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THE IMPACT OF EGYPT'S ACCESSION TO THE CONVENTION ON THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL FOR THE NUCLEAR LEGISLATIVE INFRASTRUCTURE

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ABSTRACT

The topic of the article relates to the legal framework for nuclear material security represented in the Convention on the Physical Protection of Nuclear Material, which provides for certain levels of physical protection during the international transfer of nuclear materials, and sets a general framework for cooperation between states in the field of protection, recovery, and return of stolen nuclear materials, in addition to that it aims to prevent and detect Addressing criminal and other unauthorized acts directed against nuclear or other radioactive materials and related facilities and activities and urges states parties to track them down and adopt a system for extradition or prosecution of criminals. This article aims to highlight the importance of the Convention on the Physical Protection of Nuclear Material in completing the legislative infrastructure of countries wishing to acquire a nuclear program, as it is one of the important legal tributaries to avoid the dangers resulting from the illicit trade in nuclear materials, their seizure, and their illegal use, sabotage or sabotage of nuclear facilities, Eliminate the threats posed by international terrorism and organized crime. The article also aims to shed light on the legal problems that hinder the achievement of the desired goals of the nuclear programs if the codes of conduct regarding the safety and security of radioactive sources are not followed, and that stem from the material protection Convention, and the case of illegal possession or use of radioactive material or a radioactive nuclear device, or assault Nuclear facilities and their harm. The article reviewed the need to complete the legal infrastructure necessary for the Egyptian nuclear program through Egypt's accession to the Convention on the Physical Protection of Nuclear Material, so that through this, an integrated legal environment of services and support is available to ensure the preparation of the nuclear program to the fullest extent, raise its growth rates, and increase its efficiency, which leads To increase the chances of its success and its sustainability, by imposing prior protection on the prohibited activities, thus contributing to their elimination. The article presented the infrastructure of the Egyptian nuclear legislation, in particular the law on regulating nuclear and radiological activities and its implementing regulations, and the Egyptian system for accounting and control of nuclear materials to demonstrate the adequacy of these legislations to fully protect nuclear materials, and whether they cover important aspects related to supporting nuclear non-proliferation and combating terrorism. Strengthening the physical protection of nuclear materials and nuclear facilities for peaceful purposes. The conclusion of the article that Egypt's accession to the Convention on the Physical Protection of Nuclear Material will strengthen the infrastructure for nuclear legislation, and then strengthen and maintain the security of the Egyptian nuclear program, in addition to strengthening international cooperation in developing effective measures that guarantee the physical protection of nuclear materials. And nuclear facilities, without prejudice to national sovereignty or prejudice to the nuclear technology necessary for a peaceful nuclear program.

1. Introduction.

Egypt has recently tended to revive its nuclear program for the peaceful uses of nuclear energy and restore its regional position in the nuclear field, especially as it has three establishments for the production of nuclear energy for peaceful uses, namely: the Atomic Energy Authority (AEA), the Nuclear Materials Authority (NMA) and the Nuclear Power Plants Authority (NPPA), in addition to the Egyptian Nuclear and Radiological Regulatory Authority (ENRRA), which regulates and controls nuclear activities, these four bodies constitute the infrastructure for an advanced nuclear program; And then move forward in building and operating the Egyptian nuclear program.

Entering the era of nuclear technology requires the enactment of legal legislation to regulate all matters related to building, organizing, and managing those nuclear activities, which is Egypt has done. It issued Law No. 7 of 2010 regulating nuclear and radiological activities [1].

Although nuclear materials are always the backbone of nuclear energy, the interest of legislation is always on nuclear energy and its uses. As for nuclear material, it still needs legislative measures to protect it from tampering, misuse, diversion, distortion, and switching to illegal uses.

The Egyptian legislature has established a system for accounting and controlling of nuclear materials subject to the Agreement on the Application of Safeguards Related to the Treaty on the Non-Proliferation of Nuclear Weapons between Egypt and the International Atomic Energy Agency (IAEA), and this system was issued by Presidential Decree No. 152 of 2006, but it did not include a mechanism or controls for the transfer of nuclear materials or Storage, circulation, import or export [2].

The Egyptian legislature in the law regulating nuclear and radiological activities added criminal protection of a special kind to nuclear materials, by establishing a range of crimes that are targeted by theft, defamation, illegal trade, or threat to use them in terrorist acts, which is welcome in many aspects, but the aim of protection Not achieved on its launch; As the law did not include a complete regulation of the physical protection of nuclear materials.

Egypt has recently adopted a package of nuclear security and safety programs, which depends on numerous partnerships with many countries through conferences, scientific events, and workshops held in this regard, through which it has attempted to embrace the path of development and development along the lines of many countries.

Egypt to achieve the expected successes of its peaceful nuclear program, it is necessary to study, analyze and evaluate the approach that many countries have previously taken concerning the physical protection of nuclear materials, which joined the Convention on the Physical Protection of Nuclear Material of 1980, and the amendment 2005, to see if Acceding to that Convention would strengthen the current protection system for nuclear materials, and assess whether it would be preferable to join or not.

