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FULFILLING OF NUCLEAR SAFEGUARDS REQUIREMENTS FOR NUCLEAR FACILITIES AT THE NUCLEAR MATERIALS AUTHORITY AND ITS ROLE IN COMPLETING THE NUCLEAR INFRASTRUCTURE IN EGYPT

The object of research is applying the requirements of nuclear safeguards to the processing and mining facilities through which the Nuclear Materials Authority (NMA). One of the most problematic places is the NMA carries out its related nuclear activities as the body responsible for managing and operating those facilities, which must have a prominent role in imposing physical protection on these materials to protect them. During use, storage, or internal transportation, NMA should take all security and legal measures and precautions to prevent Nuclear materials from any seizure and its recovery in the event of any seizure.

In the course of the research it is shown that the implementation of these requirements requires obtaining the necessary license to practice these activities, and that these activities are subject to the control of the Nuclear and Radiation Control Authority, by establishing a system for the safety and security of this nuclear equipment and materials. So that the system covers all equipment, tools, tasks, supplies, equipment, and materials present in any of the Authority's projects and sectors Scientific.

As a result of the research we have reached the importance of applying nuclear safeguards to nuclear facilities in completing the nuclear infrastructure in Egypt and completing the construction of the Egyptian peaceful nuclear program considering international standards issued by the International Atomic Energy Agency (IAEA).

In the future, the proposed approach is In the future, the proposed approach is to establish a general framework for the application of nuclear safeguards procedures to the processing and mining facilities of the NMA. These safeguards are applied as a basis for completing the nuclear legislative infrastructure, the safety of Nuclear Facilities and fulfilling the requirements of IAEA.

This is done by establishing a specialized unit that includes many engineers, geologists and chemists to collect all engineering and technological data, information, designs, and drawings for all nuclear and radiological facilities, activities, and practices existing at the authority under the safety standards written about equipment, tools, devices, supplies, and tasks.

Keywords: *nuclear safeguards, nuclear and radiological facilities, nuclear and radiological practices, nuclear infrastructure.*

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1. Introduction

On March 29, 2010, Law Regulating Nuclear and Radiation Activities No. 7 of 2010 to develop a legal framework that regulates all nuclear and radiological activities within the Arab Republic of Egypt in a manner that guarantees the safety and protection of humans, property, and the environment from radiological hazards [1].

The law also provided for the establishment of the Nuclear and Radiation Control Authority and mandated it to carry out all regulatory work with nuclear and radiological activities. Such as issuing, amending, stopping, renewing, withdrawing, and canceling all types of licenses for nuclear and radiological facilities and activities, personal licenses for those dealing with nuclear radiation, and obtaining all documents, documents, and information related to them.

The law mandates the supervisory authority to carry out all oversight tasks related to these activities. Such as reviewing and evaluating nuclear safety analyzes, conducting regulatory inspections, and setting rules and regulations

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for long-term planning for sites for the disposal of radioactive waste.

On October 17, 2011, Prime Minister Decision No. 1326 of 2011 was issued to issue the executive regulations for the Law on Regulating Nuclear and Radiation Activities, whereby it stipulated that the Nuclear and Radiation Control Authority should take all necessary measures to implement the provisions of the law and issue decisions and the necessary regulations, systems, standards, and technical rules for this [2].

And according to the provisions of the Nuclear and Radiation Activities Regulation Law and its implementing regulations; all mining and processing facilities must be subject to regulatory and supervisory procedures by the Nuclear and Radiation Regulatory Authority.

The Law on the Regulation of Nuclear and Radioactive Activities defined the substantive scope for the enforcement of its provisions by restricting them to Article 3 thereof in the following: «Nuclear and radiological installations, nuclear and radiological activities, and nuclear and radiological practices» [3]. The provisions of the law shall apply to nuclear and radiological installations.

They are the facilities associated with the nuclear fuel cycle – or, more precisely, – with energy production, as it applies to radiation facilities.

They are the facilities that deal or carry out activities involving the presence of radioactive sources, except for nuclear installations and installations for using X-ray machines in the medical field.

