

COMBATING NUCLEAR TERRORISM THREATS THROUGH DEVELOPMENT OF EVOLVING NUCLEAR SECURITY REGIME

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Abstract

Nuclear terrorism refers to the unauthorized use or attempted use of nuclear explosive devices (e.g., Improvised Nuclear Devices (IND's), and radioactive ones (e.g., Radiation Dispersal Devices (RDD's) or Radiation Emitting Devices (RED's)), as well as attacks/ attempted attacks on nuclear/radiation facilities. The main objective is to review some major challenges encountered by having an evolving nuclear security regime, with the main focus being on nuclear terrorism. The paper seeks to suggest recommendations that can be used in reducing the threat of nuclear terrorism and maintaining an effective nuclear security regime which can be used in combating nuclear terrorism. The research was conducted through a literature review of international instruments such as IAEA publications (e.g. IAEA NSS No. 6) on maintaining a sustainable nuclear security regime and an analysis of the indicators that could play a key role in maintaining these. The survey was also conducted on both radiation workers and the public.

Keywords: nuclear security regime, combating nuclear terrorism, illicit trafficking

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Introduction

Terrorism has always been a part of human history in various forms. However, it had not been such a clear and present danger until the 9/11 attacks. After the 9/11 attacks, terrorism evolved into a new kind of terrorism only aiming to change a system with sensational attacks that cause so many deaths.

Today, terrorism poses a threat in the form of nuclear terrorism. Its potential rate of lethality could not be compared with any other forms of terrorism if terrorists managed to detonate an intact nuclear weapon or an improvised nuclear device. In addition, the psychological effects of sabotaging a nuclear facility or exploding a „dirty bomb“ would be much more powerful than any other form of terrorism.

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In response, states have already started to cooperate through various international responses, collectively known as nuclear security. But, nuclear security is still developing and seems not yet strong enough to effectively cope with the threat of nuclear terrorism. On the other hand, there is the international nuclear nonproliferation regime based on the three pillars of nuclear nonproliferation, the peaceful use of nuclear energy, and nuclear disarmament. However, its scope is limited to address threats stemming from traditional state actors such as nuclear war and proliferation. Nonetheless, this regime still offers a useful base for nuclear security to develop a more effective framework for international responses to the threat of nuclear terrorism. The inspiration and guidance of the international nuclear nonproliferation regime would lead to more effective nuclear security (Alkis, 2022).

Establishing and implementing a sustainable nuclear security regime is not an easy task especially for developing countries, where financial and human resources are constrained. Studies show that although significant strides have been made over the years, global nuclear security threats remain significantly high as can be confirmed by the number of cases reported to the IAEA Incident Trafficking Database (ITDB). As of 31 December 2021, the ITDB contained a total of 3928 confirmed incidents reported by participating States since 1993 (IAEA, 2022), with 120 incidents being reported in the year 2021 alone by 32 Member States. This indicates that unauthorized activities and events involving nuclear and other radioactive material, including incidents of trafficking and malicious use, continue to occur (IAEA, 2022). The database provides clear evidence of porous security, easy accessibility, human complacency, and inadequate regulatory control (Daniel et al., 2017).

The threat of nuclear terrorism is real as witnessed by the terrorist incidents that have occurred in the past, and these might have serious consequences such as economic, health, environmental and societal. Therefore, there is a need to develop a Global Nuclear Security Regime through maintaining international cooperation, effective nuclear security culture, detection mechanisms and radiation awareness/training so as to guarantee an effective nuclear security which can help in combating nuclear terrorism.

This research article seeks to confirm that nuclear terrorism is a global concern among states, hence analyzes the challenges associated with an evolving nuclear security regime, especially nuclear terrorism. The article will also suggest recommendations that could be used in combating nuclear terrorism.

It must be noted that nuclear materials and radioactive sources are used throughout the world in various applications for peaceful, productive, and beneficial purposes. Even though they are widely used for beneficial purposes, they might also pose a significant nuclear security risk should regulatory control

be lost, and they fall into the wrong hands. They can be used by terrorists for malicious purposes to create weapons either as radiological dispersal devices (RDDs), or as radiation exposure/emitting devices (REDs). It is therefore the prime responsibility of the State to ensure nuclear security for nuclear materials and radioactive sources under its jurisdiction by establishing an effective nuclear security culture among relevant stakeholders (Khripunov, 2017).