The interest in researching this topic when following up the conclusion of the committee formed by the IAEA to evaluate

the nuclear infrastructure of Egypt to make recommendations and proposals to help Egypt move forward with the nuclear program, which, by extension, requires accession to nuclear security agreements, including the Convention on the Physical Protection of Nuclear Materials [3].

So; This article relates to the extent to which the models used by the countries that joined the Convention on the Physical Protection of Nuclear Material in the movement of nuclear materials through the use of the Blockchain system with tracking the movement of transactions that occur when transporting nuclear materials or operating nuclear facilities, and the importance of real benefit from Establishing a legal and security protocol for the rules relating to surveillance technologies and data, and the extent of the benefit that would accrue to the Egyptian nuclear program from using this model.

Consequently, the topic of the article seeks to identify specific mechanisms through a model based on the provisions contained in the Convention on the Physical Protection of Nuclear Material, and how this model is managed.

The article aims to create a model for managing the movement of nuclear materials during transport, storage, handling, and securing the operation of nuclear facilities, so that through this model, the provisions of the Convention on the Physical Protection of Nuclear Materials, and effective protection of nuclear materials and nuclear facilities, can be implemented.

2. Research methods.

To achieve this goal, scientific publications on the security of nuclear materials were analyzed by imposing physical protection on their transportation, circulation, storage, import, and export, and the legislation regulating this, and the formation of a model that could be used in the security of nuclear materials in Egypt as an effect of the effects of joining the Convention on the Physical Protection of Nuclear Material.

Among the methods that were used in preparing the model, the complete description of the model and the preparation of complete controls to be followed to give full protection to nuclear materials, guided by what has been done in some countries that joined the agreement.

3. Results of research and discussion.

Nuclear materials have characteristics and properties that may not be available to other materials, minerals, or metals that are similar to them or less than their composition or importance, requiring the necessity of protecting them during their transportation, storage, or use.

This protection is only available for materials that have nuclear characteristics, according to the forms, types, and importance that are determined to them under standards set by the IAEA in the guidelines issued by it, or by agreements that the agency manages the issue of signature and accession to it.

Physical protection is achieved by many means that transform, expand and impede access to these materials. It increases and weakens according to the importance of the materials to be protected and implemented in many forms according to the requirements, and they develop from time to time according to the development of attempts to attack them [4].

Many bodies undertake that protection, including international ones, such as the IAEA, and some of them are patriotic, such as the bodies and agencies in every country that are charged with exercising this protection, caring for, and developing it.

3.1. The concept of physical protection of nuclear materials.

Physical protection means the administrative and technical measures and measures including physical barriers that are used to extend physical protection to the nuclear materials used, stockpiled, and in the process of being transported; So that they prevent, impede and prevent them from diverting them into nuclear weapons or any other illegal purposes. These measures and measures are based on the level of development of available physical protection devices and systems and the types of nuclear materials.

The physical protection system aims to prevent the unauthorized withdrawal of nuclear materials or to prevent sabotage of nuclear materials by preventing sabotage of nuclear installations and facilities. The general approach to achieving this goal involves protecting from the threat by creating a system based on a combination of personnel and equipment. Procedures and facility design, taking into account the necessity of having these elements in place with the safety of the facility concerned.

3.1.1. The goal of physical protection of nuclear materials.

The theft, seizure, or misappropriation of nuclear material represents grave risks to human society, and these risks stem from the possibility of using these materials in nuclear explosive devices or as radioactive pollutants, and because an act of sabotage against a nuclear facility or charge can create an extreme radiological risk, it is important necessary to create a system in a country to protect these nuclear materials, so that the responsibility for establishing and operating such a system rests with the government of that state, and there must be international cooperation in cases where protection measures in one country depend on another country.

The concept of protection requires the design of a combination of equipment and security apparatus, a set of procedures, including the organization of guards, their locations, methods of work and tasks, and the design of nuclear facilities, including their general scheme, to confront any risks that nuclear materials or the nuclear facility may be exposed to.

The level of the nuclear material and the nuclear facility to which it belongs, the size of the threat to which it may be exposed, and the emergency measures to be taken in the event of a threat or attack must be taken into account when designing the level of physical protection measures.

To achieve the physical protection system its objectives, access to nuclear materials or facilities must be restricted to a minimum number of individuals.

It is also a requirement that all individuals who are allowed to access - without observers accompanying them - have access to nuclear materials or facilities, and careful analysis must be taken. Protection requirements related to safety considerations and physical protection to certify that they do not compromise nuclear safety even in emergency conditions, and it is imperative to provide preventive measures during the transfer of nuclear materials so that the aggressors are forced to overcome many successive measures to achieve their goals [5].

3.1.2. The Importance of Nuclear Materials.

The economic importance of nuclear materials, in general, and uranium, in particular, did not emerge until 1942 when it was confirmed that it could be used as a fissile material because it contains the isotope 235, which is the only material in nature that can fission, and this was achieved during the period from 1942 to 1948. Uranium transformed from a mere material used in dyeing and coloring to a priceless strategic

material.

