian-les-Bains Summit in 2003 they agreed on an Action Plan for Radioactive Source Security [33-34]. It called upon States to: provide an extensive support to the actions undertaken by the IAEA; establish accounting systems for high-risk radioactive sources; take all necessary measures respecting IAEA standards to improve radiological security and search and locate potential orphan sources. In addition to these general advice, a document containing several measures - in accordance with the findings of the Vienna 2003 International Conference on Security of Radioactive Sources - was published. This document provides recommendations to: establish national registers to follow sources throughout their entire lifecycle; set up guidelines on the control of exports of sources and mechanisms for monitoring these exports; improve the detection of the passage of radioactive sources at borders; launch a national initiative for the recovery and security of orphan sources.

Thereafter the G8 Global Partnership has established itself in the international nuclear security framework. Although it has only a few partner States and despite the multiplication of other binding or voluntary initiatives, it plays a central role by enabling States to coordinate their actions and to continually promote the multilateral approach to nuclear security.

Global Initiative to Combat Terrorism (GICNT)

The GICNT was created in 2006, under the initiative of the United States and Russia, as part of the G8 Summit of St. Petersburg. With 13 participating States at its first bi-annual plenary session in Rabat in 2006, the GICNT has currently 85 partners and 4 observing international organizations (European Union, Interpol, UN and IAEA). The participating States commit themselves to comply with the Statement of Principles adopted at the first plenary meeting [35]. The security of radioactive materials and substances is explicitly mentioned in the statement, in a spirit of deterrence, detection and response [36]. Indeed, the principles include measures to: develop and improve accounting, control and physical protection systems for nuclear and other radioactive materials and substances; prevent malicious use of nuclear or other radioactive substances; promote information sharing; improve mitigation and investigation capabilities.

To strengthen the capacity of partner States to prevent, detect and respond to nuclear terrorism, three working groups (nuclear detection, forensics and response/mitigation) have been established. Along with providing advice to States, their work is to ensure that the activities of the GICNT are well coordinated and complement other international efforts.

Since 2010 most of the objectives of the GICNT have been endorsed by the Nuclear Security Summit process. Yet there are significant differences between the two initiatives. With a higher number of partner States, the absence of rule of consensus and a flexible political structure, the GICNT allows each partner to contribute to the prevention of nuclear terrorism taking into account its domestic capacity and resources. As for the Global Partnership, the GICNT has established a crucial cooperation and sharing platform.

Towards a *Convention on Radiological Security*?

Radioactive sources can be found in almost every country and are used for various societal benefits. An international regime composed of multilateral initiatives, standards and binding documents has been put in place to ensure their secured utilization. The good news is that these international elements are usually applied, which reduces the risks related to radiological terrorism in an important manner [11]. These multilateral efforts also contributed to sensitizing States and the international community to the threat.

However, serious gaps remain to be filled. Indeed, while the legal and regulatory framework addresses safety in many States, there are often inadequate arrangements in implementing the existing security principles [37]. According to Mohammed ElBaradei, former IAEA Director General, "*all of us* [States] *are vulnerable because all of us use nuclear and radioactive materials that can easily move across border*" [38]. Even if some progress has been made, much more needs to be done. The question is the following: could a "*Convention on Radiological Security*" take over the role of filling the existing gaps and prevent malicious use of radioactive sources and materials?

The current regime: gaps and weaknesses

The existing regime is mainly composed of voluntary international standards established by the IAEA. Firstly the IAEA Code of Conduct and its supplementary Guidance provides a key governance framework by listing the main administrative and regulatory requirements for States and other competent authorities. Unfortunately these documents do not provide detailed guidelines on physical measures to increase radiological security [39]. As of October 2013, 119 States pledged to uphold the Code. The promotion of its universalization needs to remain a key priority. Furthermore a process was formalized in 2006 to encourage States to give information on their efforts in implementing the provisions of the Code. 8 years later only a total of 68 Member States have submitted their national reports according to this process. Secondly the Nuclear Security Series are composed of a comprehensive list of standards. Despite the fact that these publications cover a wide range of issues related to radiological security, they remain, similarly to the Code of Conduct and its Guidance, voluntary and non-binding. There are no ways for the Agency to force States to implement and endorse these standards apart from highly encouraging them to do so. It is universally recognized that the core responsibility of radiological security and nuclear security as a whole remains the States' national sovereignty. The threat of radiological security incidents cannot be successfully addressed unless States decide to give up part of their own sovereignty [40]. Besides not all States are equal in their capacity to implement the international recommendations and ensure effective domestic regulatory framework on radiological security. Indeed, financial means and human resources vary widely between States.