The purpose of the paper is to recommend ways to enhance/achieve an effective global nuclear security regime whereby by supporting the peaceful uses of nuclear and radiation energy are encouraged and also to prevent illicit transfer/acquisition and use of nuclear and other radioactive material which serves as a major catalyst in increasing nuclear terrorism. This can be achieved through robust export/import control among trans-border movements whereby strict detection devices and regulatory/legal framework are implemented between States to reduce the risk of adversaries/terrorists acquiring nuclear/radioactive materials, knowledge and technology for malicious acts (e.g., development of weapons of mass destruction). This can also be achieved through effective multilateral cooperation among States where new and modest initiatives can be shared to fill gaps identified in the evolving nuclear security regime such as legislative/regulatory framework and detection capabilities at ports of entries (POEs).

The research paper aims also to propose a more effective legislative framework for the international responses in combating nuclear terrorism threats. The end result would be a more effective and sustainable nuclear security regime with the guidance and inspiration of an international nuclear nonproliferation regime.

The research was conducted through a literature review of international instruments on nuclear terrorism and a review of the key factors involved in establishing an effective nuclear security regime. The method used was the qualitative approach where information was reviewed from IAEA publications (IAEA, 2007), Nuclear Terrorism articles (Frank, 1976) and some scholarly studies (Alkis, 2022).

The other research method used was surveys where questionnaires were distributed to radiation workers (people working with radioactive sources e.g. in mines, hospitals and also from the regulatory body – Radiation Protection Inspectorate) and also the general public from Phase 2, Gaborone neighbourhood. Radiation workers were asked about the probabilities that nuclear and radioactive material could pose significant threats if stolen or lost in transit, while the public were asked general questions on nuclear terrorism. A total of forty (40) people were asked to fill in the questionnaire. This included thirty (30) radiation workers and ten (10) from the general public.

The main limitation to the study was not being able to distribute questionnaires to other regions in the country (especially the general public) due to limited time

for conducting the research. The study was also conducted in a time frame from 9-24 April, 2024, which restricted me to travel to other regions in the country to distribute questionnaires to the general public, hence my decision to restrict myself to the capital city, Gaborone.

Nuclear Terrorism

While the human and environmental consequences of a terrorist attack with nuclear or radiological materials are barely imaginable, the threat of nuclear terrorism is real. Examples of Nuclear terrorism could include: fabrication of a dirty bomb, attacking a nuclear reactor using REDs or the acquisition or fabrication of a nuclear weapon. It must be noted that detonating INDs and using RDDs or REDs would have major consequences on the human and environmental health. Economic and political impacts would also be experienced.

The IAEA defines ‘nuclear security’ as ‘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’ (O’Neill, 1997). The agency negotiates safeguards agreements with state parties to the Nuclear Non-Proliferation Treaty (NPT) to verify that fissile material is not diverted to military use. The key point of departure from safeguards, then, is the focus of nuclear security on non-state actors and nuclear terrorism. The growth in anxiety about nuclear terrorism can be attributed to concerns about groups affiliated to Al-Qaeda which, over the past decade and a half, have demonstrated a capability to perpetrate mass casualty atrocities in North America, Europe, the Middle East, Africa and Asia.

Nevertheless, as Ferguson and Potter highlight, four possible scenarios exist:

- The theft, or illicit purchase, of an intact nuclear weapon from a national arsenal and its detonation;
- The theft or illicit purchase of fissile material to make and detonate an improvised nuclear device (IND);
- Attacks on, or the sabotage of, either civil or military nuclear facilities such as power reactors or spent fuel ponds to release radioactivity; and
- The theft, or illicit purchase, of non-nuclear radioactive materials to make and detonate a radiological dispersion device (RDD) or to make and deploy a radiation emission device (RED) (O’Neill, 1997).

A number of incidents have occurred due to the lack of effective nuclear security systems at various socio-economic activities, and extensive efforts by the world community have been taken to place nuclear material and radioactive sources under effective control. This goal remains largely elusive and may benefit from national-based innovative approaches. Therefore, nuclear security

has been identified as a global concern, and not just for states that have nuclear weapons and nuclear power plants, but also for those that only have radioactive material. This is true so, given that nearly all states have nuclear and radioactive materials used for other civilian applications. Given that nuclear security is a shared concern, enhancing leadership and getting more stakeholders in nuclear governance are therefore important.