However, after the discovery of huge quantities of uranium deposits in South Africa in 1952 and Canada in 1954, in addition to the increase in production by the United States and France, the prices of uranium decreased to reach $ 20 / kilogram of uranium from 62 dollars/kilogram of uranium.

The decline in Uranium prices continued until the early 1970s, which witnessed a major energy crisis worldwide, especially with the outbreak of the October 1973 war and the major crisis it caused in petroleum resources. This resulted in a significant increase in uranium prices, as its price reached $ 112.85 / kilogram of Uranium in the middle of 1978, this increase continued until the early eighties when prices gradually decreased again to reach $ 25.40 / kg uranium in 1990, then its price fell again to $ 20.67 / kg Uranium in 1992, and then it continued to decline by 1993 To be less than twenty dollars.

The international changes that emerged during the dissolution of the Soviet Union led to an abundance of Uranium available in the global market as a result of adopting a policy of international accord and rejecting the Cold War.

Despite all the aforementioned, the economic importance of nuclear materials still outweighs other raw materials. The economic operation of any ore depends primarily on the difference between the total cost of its production during the period of its extraction, processing, and preparation in its final form for sale, and its selling price, as this difference represents the profitability of the facility, which economic studies have proven its high feasibility compared to other raw materials.

None of the raw materials have enjoyed the same attention as nuclear materials have enjoyed from politicians, because these materials are a source of the most important energies at all, which is nuclear energy, and hence the power of governments, the period of their presence in government and their influence at the international and local levels are measured by what they possess of these nuclear materials [6]. The nuclear age that has come and will remain for a long time must be dealt with and through it, as countries find themselves motivated to enter this era without delay, if not to benefit from the tremendous nuclear technology, then it is for the political safety caused by nuclear safety, then entering the nuclear age and possessing nuclear materials It was not and will not be intended to possess nuclear weapons, but it is intended that the state and politicians can deal with any nuclear event and with any nuclear threat, as Japan does not possess any nuclear weapons despite its possession of very advanced nuclear technology.

The political situations at the international and national levels are greatly affected by the illegal uses or aggressions that nuclear materials are affected by, such as illegal smuggling of nuclear materials, transnational nuclear radiation, environmental pollution problems resulting from the use of nuclear energy, and the burial of nuclear waste. All of this is one of the phenomena that greatly affects the internal policies of states, as well as on international political relations. The possession of nuclear materials affects the stability, strength, and security of political regimes, as these materials represent the industrial, agricultural, economic, medical, educational, and even social nerve of those systems. Nuclear technology invaded and affected every aspect of life more than it was affected by it.

3.1.3. The Types of Nuclear Materials.

Nuclear materials vary according to their use; nuclear fuel materials are the materials that are used in the production of nuclear energy by chain fission, whether they are used directly without nuclear conversions (enrichment) or they have been enriched [7].

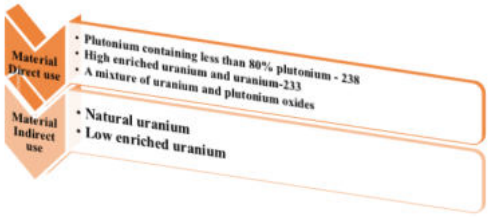
- **Direct-use Materials:**

It is the nuclear material that can be used to manufacture nuclear explosive devices without the need for nuclear conversions or enrichment, such as plutonium containing less than 80% plutonium-238, highly enriched uranium, and uranium-233, and these materials include compounds. Chemicals or any mixture of direct-use materials, such as the mixture of uranium oxides and plutonium found in MOX.

- **Indirect-use Materials:**

It is the nuclear materials that need nuclear conversions or enrichment that can be used to manufacture nuclear explosive devices, such as natural uranium or low enriched uranium, which need enrichment processes to convert them into highly enriched uranium or must be introduced into the reactor. To produce plutonium-239, which can then be separated into reprocessing units, such as depleted uranium, such as thorium, which can be converted into uranium-233, and these materials are sometimes called fertile materials.