Moreover the ICSANT and the UNSCR1540 are the two single binding instruments covering the security of radioactive sources and materials. The ICSANT, which has been ratified by merely 94 States, only covers criminal acts involving nuclear or radioactive materials that have an international dimension. Furthermore it does not contain any obligations on radiological security measures. The situation is the same for UNSCR1540 which was adopted under Chapter VII. However its follow-up Resolution 1977 (2011) called upon States to submit national action plans, only a few have been submitted. Yet the large majority of States submitted their initial report to the 1540 Committee before new radiological security standards were adopted by the IAEA. It would therefore be essential to convince States to accelerate their submission of reports to evaluate the recent standards implementation process.

Multilateral initiatives were launched more than a decade ago and gradually prepared the substrate for the political momentum to systematize and legalize radiological security. The GICNT, the G8 Global Partnership and the Nuclear Security Summit have raised the awareness of the international community on the threat of malicious use of radioactive sources. Alas these international fora only include a small number of States in their process. But yet radiological terrorism is a global threat that has to be tackled globally. Participating States should therefore aim at extending the partnerships and involving more states in the process. Furthermore the principles expressed in the framework of these partnerships remain voluntary. Even though their collaboration is highly encouraged, States have no legal obligation to implement the principles adopted within these multilateral initiatives.

Taking into account the above mentioned elements, the current regime towards the security of radioactive sources and materials is largely based on a voluntary and comprehensive implementation of the

existing standards by a limited number of States (often already having their national comprehensive security regime in place). The IAEA seems to be the cornerstone of radiological security but its initiatives depend on the goodwill of its Member States. Moreover, due to the means of each State and the selective and exclusive nature of multilateral initiatives, the regime is unbalanced and fragmented. Hence, because of the transnational nature of radiological terrorism and the large availability of radioactive sources, moving gradually towards a binding instrument seems to be a serious option to ultimately prevent this global threat.

Between doubts and ambitions: a path full of pitfalls?

Adequate timing with several advantages

For more than a decade nuclear terrorism and its related forms have been raised as a priority on the international security agenda. There has been a multiplication of international initiatives, establishment of new standards and a global call for international cooperation to prevent malicious use of radioactive sources and materials. Furthermore measures have been adopted to deter, detect and prevent illicit trafficking of dangerous radioactive substances. This awareness on the threat of radiological terrorism is illustrated by the Nuclear Security Summit process. Indeed the latter offered a unique high-level platform to discuss ways to improve radiological security through a coherent and international approach. The upcoming summit will take place in the United States in 2016. The next two years may be adequate to prepare the grounds to head towards a convention.

The advantages of a Convention on Radiological Security would be manifold. Nowadays radiological security and its related aspects are covered by a patchwork of binding and non-binding instruments. Such a fragmented framework makes the interpretation and implementation of the standards and norms often very complex for States. National authorities with a lesser nuclear security culture could face problems in understanding the requirements provided in international standards. Harmonizing the entire regime through a convention would provide the States with more clarity on the measures to be taken to effectively secure the sources residing on or being transported through their territory. Working towards the harmonization of the existing instruments is particularly relevant in a globalized society in which the transport of radioactive sources is continuously increasing all over the world.

Furthermore radiological security is in principle different from the security covering fissile materials and it needs a separate regime. Comprehensive regimes of fissile materials security can found in a few States only. Because of a relatively low availability and utilization, facility operators and industries are more aware of the dangers related to the use of fissile materials. Such facilities usually have a strong nuclear security culture as they are associated to nuclear weapons and national security concerns. In contrast radioactive sources are extensively employed for many applications. Facilities using the radiation sources often lack the nuclear security culture as their purposes are not related to regional or national security matters. Along with raising the awareness at the national level, a Convention on Radiological Security should also sensitize local personnel working with radiation sources on a daily basis. It would raise the perception of the threat of radiological terrorism and so increase the level of security at the basic level. States that ratify the Convention would be under the obligation to implement the provisions of the latter.

Finally a Convention on Radiological Security would have strong political and legal effects both nationally and internationally. It would prevent the perception of some States that they do not have to implement effective control on radiation sources as they only have a limited number of these.

Staying pragmatic: the difficulties

Any Convention negotiation involves difficulties. Firstly, as previously mentioned, radiological security remains a matter of national sovereignty. States can legislate on their own to ensure an effective radiological security regime in their national facilities. Radiation sources have a strong commercial scope as they are used in various industries such as medicine, science and industry. In this context States might be reluctant to confer some of their sovereignty to an international convention. This also explains why many States still consider that the threat of radiological terrorism has to be dealt domestically only. This argument is arguably difficult to hold as the international community is multiplying multilateral initiatives to address the threat specifically because the nature of terrorism networks is nowadays largely transnational.