Eighty discs of the radioactive Americium 241 were found in the southern city of Plovdiv during a special law enforcement operation, the Plovdiv District Prosecution Office told a news briefing on Friday. Two men have been detained for 72 hours and have been charged with involvement in an organized crime group dealing illegally in ionization sources. This demonstrates a recent incident in the Plovdiv Region, Bulgaria, where a radioactive source was stolen/smuggled in September 19, 2024 (Petrova, 2024). Two young Georgians, Ruben Gabisonia and Mikona Jiqia, were arrested by local police on routine patrol in November 2007 for attempting to smuggle cesium-137 through the Georgian town of Zugdidi in a package containing both the cesium and hazelnuts. Both individuals were impoverished residents of the local area who were acting as a courier and seller for other unidentified traffickers (Kupatadze, 2010). This indicates that nuclear threat is real as these plates might be sold to terrorists who might use them for malicious acts to destroy infrastructure and contribute massively to nuclear terrorism. These cases demonstrate that the illegal transportation and storage of radioactive sources is an international problem experienced globally by many states.

Nuclear and radioactive applications and their related activities are used daily for mainly peaceful purposes. However, the misuse of these materials can have the potential to cause significant physical harm to people, property and environment if they are accessed by terrorists/ criminal groups. They could also be used to cause significant social disruption and anxiety in the community.

Previous nuclear security-related accidents and incidents, and other terrorist attacks that have happened around the globe in the previous years are a clear sign that credible nuclear security threats do exist, and as such, nuclear security is important. These ongoing threats demand the attention of senior officials across government agencies all around the world as part of their responsibility to protect their people and their national interests.

The International Atomic Energy Agency (IAEA) supports States to establish, maintain and sustain effective nuclear security regimes by developing both legally and non-legally binding instruments, recommendations, and technical guidance on information protection; physical protection; material accounting and control; detection of and response to trafficking in such material; national response plans; and contingency measures (IAEA, 2011).

Nuclear Threats to State Security

It must be noted not terrorists do not share the same goals or need the same capabilities as states and are not bound by international law or nuclear treaties and agreements. Finally, these terrorists could still use various methods of delivering nuclear or radioactive material for malicious acts as they have no regard for the consequences that may arise due to nuclear security threats.

A pathway to an attack begins with motivation, planning, and intent. Next, for a credible threat, the acquisition of radiological materials, nuclear materials, nuclear components, or a nuclear device is an essential step. Material acquisition of weapons-usable special nuclear material is the most critical step for a terrorist group, as the enrichment and reprocessing steps that are critical to a nation-state's program are currently beyond the known capability of terrorist groups (Daniel, Frank, Potter, 2020).



Source: Daniel, Frank, Potter (2020).

Figure 1: Nuclear Event Pathway

It must be noted that the responsibility to ensure security of nuclear and other radioactive materials within its jurisdiction lies entirely with the State. The overall objective of a State's nuclear security regime is to protect persons, property, society, and the environment from the harmful consequences of a nuclear security event. States are required to establish and maintain legal and regulatory frameworks to govern detection and response to a nuclear security event as well as to clearly define and allocate responsibilities to different competent authorities to implement various elements of nuclear security (IAEA, 2011).

Further, nuclear security events are not usually limited to one State; thus, it is necessary for a State to establish relations and effective cooperation with other States as well as relevant international organizations. In particular, the State should nominate a national point of contact for other States and for the relevant international organizations for all matters related to the detection of and response to such acts (IAEA, 2011).

Weapons of mass destruction (WMD) and RNE events have immense capabilities for catastrophic destruction. Radiological, and nuclear (RN)-focused applied sciences and technology comprise of the daily life of mankind. Negative

forces, non-state actors, and other related problems are also on the rise, and they might utilize technology to harm governments, destroy assets, and claim a lot of lives (IAEA, 2008).

Types of Radiological threats (RDD, RED & IND)

Four distinct types of nuclear terrorist acts can be considered: overt threat to use nuclear explosive devices or radiological weapons, or an overt threat to attack a nuclear facility; use of nuclear explosive devices; use of radiological weapons; and attacks on nuclear facilities housing nuclear weapons, peaceful nuclear explosive devices, nuclear fuel cycle processes and materials, or nuclear weapons fabrication processes and materials (O'Neill, 1997).

Threats to nuclear security might include scenarios where terrorists acquire nuclear weapons for building an improvised nuclear device (IND). Radioactive materials can also be stolen by adversaries to create radiological dispersal devices (RDDs) and radiological exposure devices (REDs). These can be used as dirty bombs or Weapons of Mass Destruction (WMD's) to cause harm to the environment or individuals.

Threats could be the sabotage of facilities in which radioactive material can be found or of such material in transport by using outsider/insider threats. The political and economic consequences, and the impact upon human health and the environment, of the malicious use of radioactive material could be devastating, particularly in the case of a nuclear explosive device, and could be unpredictably disruptive in the case of malicious acts resulting in the dispersal of radioactive material (IAEA, 2008).