The provisions of the law also apply to nuclear and radiological activities, which are activities related to the production, use, and circulation of radioactive sources, all activities related to the management of burial of radioactive waste, and any other practices in which humans, property.

Environment may be exposed to ionizing radiation from natural or industrial sources, except for activities involving the uses of radiation devices, by example, x-ray in the medical field.

The provisions of the law shall also apply to nuclear and radiological practices. They are human activities that introduce more sources or pathways of exposure to ionizing radiation or expand the scope of this exposure to include additional people or modify the network of exposure pathways from existing sources other than activities that involve the use of x-rays in the medical field.

The nuclear fuel cycle includes all processes related to energy production, including mining and processing uranium or thorium ores, converting uranium, uranium enrichment, making nuclear fuel, operating nuclear reactors, including research reactors, reprocessing spent nuclear fuel, and all waste disposal activities. And any development research activities related to any of these processes [4].

So, this research relates to the extent of benefit from following the nuclear safeguards system on the facilities in which the Nuclear Material Authority conducts its research, exploration, and extractive activities, and which are subject to regulation and control by the Nuclear and Radiation Control Authority under international standards and national legislation.

Consequently, the topic of the research seeks to identify the mechanism of the authority's nuclear and radiological facilities, activities, and practices subject to nuclear regulation and control procedures and the necessity for them to fulfill all the requirements and requirements set by the ENNRA, whether those related to management and operation or related to foreclosure and exit from service [5].

Thus, *the object of research* is applying the requirements of nuclear safeguards to the processing and mining facilities through which the Nuclear Materials Authority (NMA). *The aim of research* is suggest the necessary measures to prevent nuclear materials, residues, or radioactive waste from reaching, destroying, losing, or stolen. It's necessary for measuring the impact of applying and extending those national and international standards on all nuclear and radiological installations throughout their life cycle, starting from design until their release out of service and develop it.

2. Methods of research

To achieve this aim, scientific publications were analyzed:
– on means of applying the nuclear safeguards mechanisms established by national legislation and international standards on nuclear and radiological installations and ensuring their achievement;
– the effect of applying standards during work in those facilities to achieve nuclear safety and security for nuclear and radiological installations [6].

Among the methods that were used to measure this impact were a complete description of the activities and the preparation of complete controls to be followed during construction and management in all its stages.

The research is based on the general descriptive, analytical, and quantitative approach based on information, publications, studies, scientific periodicals, and available electronic information sources.

3. Research results and discussion

Egypt has been concerned with implementing nuclear safeguards on all its nuclear and radiological facilities, as it is an important guarantee for the completion of its peaceful nuclear program, the preservation of those facilities, activities, and practices, as well as the preservation of life and property [7].

This interest has been confirmed by the international agreements to which it has acceded, as well as through the nuclear legislative structure, on top of which is the Regulation of Nuclear and Radiation Activities Law No. 7 of 2010, the Egyptian Environmental Law No. 4 of 1994, and many decisions that regulate nuclear activities and nuclear and radiological practices.

3.1. Definition of mining and processing facilities. The Egyptian legislature defined «mining» in the law regulating nuclear and radiological activities as: «The process of extraction from the surface of the earth or its interior for ores that contain radionuclides belonging to the uranium series or the thorium series and any other radionuclides, either in quantities or concentrations sufficient to justify exploitation or when the ore is found accompanied by other minerals, in quantities or concentrations that require radiation protection measures».

The Egyptian legislator also defined «processing» as: «the process by which the extracted ores are milled, concentrated and smoothed or any other process to facilitate the separation of the materials to be used».

Mining and processing are carried out in a facility for processing and processing radioactive ores. Any ores that contain radionuclides belonging to the uranium or thorium

series, either in quantities or concentrations sufficient to justify exploitation, or when ores are found accompanied by other materials that are mined in quantities or concentrations that require taking measures to prevent radiation and treat the radioactive ores resulting from those mines to produce a chemical center [8].

Whether the mining or processing took place after the ore was extracted from the ground, or it was done by extracting uranium from its ores without extracting the ore from the ground. It is a modern method of mining uranium without opening mines or digging tunnels, where an acidic liquid is connected to the uranium ore through a network. From the tubes, the uranium is dissolved from its ores, and then the liquid containing uranium ore is withdrawn.