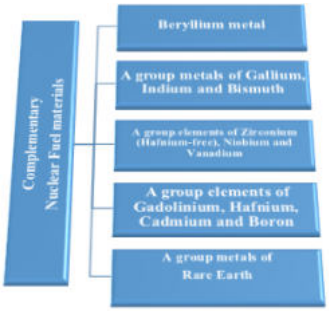
Fig. 1. - Nuclear Fuel Materials



- **Complementary materials to nuclear fuel**

It is non-fissionable materials that are used in the processing or use or production of special fissile materials, or in the field of industry and nuclear constructions, the most important of which is: Beryllium metal, which is mainly used as a source of neutrons in uranium batteries, in addition to its importance as a structural material in some nuclear industries , and a group of metals, Gallium, Indium and Bismuth, which are used as feedstocks for thermal transfer processes in nuclear reactors, and a group of elements of Zirconium (Hafnium-free), Niobium and Vanadium, which are used as structural materials characterized by a high degree of corrosion resistance, and at the same time characterized by a low degree of Neutron absorption, Therefore, it is mainly used in the packaging of nuclear fuel cylinders to protect them from corrosion by cooled and calming materials such as air, water, carbon dioxide, graphite, molten sodium ..... etc., and a group of Gadolinium, Hafnium, Cadmium and Boron elements, which are used as rods that control the rates of reactions in nuclear reactors. Thus, it controls the rates of thermal energy generated by it through the introduction of those rods between nuclear fuel units, due to the high degree of absorption of these elements of thermal neutrons, and a group of rare earth elements, Rare Earth Elements, which are used as rods to control the speed of nuclear reactions because they are distinguished by their high neutron absorption, as well as their hardness and resistance to corrosion.

Fig. 2. - Complementary Nuclear Fuel materials



3.2. The legal framework for the protection of nuclear materials in Egypt.

Egypt was interested in setting up a legal framework for the protection of nuclear materials through which it sought to provide security and protection for nuclear materials, on the international level. Egypt has joined many international and regional Treaties and Conventions related to nuclear security and safety. We have prepared a list of international legal Treaties and Conventions that were concluded under the auspices of the IAEA and Egypt's position on them.

Tab. 1. - List of International Legal Treaties and Conventions Concluded under the Auspices of the IAEA and Egypt's position.

Name of Treaty/ Convention/ Agreement	Aim	Entry Into Force	Egypt's position
Treaty on the Non-Proliferation of Nuclear Weapons	Preventing the spread of nuclear weapons and weapons technology To enhance cooperation on the peaceful uses of nuclear energy	5/3/1970	26/1/1981
Agreement on the Application of Safeguards in Relation to the Treaty on the Non-Proliferation of Nuclear Weapons	Comprehensive safeguards agreements entered into by the agency with non-nuclear-weapon states that are parties to the NPT	---------	30/6/1982
Vienna Convention on Civil Liability for Nuclear Damage	Establishing some standards to provide financial protection against damage caused by some peaceful uses of nuclear energy	12/11/1977	5/11/1965
Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (Joint Protocol)	Establishing treaty relations between the contracting parties to the Vienna Convention and the contracting parties to the Paris Convention, and avoiding the inconsistencies that may arise from the application of both conventions to the same nuclear incident	4/10/2003	Not Joined
Convention on Supplementary Compensation for Nuclear Damage	Establishing a minimum amount for the national compensation and increasing the amount of compensation through public funds provided by the contracting parties in case the national amount is insufficient for compensation for nuclear damage	29/9/1997	Not Joined
Convention on Early Notification of a Nuclear Accident	Establish a system for reporting nuclear accidents with the potential to lead to transnational launches	27/10/1986	6/7/1988
Convention on Nuclear Safety	Commit Contracting Parties operating land-based civil nuclear power plants to maintain a high level of safety by establishing fundamental safety principles to which States would subscribe.	24/10/1996	Singed but Not Joined
Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management	Establishing fundamental safety principles and creating a similar "peer review" process to the Convention on Nuclear Safety	18/6/2001	Not Joined
Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	Prompt assistance and support in the event of nuclear accidents or radiological emergencies	17/10/1988	26/2/1987
International Convention for the Suppression of Acts of Nuclear Terrorism	criminalize acts of nuclear terrorism and promote police and judicial cooperation to prevent, investigate and punish those acts	7/7/2007	7/7/2007
The Convention on the Physical Protection of Nuclear Material	Preventing, detecting, and responding to criminal and other unauthorized acts involving or directed against nuclear or other radioactive materials and related facilities or activities.	8/2/1987	Not Joined
Amendment The Convention on the Physical Protection of Nuclear Material	The amendment reduces the risk of a terrorist attack by using and smuggling nuclear materials	8/5/2016	Not Joined

Egypt's vision 2030, the seventh goal of the vision entitled: "Egyptian peace and security" has identified the importance of energy security, among which is the importance of security nuclear energy. It stated:"The state establishes top priority on security in its comprehensive sense at the national and regional levels as an imperative to achieve and maintain sustainable development, which includes ensuring food and water security, sustainable energy security, political, economic, social and environmental stability, information security (cyber), securing Egyptian borders, combating terrorism and organized crime" [8].

In terms of legal regulation; Law No. 7 of 2010 promulgating the law regulating nuclear and radiological activities guides to establish a nuclear security system for nuclear and radiological facilities and activities, nuclear materials, nuclear fuel, and radioactive sources, including radioactive waste and spent nuclear fuel, in the organizational structure of the ENRRA.

The Egyptian System for Accounting and Control of Nuclear Material Subject to the Agreement on the Application of Safeguards Related to the Treaty on the Non-Proliferation of Nuclear Weapons between Egypt and the IAEA issued by Presidential Decree No. 152 of 2006 set out many measures that are needed in every nuclear facility and any site containing nuclear materials.