Secondly, like other binding instruments, a Convention would drastically reduce the flexibility in implementing standards. To date States enjoy a large freedom in the way they decide to implement existing principles. This is particularly interesting in a sense that States can take into account their own domestic particularities to improve radiological security. A Convention would oblige them to implement international standards in a certain manner. To mitigate this absence of flexibility the solution could be to negotiate common basic standards in the Convention that would be applicable to all States and then provide some freedom in implementing additional secondary standards. This approach was already used in the multilateral commitment on radiological security during the 2014 Nuclear Security Summit.

Thirdly, experts often argue that States would have no guarantee that the provisions of the future Convention would have the same level of completeness as the existing standards of the Code of Conduct and its Guidance [37]. This argument sounds valid in essence. Nevertheless experts and States should focus on identifying fundamental standards in the existing instruments such as the Nuclear Security Series and the Code of Conduct and ensure that these are included in the Convention. When shifting from voluntary to legally binding instruments, negotiators are not be able to guarantee the outcomes of the negotiations. It is precisely the role of experts to focus on the most important standards and ensure that they would be present in the new Convention.

Finally moving towards a Convention on Radiological Security would require the States to be convinced to enter time-consuming negotiations. Some argue that they would rather focus on promoting existing standards than entering into possibly long negotiations [41]. Instead national experts should meet on a regular basis prior to going to the negotiations table. The advantage of the radiological security field is that it is already covered by a wide range of internationally accepted standards. It might therefore be possible to quickly agree on the main provisions of the Convention as the negotiations would not start from zero. In this regard: where would the Convention be negotiated? The IAEA seems to be the best forum. The most likely scenario would be to follow the example of the negotiations of the Convention on Nuclear Safety:

1. Agreement by a group of States within the Agency
2. Approval of the Board of Governors
3. Set up a team in charge of preparing the technical aspects of the Convention within the Secretariat
4. Creation of a working group composed of national experts that will propose a draft
5. Agreement of a draft by States
6. Adoption of the Convention by States, followed by the signature and ratification process
7. Entry into force of the Convention deepening on the requirements expressed in its provisions

A Convention on Radiological Security: practical considerations

Initial steps

To date the feasibility of opening negotiations for a Convention on Radiological Security is unclear. It would require a group of States willing to bring the matter to the competent international fora and openly start discussions on the scope and content of the future convention. Due to a lack of consensus at the international level, it might be premature to candidly call for a Convention. However, this does not mean it is not time yet to open the path of potential future negotiations by initiating a political momentum to promote its usefulness.

In fact a first step would be - for the 53 States participating in the Nuclear Security Summit - to show their leadership in the field and extensively promote the implementation of principles related to radiological security. Since 2010 the Nuclear Security Summit has had the merit to raise the awareness of the international community to the threat of nuclear terrorism. More recently at the 2014 Summit in The Hague, participating States emphasized the necessity to further secure radioactive sources and materials. As previously mentioned, along with calling for securing high-risk radioactive sources before 2016, more than half of the participating States have committed themselves to a multilateral document on radiological security which represents, to date, one of the biggest breakthroughs in the field of radiological security. The 53 States participating in the Summit process should be the driving force in raising awareness on the

necessity to move towards an implementation of the existing standards and, ultimately, call for negotiations of a Convention.

Outline of several preliminary key provisions

- Scope:

It has to be decided which of the radiation sources and under what definition should be covered by the Convention. It might be troublesome to agree if the agreement should differentiate between radioactive sources and materials and if it should cover radiation generators.

- Using existing principles as the basis:

The current standards are covering a wide range of issues related to radiological security. Many of them became best practices and are applied in many countries. They can be found mainly in the Nuclear Security Series as well as in the Code of Conduct and its Guidance on Import and Export of Radioactive Sources.

In order to ensure a minimum level of security, the Convention should include these principles. It is not about starting from zero. As they are widely applied, it would not be too arduous for State parties to negotiate and implement these basic rules. Similarly to the multilateral commitment at the 2014 Nuclear Security Summit, States could leave the door open to adopt additional standards to show their national commitment in ensuring radiological security.

This approach would guarantee a minimum level of international security, while at the same time allow States to go further in their national measures by providing them additional principles they could endorse to strengthen internal radiological security.