These two processes take place inside a processing or mining facility or both. Mining and processing are carried out to extract the uranium, which is either found in sedimentary rocks in the form of fine grains emitted in those rocks, especially sandstones and lead, or some igneous and metamorphic rocks, where uranium minerals are mixed with other rock materials in the form of veins or other multiple forms, or phosphate rocks. These rocks are one of the important and necessary resources for the production of uranium, although this importance has decreased a lot in the present era, or it was found in the black sand scattered along the coasts along the seas mixed with some other economic minerals such as magnetite and aluminite with sand, and the uranium minerals can be separated and purified from the black sand.

The Egyptian government authorities are obligated, under the directives issued by the International Atomic Energy Agency, to establish an appropriate legal framework that helps to regulate the control of nuclear and radiological activities, by adopting the legislation and regulations that include the arrangements, standards, and measures that require the fulfillment of these obligations and entrusting this task to the independent supervisory body that is established for this.

3.1.1. Conditions and requirements for operating mining and processing facilities. The Nuclear and Radiation Activities Regulation Law required obtaining the approval of the Nuclear and Radiation Control Authority before authorizing the initiation of any activity related to materials and raw materials that emit ionizing radiation as follows:

– uranium or thorium exploration and evaluation processes;
– extraction or transportation of discovered uranium or thorium ores for testing and extraction purposes;
– construction and operation of mining and processing facilities for ores and materials that emit ionizing radiation;
– to stop the licensed activity in the mining or ore processing facility permanently or temporarily.

The law allows the authority to specify the documents necessary to obtain the approval, and that among them are:

– radiation environmental impact assessment study;
– radiation safety management systems;
– description of the design and construction methods;
– quality assurance plans and project operation.

The law also obligates the licensee to keep records related to the design and construction of any mining and processing projects at the worksite, and obligates it, periodically and regularly, to keep all data related to the estimation of radiation doses, internal exposure to radioactive materials to individuals, and the radiation measurements were taken [9].

3.1.2. Conditions and requirements of scraping mining and processing facilities. The law obliges the licensee to take the necessary measures after the end of the operational life of the mining or processing facility, and to maintain it in a safe and stable condition, and that the radiation emissions are within the limits set by the authority.

The law also did not permit the dismantling of a licensed mining or processing facility before obtaining approval from the authority and submitting a plan for dismantling. The authority specifies rules and procedures for obtaining approval and the measures that must be followed in dismantling.

The Detection or dismantling of any of the mining facilities is done through preparing a plan called the dismantling plan, which includes the method or methods of dismantling, the operational steps for it, its procedures, the means for its suspension, and the period of its implementation.

Detection or dismantling must be done through preparing a plan for managing and disposing of radioactive waste, solid and liquid, which includes how it is handled, treated, temporarily stored, or disposed of permanently [10].

Detection or dismantling – as well – is done through preparing a program for radiation protection, so that it includes how to protect humans from exposure to ionizing radiation, the means necessary to achieve that prevention, and the means to prevent accidents, and scare their effects if they happen.

Detection or dismantling – also – is done through the preparation of a nuclear and radiological contingency plan, which includes a set of procedures to be applied in the event of an accident.

Actions are applied whether those related to contingency planning and preparedness, or those related to what must be taken during the state of emergency, or those related to the following situation: Emergency, that is, after its end.

Finally, detection or dismantling is done by preparing a plan for physical protection of materials, equipment, or supplies, so that the procedures to be followed to prevent include theft or sabotage of any of those materials or tools, or after theft or sabotage.

3.2. The necessary measures to prevent the access, destruction, loss, or theft of nuclear materials, residues, or radioactive wastes.

3.2.1. Legal measures. The Nuclear and Radiation Activities Regulation Law obligated the «licensee» to engage in mining and processing activities to inform the agency – that is, the Nuclear and Radiation Control Authority – immediately of the following:

– accidental or emergency leakage of radiation from the facility or activity;
– quantitative loss or theft may result in radiation hazards from uranium or thorium ores;
– any attempt to breach nuclear security systems;
– any abnormal defect in any of the mine's work systems or the processing unit.