The regulation of rules and procedures related to the work of nuclear safeguards issued by Resolution of the Board of Directors of the ENRRA No. 1 of 2014 obligated nuclear material holders to establish and maintain inventory and operation records related to the possession, circulation, or production of nuclear materials, and to submit a special report to the ENRRA when an accident occurs theft or loss of nuclear materials. The aforementioned regulation also specified the rules and procedures for the local transfer of nuclear materials, as well as the rules and procedures for the international movement of nuclear materials upon import or export [9].

3.3. The adequacy of the legislation for the physical protection of nuclear material.

Egyptian legislation guarantees the establishment of a nuclear security system for nuclear and radiological facilities and activities, nuclear materials, nuclear fuel, and radioactive sources to achieve the following objectives:

- Following up on identifying the types of anticipated threats that must be taken into consideration in the design of the country's nuclear security systems, analyzing them at the national level, and identifying appropriate means to confront them.
- Reviewing the design of nuclear security systems and evaluating the performance of those systems during operation in light of potential threats and the appropriate means to confront them.
- Establishing the appropriate classification of nuclear materials and evaluating the performance of these systems during operation in light of the potential threats and the appropriate means to confront them.
- Establishing the appropriate classification of nuclear materials and radioactive sources from a nuclear security point of view, and the measures that need to be taken regarding each category to protect the materials and sources referred to, in a way that ensures proportionality between its danger and the required level of protection.
- Approval of export and import operations.
- Control over procedures and measures to combat illegal trade in the aforementioned materials and sources.
- Establishing a database for nuclear materials and radioactive sources in the country in all fields in a manner that ensures compatibility with data related to the Egyptian system for accounting and control of nuclear materials.
- Ensure that the necessary protection is provided for nuclear and radiological installations, as well as nuclear materials, radioactive sources used and stored, and what is being transported from them by any means, including international transport, through the implementation of the necessary administrative and technical measures.

Egyptian legislation also included the necessary controls for nuclear security, which we summarize as follows [10]:

- The Egyptian Nuclear Security System at the ENRRA shall ensure the availability of the necessary protection systems for nuclear and radiological installations, as well as for nuclear materials and radioactive sources used or stored, especially what is transferred internationally, and for this purpose, it has the right to carry out system review and field inspections on them.
- The ENRRA determines the requirements for the physical protection of the nuclear materials used, stored, and in the process of transporting them, and for the nuclear installations to ensure resistance to withdrawing nuclear materials without permission or sabotaging the nuclear facilities.
- The ENRRA reviews the emergency plans prepared by the licensee to deal with withdrawals and unauthorized use of nuclear materials, or operations to sabotage nuclear installations or materials.
- The ENRRA inventories and classifies the nuclear materials and radioactive sources in the country determined by the regulations, systems, standards, and technical rules issued by the authority from the perspective of nuclear security of nuclear materials and review the measures that should be taken in the matter of each category to protect them in proportion to their severity within the framework of the principle of cost-benefit analysis To enhance security (tiered approach).
- The ENRRA is committed to the confidentiality and preservation of any information or documents of a confidential nature regarding physical protection systems. It also specifies the confidentiality requirements for these systems and the associated accurate information documents or details that their disclosure without permission could prejudice the physical protection of nuclear materials and nuclear installations.
- The ENRRA determines the types of restrictions that are imposed on access to sensitive information by limiting it to those whose work requires access to it, and maximum protection must be provided for information related to what might or exist gaps in the physical protection systems.
- The ENRRA may cooperate or consult with the concerned national authorities in matters related to the physical protection operations and their development, and it may also consult with foreign authorities in the event of cooperation to retrieve any materials that were stolen or lost through the official authorities in the state and coordination with the Supreme Committee for Nuclear and Radiation Emergencies.

3.4. Convention on the Physical Protection of Nuclear Material.

The Convention on the Physical Protection of Nuclear Material was opened for signature on March 3, 1980, according to Article 18, paragraph 1, of the Convention; This was after negotiations were held on October 28, 1979, and the Convention entered into force on February 8, 1987, that is, on the thirtieth day from the date on which the twenty-first instrument of acceptance or approval was deposited with the depositary, under paragraph 1 of Article 19 of the Convention. The Convention is the only legally binding international undertaking in the field of physical protection of nuclear material. It focuses on the physical protection of nuclear material used for peaceful purposes during international transport but does not cover the protection of nuclear installations or nuclear materials for domestic uses, storage, or transportation [11].

And after the number of nuclear materials for peaceful uses in the world increased by 70 % since 1999 and continued growth in use with the increase in the global use of nuclear energy and with the increased risk of a terrorist attack using nuclear materials through smuggling of those materials or an attack on a nuclear power plant Or other nuclear facilities or nuclear materials during transportation. The states decided that the Convention should be amended, so the amendment adopted in 2005 was considered one of the most important achievements in the field of nuclear security [12].