Risks & Vulnerabilities

In addition to the facilities, there are types of transport carrying fresh and spent fuel, radioactive waste and other nuclear material. The total amount of spent fuel is estimated to 190,000 tHM (tons heavy metal). To protect these facilities and this material from theft or sabotage present a formidable security challenge. Data on illicit trafficking incidents collected by the ITDB since 1993 show a small number of instances which have involved various quantities – latterly small – of high enriched uranium (HEU) and one case involving weapons usable plutonium (Pu). Given the serious consequences of the detonation of an improvised nuclear explosive device, even small numbers of incidents involving HEU or Pu are of very high concern. The security of nuclear material, especially weapons-usable material has benefited from a sustained programme of national and international measures to enhance its security but trafficking incidents involving

nuclear material point to possible weaknesses and may be indicative of the illicit availability of larger undetected quantities (IAEA, 2006).

There is a large number of radioactive sources in use or storage. The precise number is not known, but it is estimated that there are probably well in excess of 100,000 Category 1 and 213 sources and the number of Category 3 sources exceeds 1,000,000. In all, there may be over 3,000,000 sources worldwide. Many are not suitable for use in a simple RDD but estimates of how many might be used for malicious purposes are complicated by consideration of the disruptive and psychological effects of an RDD; immediate casualties and destruction are not the only considerations. There are, therefore, a large but unknown number of radioactive sources which could be used in an RDD. States participating in the ITDB have reported 535 confirmed incidents involving radioactive sources since 1993. The large number of incidents indicates that measures to control sources are not adequate and that, for sources suitable for RDDs, security needs improvement (IAEA, 2006).

It must be emphasised that the security of nuclear material, especially weapons-usable material has benefited from a sustained programme of national and international measures to enhance its security. Trafficking incidents involving nuclear material may be due to possible weaknesses and may be indicative of the illicit availability of larger undetected quantities.

Illicit Trafficking Under False Pretences

Criminal or unauthorized acts involving nuclear and other radioactive material might be intensified by the prevalence of incidents dealing with false representations of nuclear or other radioactive material. These acts must also be given the same urgency of assessment as those involving the actual diversion of nuclear or other radioactive material. Hoaxes or scams can also be observed where there are false claims regarding the presence of radionuclides that do not exist or misrepresent the nature or quantity of trafficked material. These cases require careful investigation whenever they are reported to determine their authenticity.

Several hoaxes and scams are particularly noteworthy. These include many reports of 'red mercury', which has been commonly purported to be a constituent of nuclear weapons. Osmium-187 has also been touted as an essential nuclear weapons component. These assertions involving non-fissile material have no technical merit but continue to circulate throughout the world. In most cases, these episodes involve profit-motivated sellers who hope to deceive unsophisticated buyers in the context of economic downturns affecting the Newly Independent States (NIS) and Eastern Europe. More interesting is the rumoured existence of unaccounted compact tactical nuclear weapons ('suitcase bombs') that originated from arsenals in the NIS. Again, while there is little reliable information, this

story persists as a potential threat. Because of the relative ease of misrepresenting factual information, scams, hoaxes, and other exaggerated claims are considerably more prevalent than instances in which nuclear or radioactive material is actually intercepted (IAEA, 2007).

Results of the Survey and Analysis of the Results

The survey was conducted in Gaborone, on residents for the general public. Radiation workers working within Gaborone were also given a questionnaire to fill in. Radiation workers mostly sent their responses by email while the public used hard copies which I later collected. The survey was done in April 2024, whereby questionnaires were distributed to the public on April 15, 2024 and feedback was given on April, 20, 2024. The feedback from radiation workers was mostly sent through emails and the final feedback was received on April 20, 2024. The goal of conducting the survey was to understand radiation workers' and the public's perspectives, opinions, attitudes, beliefs, and behaviors towards nuclear terrorism. The responses would then provide an insight into how nuclear terrorism is interpreted by the public and radiation workers. This would help the research in suggesting ways to combat nuclear terrorism through radiation awareness or training.