- IAEA as the reference organization:

Due to its worldwide legitimacy and technical expertise in the field of nuclear security, the IAEA seems to be the ideal and logical actor to play a leading role in the future Convention. Nuclear security has increasingly been on the forefront of the IAEA agenda in the past years. Moreover, the recent elevation of its Office of Nuclear Security, also in charge of radiological security, to a Division shows that the topic is a growing concern for the Agency. Its role in the Convention could be various, i.e. assisting States in their implementation process, provide continuous technical advice or hold the review process meetings.

In order for the IAEA to perform its duties under the Convention, it will be necessary to give the organization the means to do so. Two elements have to be taken into account. Firstly, there is a need to clarify its mandate to all its Member States. As mentioned previously, nuclear security is not embodied in its Statute but derives from its statutory functions. As nuclear security remains a matter of national sovereignty, some States are reluctant to confer the IAEA some competences on that matter. Such an issue should be solved before entering into negotiations of a Convention. Secondly, the financial means and human resources of the Agency depend only on the contribution of its Member States. Therefore if the objective is to ultimately confer - according to the provisions of the Convention - several competences to the IAEA, it will be essential for States to evaluate their financial support in the coming years.

- Information sharing and consultation:

The main objective of the Convention would be to enhance radiological security in order to prevent malicious use of radioactive sources and materials. In this context and in order to improve the regime, every State would have a fundamental interest in knowing what the situation is on the other side of its borders. As radiological terrorism is a transnational threat, States should appreciate the fact that their neighbors are also taking the necessary steps to guarantee the radiological security. Providing national implementation plans - similarly to the UNSCR1540-type reports, would bring confidence among State parties and would also convince the ones still lacking radiological security standards implementation to continue their efforts.

- Reporting system:

Radioactive sources stolen in one State could be used in another. Starting from this assumption every incident (theft, sabotage or loss) should have to be reported to the IAEA. The Agency has already shown its seriousness in handling such information in the framework of the International Incident and Trafficking Database (ITDB). The information sent to the IAEA should not be open to the public but subsequently used to prevent malicious acts and further failures of the regime. Such a reporting system would allow the Agency to inform its State members of possible upcoming radiological terrorism threats, that would raise their security measures. This reporting system could be based on the one of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

- Review mechanism:

Radiological terrorism is a moving target. Technological advances related to the use of radiation sources or the capabilities of terrorist groups could rapidly evolve. For this reason the Convention will have to provide a review mechanism that will allow States to gather and discuss whether the provisions of the Convention are still in accordance with the threat. Such a review mechanism could be organized in the similar manner as with the Code of Conduct, i.e. triennial meetings with legal and technical experts in Vienna. Taking into account the evolving nature of the threat, avoiding a static convention should be a priority.

- Consequences of non-compliance

One of the main weaknesses of the international legal system is that it often lacks the capacity of enforcing international norms. In this regard the use of non-compliance mechanisms plays an important role in maintaining the efficiency of international treaties or conventions. However, in the case of a Convention on Radiological Security, using aggressive non-compliance mechanisms such as sanctions might not be the best option. Unlike fissile materials, which are associated with military goals, radioactive sources and radiation generators are generally used for peaceful purposes. Threatening a State which is not able to comply with the provisions of the new convention by refusing to supply it with ionizing radiation technologies, is certainly not the best encouragement to join it. A good solution to enforce new standards would be to condition the Agency's support to the States with the necessity of conducting the supported undertaking in accordance with the standard agreed in the Convention. Other States could also influence the compliance verification by using of the standard diplomatic procedures within the Board of Governors and General Conference.

Conclusion

Advantages and effectiveness of soft law have been discussed numerous times [42]. Non-binding norms have an unquestionable virtue of being easier to agree upon by States. Furthermore, without a standardize implementation process, they give competent authorities a flexibility which allows them to work more rapidly at applying standards. However, the time has passed since the Code of Conduct started to serve as guidance "*for development and harmonization of polices, laws and regulations on the safety and security of radiative sources*" [4]. Perhaps it is time to summarize and conclude the acquired experience by moving towards a common international radiological security platform. The IAEA Director General, Yukiya Amano, points out in the foreword to the BSS that "*[s]tandards are only effective if they are properly applied in practice*"[5]. A question remains: what will happen if the standards are not applied at all? The proposal of a legally binding document on radiological security certainly raises discussion on its legitimacy. There are a lot of questions to be answered in this matter, but it is now time to undertake this venture using the fora provided by the Nuclear Security Summits. The current international tension and increasing globalization may hamper or catalyze the debate on securing the radiological threat. The Convention on Radiological Security may never come into existence, nevertheless common international efforts are necessary to improve a still far from being perfect radiological security regime.

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