The amendment expands the scope of the Convention on the Physical Protection of Nuclear Material to also include requirements for the physical protection of nuclear installations and nuclear materials for domestic use, storage, and transportation, and broadens the scope of current crimes

specified in the Convention on the Physical Protection of Nuclear Material, such as theft of nuclear material, and also introduces new crimes, including smuggling. Nuclear materials and actual sabotage or threat to nuclear facilities, and calls upon states to reduce any radiological consequences of sabotage, prevent and combat-related crimes, and provides for expanding cooperation between countries regarding locating and recovering stolen or smuggled nuclear material, even if this concerns states that do not have materials or Nuclear installations, and states are required, in the event of theft, burglary, or any unlawful taking of nuclear materials or a credible threat, to share information, as appropriate, with each other, the IAEA and other relevant international organizations to recover and protect these materials.

3.4.1. Contributions of the Convention on the Physical Protection of Nuclear Material.

The Convention and its Amendment seek to the universal application to help ensure that nuclear materials around the world are adequately protected from malicious acts committed by terrorists and other criminals. Achieving global implementation requires, among other things, increased coordination and information exchange between states by holding periodic meetings to improve mechanisms. Information exchange, while also protecting confidentiality, in addition to convening a conference of states parties five years after the entry into force of the amendment, to review what has been implemented and its suitability to achieve the objectives of the Convention and its amendment [13]. Although the implementation of the convention and its amendment rests with states, the agency is obligated to provide technical assistance for the protection of nuclear materials in the states parties upon their request. Technical assistance includes drafting national legislation, establishing and maintaining a national system for physical protection, establishing a strong arrangement on information exchange, strengthening Peer review missions to provide advice to states on fulfilling their nuclear security obligations and commitments, and also providing assistance to states that are not parties to the convention or amendment, upon request.

3.4.2. The Role of the IAEA in Establishing the Nuclear security System in Egypt

The IAEA plays a prominent role in assisting countries in establishing, maintaining, and developing national nuclear security systems, and the Agency does this by providing guidance, training, advice, and equipment to member states, as well as by facilitating the exchange of information between them. Since 2002, the Agency has provided training in the field of nuclear security to more than 19,000 people from more than 120 countries, it has also conducted physical safeguards upgrades and implemented risk reduction activities such as repatriation of highly enriched Uranium (HEU).

The IAEA also regularly provides nuclear security assistance to major international sporting events, including the 2016 Olympic Games in Rio de Janeiro. The agency maintains an Incident and Trafficking Database (ITDB), in which 131 countries participate voluntarily, with the ITDB containing 2,899 incidents reported since 1995 [14].

In the event of an accident related to nuclear security, the IAEA's Accident and Emergency Center can contact the affected country, view and facilitate requests for assistance, assess the event and its potential consequences, exchange information with other countries, and communicate with the public and the media, while protecting confidentiality, and coordinate the response with other international organizations.

Egypt has also made progress on a project supported by the IAEA to improve physical protection in research reactors, a project that began in 2015 that aims to strengthen the nuclear security infrastructure and build capacity to support Egypt's security-related preparations for a planned nuclear energy program, where the Egyptian authorities have installed Security systems and updates for physical protection at the ETRRR1 and ETRR2 research reactors, which were well received by IAEA officials during a meeting held in April 2018 with Egyptian officials, as they emphasized the agency's tireless endeavor to assist the Egyptian national authorities in enhancing their regulatory functions related to nuclear security, including In this, in the development of regulations and regulatory guides in the next stages of the project, which end in 2021, as the IAEA is expected to provide more support to Egypt in enhancing physical protection in a radioisotope facility and a fuel manufacturing plant, which will help in strengthening security measures and systems according to The need in radiation facilities that use radioactive sources [15].

The IAEA will also support Egypt in establishing the Nuclear Security Support Center at the headquarters of the Egyptian Nuclear and Radiation Regulatory Authority (ENRRA). Which provides training and technical and scientific support to national stakeholders in Egypt with nuclear responsibilities as part of Egypt's integrated plan to support nuclear security. The IAEA will assist Egypt in its work to strengthen and maintain the national nuclear security system, and the support will focus on five main functional areas: The legislative framework Regulatory, prevention, detection, response, and sustainability [16].

Fig. 3. - Egyptian and IAEA officials during a meeting held in April 2018 to review progress in an IAEA-supported project that improved physical protection at Egypt's research reactors. (Photo: IAEA)

3.5. The Proposed Model for the Protection of Nuclear Material under The Convention on the Physical Protection of Nuclear Material.

Blockchain software plays great importance in preserving data through certain technologies, through which it is possible to create a system that contains transparent, verifiable, and tamper-proof mechanisms as a digital network for information that can simplify and secure data in the absence of any central authority, hence, Blockchain program technologies are a manifestation of Manifestations of the decentralization of data distribution through specific technological solutions, this technology is attributed to the potential to revolutionize large-scale industries such as banking, government, and healthcare [17].

Although most of the countries that have Nuclear industries have developed systems for inventing nuclear materials, and they also maintain databases of their physical stockpiles, these systems lack adequate supervision and are not linked to a single chain that prevents the theft of nuclear materials, to the point that it is practical Discovering the loss or theft of nuclear material can take long days, sometimes up to thirty days [18].