The results from the survey were as follows:

Radiation Workers

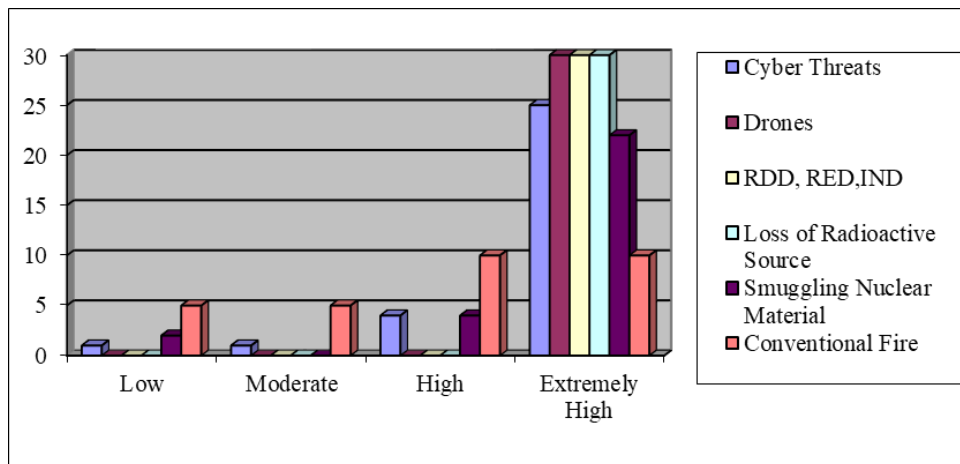
Table 1: Analysis from Radiation workers on probability of certain acts contributing to nuclear terrorism

| | Low | Moderate | High | Extremely High |
|-----------------------------|-----|----------|------|----------------|
| Cyber threats | 1 | 1 | 4 | 25 |
| Drones | 0 | 0 | 0 | 30 |
| RDD, RED, RDD | 0 | 0 | 0 | 30 |
| Loss of Radioactive Sources | 0 | 0 | 0 | 30 |
| Smuggling Nuclear Material | 2 | 0 | 4 | 22 |
| Conventional fire | 5 | 5 | 10 | 10 |

Source: Author's survey.

Thirty (30) radiation workers were each given a questionnaire to complete. The criteria used was each radiation worker should rate the probability that a

given factor can contribute to nuclear terrorism. The ratings ranged from low, moderate, high and extremely high (Table 1).



Source: Author’s survey.

Figure 2: Showing Probability of certain acts contributing to Nuclear Terrorism

The results from Table 1 were then analysed in a bar graph where the number of participants who answered the questionnaire are plotted against the probabilities of certain acts contributing to nuclear terrorism (Figure 2).

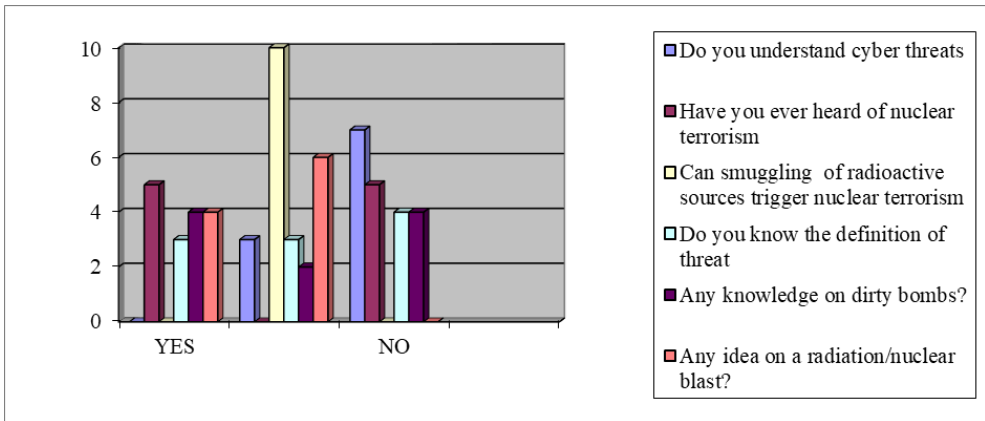
Table 2: Analysis from the general public on the probability of certain acts contributing to nuclear terrorism

| | YES | NO | PARTIALLY/NO IDEA |
|-----------------------------------------------------------------|-----|----|-------------------|
| Do you understand Cyber threats? | 0 | 7 | 3 |
| Have you ever heard of nuclear terrorism? | 5 | 5 | 0 |
| Can smuggling of radioactive sources trigger nuclear terrorism? | 0 | 0 | 10 |
| Do you know the definition of threat? | 3 | 4 | 3 |
| Any knowledge on dirty bombs? | 4 | 4 | 2 |
| Any idea of a radiation/nuclear blast? | 4 | 0 | 6 |

Source: Author’s survey.