It also obligates it – that is, the licensee – to submit periodic reports to the Authority on the health and safety of workers and on any accident that occurs.

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3.2.2. Physical Protection of Nuclear Materials. The theft, seizure, or embezzlement of nuclear material represents grave risks to human society. These risks stem from the possibility of these materials being used in nuclear explosive devices or as radioactive pollutants, and it is very necessary to put in place a system to protect these nuclear materials [11].

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

3.2.3. What is Meant by Physical Protection? The Law on the Regulation of Nuclear and Radioactive Activities defines «physical protection» as: «A set of systems and procedures aimed at preventing the theft, movement, or transfer of nuclear material without permission, as well as preventing the sabotage of nuclear facilities or attacks on them by individuals or groups. They are thus the administrative procedures and measures. The technology that is used to extend physical protection over the nuclear materials used, stored, and in the process of being transferred, to prevent, impede and prevent their theft or transfer without permission. These procedures and those measures are based on the level of development of the 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, considering the necessity of having these elements in place with the safety of the facility concerned.

3.2.4. Physical protection tasks. For a 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 must be responsible for the following five functions: deterrence, detection, evaluation, obstruction, and response.

3.3. The concept of nuclear safeguards. The Non-Proliferation Treaty is one of the most important international treaties concluded since the end of World War II. As it aimed to stop the nuclear arms race, prevent the spread of nuclear weapons, and instead work towards the use of nuclear energy for peaceful purposes for the development and development of societies and the achievement of human well-being.

The Treaty contains substantive provisions that harmonize the unconditional right of states to use peaceful nuclear energy technology with the obligations they undertake to not use them for military purposes. Among the most important provisions of the treaty [12]:

– the pledge of non-nuclear-weapon states not to manufacture or acquire any nuclear weapons, either directly or indirectly. To this end, the states should sign an agreement with the International Atomic Energy Agency to inspect their nuclear facilities, known as the «Safeguards Agreement»;
– the commitment of the States Parties to the Treaty to facilitate and encourage cooperation among themselves to increase and develop the peaceful uses of nuclear energy. The activities of uranium enrichment or the reprocessing of plutonium are not excluded from this;
– the Treaty recognized the right of any group of States to conclude regional treaties to free their regions from any nuclear weapons in a way that enhances peace and security at the international and regional levels;
– the nuclear-weapon states have pledged to continue negotiations aimed at stopping the nuclear arms race and concluding a treaty on their nuclear disarmament;
– the Treaty guarantees to all state parties, within the framework of exercising their national sovereignty, the right to withdraw from the treaty if they consider that events related to the subject of the treaty have harmed their national interests.

The concept of nuclear safeguards refers to the set of technical measures that the IAEA (International Atomic Energy Agency) applies to nuclear facilities and materials, through which it seeks to independently verify the legal obligation of a state not to misuse nuclear facilities and not to divert nuclear materials from peaceful uses (Fig. 1). States accept these measures through the conclusion of safeguards agreements [13].

Fig. 1. The identiFIDNER device to identify the type and focus of radioactive nuclei (adapted from IAEA [8])

3.3.1. The International Framework for Nuclear Safeguards. Nuclear safeguards are how the IAEA verifies the legal obligations of states under their safeguard's agreements with the IAEA.

IAEA guarantees are part of legally binding agreements. In keeping with the IAEA's statute, states accept these safeguards by entering into such agreements with the IAEA.

Most safeguards agreements are comprehensive safeguards agreements that the IAEA has with non-nuclear-weapon states that are parties to the Non-Proliferation Treaty (NPT) and the Nuclear-Weapon-Free Zone treaties.

The IAEA has so far entered into comprehensive safeguards agreements with 175 countries. About 100 of these countries have also concluded small quantities protocols attached to their comprehensive safeguard's agreements.

Under the Comprehensive Safeguards Agreement, the IAEA has the right and obligation to ensure that safeguards are applied to all nuclear materials in the State's territory, jurisdiction, or control, for the exclusive purpose of

verifying that such materials are not diverted into nuclear weapons or other nuclear explosive devices.