The IAEA became aware of the importance of the role played by Blockchain program technologies and began to explore how it could be applied in the nuclear field, as a means of non-proliferation, nuclear security, and export and import control

of nuclear materials [19]. Egypt enjoys great security, economic and political stability, unlike many neighboring countries in the Middle East region. It also enjoys great support from the IAEA, which makes it possible for it to adopt Blockchain program technologies to ensure nuclear security, accounts, and control of nuclear materials at the national level, and to enhance regional nuclear security, hence enhancing international nuclear security [20].

The program can be used as a secure and shared platform for managing the information needed to enhance nuclear material accounting and control systems, as well as in designing facilities and implementing effective safeguards by providing accurate, complete and reliable information on nuclear material to operators and professionals, through which information and activities about the flow of nuclear material within or across a facility can be preserved. Establishments that can be protected in a certain way, and can be easily changed and separated if that information reaches a deduction from the liabilities.

Techniques can also be used in the transportation of nuclear materials, where carriers, shippers, and relevant national authorities participate in the placement of shipments to ensure the continuity of knowledge during transport, that is, the possibility of tracking shipments through their documents, and tracking the paths of nuclear materials and their locations, and at any stage of transit [21].

Technology can also be used to confront any threat from within or attempt to penetrate any nuclear facility, and to monitor the activity of individuals, through biometric devices related to identifying the faces of employees, especially those who deal with highly sensitive and valuable information. Techniques can also be used to enhance incident reporting by protecting the identity of the participants responsible for the integrity of the reporting system, maintaining anonymity, and assuring that reports will not be mishandled or leaked in the event of an accident, which stimulates the preparation of those reports and leads accordingly to Data quality and accuracy, thus strengthening oversight and ensuring the integrity of information analysis on incidents.

It can be expected that Blockchain technologies will enhance the security of parallel data for nuclear security, and face any technological penetration of it, provided that all technical precautions are followed, and the obstacles that impede its work are faced [22].

3.5.1. Tasks of physical protection of nuclear materials.

For the physical protection system to be able to cope with the possibility of withdrawing nuclear materials without permission or the possibility of sabotaging these materials through sabotage of nuclear installations and facilities, it should be responsible for the following functions [23]:

- **Deterrence.**

It is possible to prevent the withdrawal of nuclear material without permission - that is, the theft of nuclear materials or their robbery in any other illegal way - or to prevent their sabotage in one of two ways: either to prevent opponents, or to overcome them if they tried to steal nuclear materials or sabotage nuclear materials or nuclear facilities, and deterrence is achieved. By implementing a physical protection regime that the litigants consider insurmountable; Physical safeguards would make nuclear material or protected nuclear facilities an unattractive target.

Although protection from drawing without permission or from sabotage requires studying many factors, the philosophy of material protection differs in drawing without permission from sabotage.

- **Detection.**

The detection means the discovery of an attempted intrusion or an actual intrusion operation whose objective to withdraw nuclear materials, equipment, systems, or devices located in a protected area without permission, or to sabotage them.

Detection, in its narrow sense, is a physical phenomenon; Meaning that a sensor or a person determines the existence of something that needs to be investigated or evaluated in a particular place, and this detection can be achieved by sensors or personal monitoring, for example by an employee or a guard.

For the detection to be effective, it must be accompanied by an evaluation of what was detected, i.e., has the sensor detected the presence of an animal or a person? Did the sensor trigger due to weather conditions, resulting in a false alarm? And is the person who is seen or detected by one of the entrance guards considered a person authorized to enter the facility, or is this person a threat to the facility? Sensors are an important part of the detection system and alarms, when activated, indicate the presence of an activity that requires evaluation.

- **Evaluation.**

The evaluation means that a guard or an electronic system determines the cause of the alarm and its severity, and a central alarm station must be established to be able to continuously evaluate the detection and evaluation information and to communicate with the guards and the response force, and the central alarm station should be fortified; That is, it must be constructed and located in such a way that it can continue to operate at all times, even in the event of an attack.

To assist in the evaluation, each sensor sector is covered by a closed-circuit television monitoring unit, in addition to the eye checks performed by the guards, whether they are in a fixed location or are roaming [24].

- **Obstruction.**

Obstruction is an important element necessary for physical protection, given that it is usually not possible to maintain a sufficient number of guards at all ports to provide immediate protection against all kinds of opponents; Some obstructive measures are required to provide the guards with the necessary time, after detection of the intrusion, to counter this intrusion and to request assistance.

This obstruction can be achieved by erecting barriers such as fences, walls, and locks necessary to slow down the movement of opponents sufficiently to provide the necessary time for guards or members of the counterforce to take their positions between the opponents and their targets and to use force, including also the use of weapons in cases where the guards are armed, to stop or disrupt the attack before the opponents can reach their goals, and obstructive operations should be sufficient to prevent the opponents from accomplishing their mission before the guards or counter forces can intervene and neutralize the opponents.