Ten (10) participants from the public were each given a questionnaire to complete. The criteria used was each participant should rate the probability that

a given factor can contribute to nuclear terrorism. The ratings ranged from Yes, No and Partially/No Idea.



Source: Author's survey.

Figure 3: Showing Analysis of Results on Questionnaire conducted on the public

The results from Table 2 were then analysed in a bar graph where the number of participants who answered the questionnaire are plotted against the probabilities of certain acts contributing to nuclear terrorism (Figure 3).

The results from both tables and figures indicate a significant gap between the radiation workers and the public on nuclear and radiation awareness. The radiation workers demonstrate some satisfactory knowledge and understanding of the topic of nuclear terrorism (Table 1 and Figure 2). This might be due to the fact that most of the radiation workers have extensive training and education background in Nuclear Security and radiation aspects due to their field of work. The analysis of the general public demonstrates lack of understanding on the topic of nuclear terrorism. Table 2 and Figure 3 shows most participants answered with a 'No' or 'Partially No Idea', demonstrating that they had no clear understanding of the topic. Therefore, there is need to sensitize the public on basic information regarding nuclear terrorism and the consequences that can result from illicit trafficking of nuclear and other radioactive material. The public and radiation workers can support and even enhance detection capabilities through awareness-building and partnerships. This will be key in preventing and/or detecting unauthorized transport of nuclear and/or radioactive material, therefore maintaining an effective nuclear security regime.

General Characteristics of the Nuclear Security Regime

The nuclear security regime plays a major role in a State's overall security regime. It involves nuclear/radioactive material, (both under regulatory control or out of regulatory control), their associated facilities and associated activities, throughout their lifetimes.

The main objective of the nuclear security regime is to protect people, property, society, and the environment from the harmful/adverse effects of nuclear security events. Therefore, nuclear security performs the following functions to achieve its goal:

- prevent the misuse of nuclear energy for non-peaceful purposes;
- prevent, detect and respond to any potential nuclear security events;
- reduce risks and mitigate radiological impacts on society and the environment in the event of crimes against nuclear security; and
- strengthen technology and provide legal assurance.

Therefore, an effective nuclear security regime should comprise of the following aspects:

- the implementation of relevant international legal instruments;
- information protection;
- physical protection; material accounting and control;
- detection of and response to trafficking in such material;
- national response plans.

Weaknesses in the Nuclear Security Regime

The following can be viewed as aspects of a weak nuclear security regime:

- **Legislative & Regulatory Framework** – There is no act nor regulation to incorporate nuclear security aspects which would assist to prevent and deter, and respond to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities.
- **Detection Capabilities** – The absence of an effective nuclear security detection equipment at major inland transit routes or Ports of Entry to prevent unauthorized transportation of nuclear and other radioactive material out of regulatory control. The result will be various theft cases of nuclear and radioactive material which go undetected.
- **Capacity Building** – The lack of capacity building in terms of education and training often contributes to an ineffective nuclear security regime whereby personnel lacks competence and skills in handling nuclear security aspects. Therefore, the technical expertise needed to provide scientific

and engineering advice on the design of detection systems and measures, operational concepts/procedures, data and trend analysis is very limited in most developing countries. This can lead to illicit trafficking of nuclear/ radioactive material hence which can be used by adversaries to carry out malicious acts and increase cases of nuclear terrorism.

- **National Coordination-** Regulatory controls e.g., enforcement measures do not cover detection of nuclear and other radioactive materials. Physical protection checks done during inspections are based on a graded approach, however they do not cover nuclear security issues e.g., minimal physical protection requirements. This can result in security measures being compromised hence radioactive materials can be stolen and used for malicious acts.
- **International Cooperation** – The lack of national and international cooperation among States to improve nuclear security around the world is also a major challenge. The promotion of information sharing/ experience in combating nuclear terrorism is often compromised and can lead to inadequate promotion and adherence to nuclear security standards and norms.

Recommendations on Strengthening the Nuclear Security Regime as a Measure of Counteracting Nuclear Terrorism

There is a need to strengthen the Nuclear Security Regime so as to reduce the illicit trafficking of nuclear and radioactive material. These materials can be used by adversaries to carry out malicious acts which contribute immensely to nuclear terrorism. The following are some of the recommendations which can be used by states to achieve an effective international Nuclear Security Regime as a measure of reducing nuclear terrorism:

- ***Legislative and Regulatory Framework*** – There is a need to have national laws that are aligned to international instruments regarding combating nuclear terrorism. These should include both binding and non-binding legal instruments. These will assist in apprehending adversaries committing malicious acts (criminal or unauthorized acts) with nuclear security implications. Criminal acts should include threatening or attempting to commit or actually committing such an act. The Stiff penalties should be meted against offenders of the nuclear security laws. An example of such is the Counter Terrorism Act which each country could adopt. Its aim will be to provide measures to prevent and combat terrorism acts, e.g., terrorism financing and to provide for matters related thereto.
- ***Detection Capability*** – There is a need to have effective and modern detection equipment in dealing with illicit trafficking of nuclear and radioactive material e.g. Radiation Portal Monitors (RPMs) that can detect the presence

of both radioactive and nuclear material. There is a need to maintain nuclear and other radioactive material under regulatory control so that advisories can be prevented from acquiring the material to use it on malicious acts. Security measures have to be deployed at storage facilities by the users to help secure the source from unauthorised access.

- *Capacity Building* – There is a need for States to take advantage of the training programs offered by the International Atomic Energy Agency (IAEA) in Nuclear Security and Terrorism or any other nuclear safety/security workshops. These will enhance technical experts with knowledge and technical capability needed in combating illicit trafficking of nuclear/radioactive material hence reducing the likelihood of nuclear terrorism in states. E.g., frontline officers (FLO's such as Customs, border police and Intelligence Services). Each State has the primary responsibility to build the capacity of organizations and people in order to develop, implement and sustain a nuclear security regime. To discharge its responsibilities, the State has to strengthen its capacity at national, organizational and individual levels. Specifically, the State has to be able to enhance the competences and capabilities of relevant stakeholders in fulfilling their responsibilities within the nuclear security regime. Such an endeavour involves various elements in capacity building, ranging from education and training to the development of a knowledge network. The development of human resources of nuclear security is one of the important components in building a strong nuclear security regime. Adequate nuclear security infrastructure, including the use of appropriate detection systems and supported by appropriate personnel competencies, will result in a strong nuclear security system (Huda et al., 2022).

International & Regional Cooperation – Member States should liaise with international bodies (e.g., IAEA & United Nations) to gain more knowledge and expertise in combating nuclear terrorism. This can be achieved by participating in network facilitated by the IAEA such as the Frontline Officers Network and the Nuclear Security Support Centre (NSSC). The IAEA needs to be brought into full play, whereby the promotion and application of nuclear security standards and norms is adhered, and information sharing/experience is exercised. Special focus should be placed on helping countries with a developing nuclear security regime in improving their detection and technical capabilities and provide nuclear security aid.

- *National Coordination* – Nuclear security of the nuclear and radioactive materials out of regulatory control (MORC) nationally needs strong inter-agency coordination, given the wide range of the aspects of out of regulatory control that need to be considered, from export-import activities to radiation detection. In addition, nuclear security requires various approaches, from

legal to technical approaches. Various agencies and stakeholders are involved in supporting the nuclear security of MORC (Huda et al., 2022).

International Treaties & Instruments Involved in Combating Nuclear Terrorism

The international legal framework for nuclear security comprises of legal instruments and principles whose purpose is to prevent, detect and respond to criminal and other unauthorized acts involving or directed to nuclear or other radioactive material and associated facilities or activities. Adherence to these instruments can play a major role in combating nuclear terrorism.

International Responses to Nuclear Terrorism

The following are some of the legal instruments used to prevent, detect and respond to criminal or unauthorized acts involving nuclear and other radioactive material;

- UN Security Council Resolution 1373 – UN Security Council adopted resolution September 28, 2001 to coordinate international efforts and counteract international terrorism due to its level of destruction. It is legally binding.
- UN Security Council Resolution 1540 – Being aware of the lack of international law that address the risk of terrorists' acquisition of WMD, the UN Security Council advanced its counter terrorism policies by adopting the Resolution 1540 to put pressure on all states to enforce these following provisions (Alkis, 2022). The resolution is also binding.
- International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT) – was opened for signature in 2005. According to the convention, any person commits an offence if that person unlawfully and intentionally possesses, use or threaten to use radioactive material with an intent to cause damage; or damages facilities with the same intent; or attempts to do so; or participate in, organize or contributes to such actions (Alkis, 2022).

Nuclear Non-proliferation Regime

The international nuclear non-proliferation regime is a universal framework consisting of international agreements and organizations which focus on preventing the spread of nuclear weapons as well as strengthening the peaceful use of nuclear energy, arms control and disarmament process (Alkis, 2022).