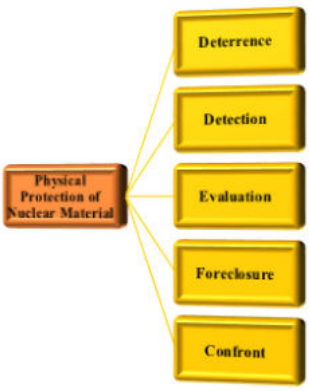
- **Confront.**

Preventing sabotage is addressed by preventing adversaries from accessing or containing nuclear materials before they withdraw those materials from the facility.

The sentinels and the response force, or both must respond faster than they do to prevent unauthorized withdrawals so that adversaries are stopped before they can gain access to nuclear materials or vital equipment that could be sabotaged and whose sabotage could potentially lead to a radioactive release.

Periodic exercises of the response force inside or outside the site shall be conducted to verify the effectiveness of the response systems and the extent of the need to correct or modify the facility's defensive strategies, including the defensive barriers necessary to provide cover for the guards and members of the response forces when trying to confront the attack.

Fig. 4. - The Physical Protection Functions of Nuclear Material



3.6. Discuss the research results.

Countries have long been interested in extending physical protection for nuclear materials and nuclear facilities. This was evident in the signing of the Convention on the Physical Protection of Nuclear Material in 1981 and then to the amendment made to it in 2005 according to which the name of the agreement was changed to the Convention on the Physical Protection of Nuclear Material.

Through the Convention and its amendment, the IAEA has been able to assist countries in establishing, maintaining, and developing national nuclear security systems. The IAEA does this by providing guidance, training, advice, and equipment to member states, as well as by facilitating the exchange of information among them [25].

For Egypt to benefit from the maximum benefit from the assistance and facilities provided by the agency to the member states of the agreement; Egypt should join the Convention on the Physical Protection of Nuclear Material, with the possibility of making some reservations on some of the provisions contained in the amendment that was made in 2005 and which entered into force on May 8, 2016, which we summarize as follows:

- Interpretation of the basic principles for the physical protection of nuclear material and nuclear facilities contained in Paragraph 3 of Article 2A of the 2005 Amendment as mere guidelines that the state must implement to implement the provisions of paragraphs 1 and 2 of Article 2A, and that these principles do not constitute obligations Egypt is obligated to implement legal provisions, as it conflicts with the state's sovereignty and allows directing the state to what might conflict with its national and international interests.
- Reserving the provisions of Article 7 (1) (k) of the 2005 amendment to the Convention on the Physical Protection of Nuclear Material and Nuclear Facilities, which includes "attempting to commit any crime outlined in paragraphs (a) to (e)" for the general nature of the text, and not being limited to one of the crimes mentioned in paragraph 1 of Article 7 specifically.
- Under paragraph 3 of Article 17, Egypt affirms that it does not consider itself bound by the dispute settlement procedures stipulated in paragraph 2 of Article 17 of the 2005 amendment to the Convention on the Physical Protection of Nuclear Material and Nuclear Facilities.
- Reserving what was stated in Paragraph 4 of Article 2 of the 2005 Amendment, concerning the exclusion of nuclear materials that the state decides that there is no need to subject to physical protection, due to the general nature of the text and the lack of precise definition of the type of nuclear material excluded.
- The interpretation of armed conflicts in Article 2 (4) (b) does not apply to wars waged by armed forces against terrorist groups everywhere in Egypt.

3.7. Conflict of interest declaration

The author declares that they have no known competing financial interests or personal relationships that could appear to influence the work featured in this paper.

4. Conclusions.

- The physical protection of nuclear materials plays an essential role in ensuring the safe and peaceful use of nuclear energy [26].
- There is no single international legal instrument that deals with nuclear security in a comprehensive manner.
- The responsibility for the physical protection of nuclear material within each country rests entirely with that state, under its national and international obligations.
- Measures of physical protection of nuclear materials can improve public confidence in the peaceful uses of nuclear applications, and they should not impede international cooperation in the field of peaceful uses of nuclear energy.
- The IAEA assists member states in joining and implementing relevant international legal tools, including the field of nuclear security.
- The Convention on the Physical Protection of Nuclear Material, after its amendment to the Convention on the Physical Protection of Nuclear Material and Nuclear Facilities, has set up a strict security system that largely prevents attacks on nuclear materials and nuclear facilities, and establishes a system for the transfer, passage, use, circulation and storage of nuclear materials inside and outside the country.
- Egypt's accession to the Convention on the Physical Protection of Nuclear Material would strengthen the legislative infrastructure for the Egyptian nuclear program, and encourage the Agency to provide all assistance and facilities necessary for the implementation and development of the program.
- Egypt can adopt Blockchain program technologies due to its vast experience in the nuclear field, and its adoption of systems and techniques related to nuclear security in its management of two nuclear research reactors for a long time.
- Egypt's adoption of Blockchain program technologies will strengthen its role in maintaining nuclear security at the regional level, and help transfer its acquired expertise to neighboring countries in the region [27].

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