- Nuclear Non-Proliferation Treaty, (NPT) – based on the three pillars of nuclear non-proliferation, peaceful use of nuclear energy and nuclear

disarmament, all of which mutually reinforce each other. It also plays a major role in the structure of the international nuclear non-proliferation regime by creating international laws and rules for states to abide by.

- International Atomic Energy Agency (IAEA) – The IAEA safeguards system comprises an extensive set of technical measures through which the IAEA Secretariat independently verifies the correctness and the completeness of the declarations made by States about their nuclear material and activities. In broad outline, safeguards activities comprise three functions: accountancy, containment and surveillance (IAEA, 2008).

Conclusion

An effective nuclear security regime depends on three (3) pillars mainly being; the legislative and regulatory framework, nuclear security systems/measures and institutions/relevant stakeholders that are involved with nuclear security. Therefore, the development of an effective nuclear security regime is of paramount importance as it establishes systems and measures for the detection of criminal or unauthorized acts with nuclear security implications involving nuclear or radioactive material out of regulatory control. History has proven that availability of nuclear/radioactive material due to dynamics in technology, has increased the probability of terrorists or criminal parties obtaining material for the purposes of malicious acts or sabotage of nuclear facilities. Therefore, there is a need to provide a broad range of monitoring controls to ensure that nuclear/radioactive material is not acquired for illicit purposes. Proper measures are required as a long-term effort in preventing nuclear and other radioactive material from compromising global peace and security.

There is a need to strengthen nuclear security instruments and bodies through global cooperation and partnership where information sharing and training are encouraged to build capacity in combating nuclear terrorism. It is crucial for the existence of a regulatory framework to be promoted in which nuclear security could be more effective by being inspired with the international nuclear non-proliferation regime.

References

- Alkis, M. A. (2022). Threat of Nuclear Terrorism; The Developing Nuclear Security Regime, Vol. 7, No. 1.
- Alkis, M. A. (2017). Threat Of Nuclear Terrorism: Towards An Effective Nuclear Security Regime.
- Baraedi, T. (2024). Survey on the radiation workers and public regarding probability of certain factors contributing to Nuclear Terrorism.

- Daniel, W.H.K., Frank, H. A. Potter, W. C. (2020). The Nuclear Matters Handbook 2020 [Revised].
- Daniel W. et. al, (2017). Nuclear Security Culture for Users of Radioactive Sources Model Self-Assessment, Enhancement, University of Georgia.
- Ferguson, C. D., Potter, W. C. (2005). The Four Faces of Nuclear Terrorism.
- Frank, R. F. (1976). Nuclear Terrorism and the Escalation of International Conflict, Naval War College Review: Vol. 29: No. 4, Article 4, available at: <https://digital-commons.usnwc.edu/nwc-review/vol29/iss4/4>
- Huda, K., Wiringgalih, P., Hermawan, D. (2022). Challenges in the development of nuclear security systems for nuclear and other radioactive materials out of regulatory control, AIP Conference Proceedings 2525, 100002, <https://doi.org/10.1063/5.0127259>
- International Atomic Energy Agency. (2011a). Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15.
- International Atomic Energy Agency. (2011b). Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities, INFCIRC/225/Revision 5, IAEA Nuclear Security Series No. 13, IAEA, Vienna.
- International Atomic Energy Agency. (2008). Nuclear Security Culture, Nuclear Security Series No. 7, Vienna.
- International Atomic Energy Agency. (2007). Combatting Illicit Trafficking in Nuclear and other Radioactive Material, IAEA Nuclear Security Series No. 6, IAEA, Vienna.
- International Atomic Energy Agency. (2006). GOV/2006/46-GC (50)/13. Nuclear Security Measures to Protect Against Nuclear Terrorism, report by the Director General.
- Khripunov, I., Siuzdak, J., Nichols, K., Lozova, V., Gerencir, H., Mudano, R., & White, J. (2017). Nuclear Security Culture For Users Of Radioactive Sources Model Self Assessment Enhancement, University of Georgia Center for International Trade and Security.
- Kupatadze, A. (2010). Organized Crime and the trafficking of Radiological Materials, Nonproliferation Review, Vol. 17, No. 2, Monterey Institute of International Studies, James Martin Center for Nonproliferation Studies, DOI: 10.1080/10736700.2010.485425
- O'Neill, K. (1997). Institute for Science & International Security.
- Petrova, P. (2024). Eighty Discs of Radioactive Americium 241 Found in Plovdiv, Bulgaria News Agency, available at: <https://www.bta.bg/en/news/bulgaria/746509-eighty-discs-of-radioactive-americiu-241-found-in-plovdiv>