The five nuclear-weapon states that are parties to the NPT have concluded voluntary safeguards agreements under which the IAEA applies safeguards to nuclear material in facilities voluntarily offered by the state and selected by the agency to implement the safeguards [14].

The IAEA applies safeguards under voluntary safeguards agreements to verify that nuclear material remains within peaceful activities and is not withdrawn from safeguards except as stipulated in the agreement.

Safeguards are implemented in three countries that are not a party to the NPT – India, Pakistan, and Israel – based on specific agreements with the IAEA that those states entered with the Agency. Under these agreements, the IAEA applies safeguards to ensure that the nuclear materials, facilities, and other items specified under the safeguard's agreement are not used in the manufacture of any nuclear weapons or to further any military purpose and that these terms are used exclusively for peaceful purposes and are not used in the manufacture of any explosive nuclear devices.

3.3.2. Elements of IAEA Nuclear Safeguards. IAEA safeguards play a central role in preventing the spread of nuclear weapons through independent verification of states' compliance with nuclear non-proliferation commitments. IAEA safeguards are included in legally binding agreements between states and the agency. These agreements provide a legal basis for implementing safeguards.

The legal framework for IAEA safeguards is made up of many elements, including:

– the IAEA statute;
– State obligations under the Treaty on the Non-Proliferation of Nuclear Weapons and treaties establishing nuclear-weapon-free zones;
– Safeguard instruments such as to safeguard agreements, protocols, and subsidiary arrangements of such agreements;
– decisions of the IAEA's Board of Governors.

The IAEA enters into three types of safeguards agreements:

1. Comprehensive safeguards agreements with non-nuclear-weapon states that are parties to the NPT.
2. Voluntary Safeguards Agreements with the NPT states.
3. Safeguards agreements regarding specific items with countries not party to the NPT.

Each of these agreements could be complemented by an additional protocol that includes providing information on, and access to, all parts of the nation's nuclear fuel cycle, from mines to nuclear waste.

Small Quantities Protocol can be concluded in conjunction with a blanket safeguard's agreement. Small quantities protocols are currently available for countries that have little or no nuclear material and no nuclear material in a facility.

3.3.2.1. Safeguards Department (IAEA). The Safeguards Department carries out the duties and responsibilities of its entrusted agency as the world's inspection body for nuclear weapons and supports global efforts to stop the spread of nuclear weapons.

The main role of the administration is to manage and implement IAEA safeguards. It also contributes to nuclear arms control and disarmament, by fulfilling requests for verification and other technical assistance associated with related agreements and arrangements [15].

3.3.2.1.1. Operations Divisions. The administration has three divisions of operations that play a pivotal role in verifying that countries that have safeguards agreements in force do not distort declared nuclear material from peaceful nuclear activities, and there are no indications of nuclear material or undeclared activities in the country.

Each division is responsible for implementing safeguards in a different geographical area:

1. Operations Division (A): Australasia and East Asia.
2. Operations Division (B): Middle East, South Asia, Africa, some non-European countries, and the Americas.
3. Operations Division (C): Europe, Russian Federation, and Central Asia.

3.3.2.1.2. Concepts and Planning Division. This division:

– develops concepts, approaches, and methods related to safeguard nuclear materials, facilities, and activities;
– prepares safeguards policy and guidance documents;
– assists the operations divisions in implementing safeguards issues;
– it supports advisory and policy-making bodies;
– undertakes strategic planning for the department;
– coordinates research and development activities, including management of Member State support programs;
– helps staff from the Member States through training, advisory missions, and guidance documents.

3.3.2.1.3. Information management division. The main task of this division is to operate and develop a group of specialists in the field of information analysis and data processing, as well as receiving, processing, and analyzing accounting data and additional protocol declarations.

The Division evaluates the physical balance as well as the analytical results of nuclear, non-nuclear materials, and environmental samples, and provides other types of statistical support.

It also collects, processes, and analyzes scientific, technical, political, and geospatial literature, and develops and implements new techniques and methodologies for collecting, processing, and analyzing information.

3.3.2.1.4. Technical and scientific services division. This division provides scientific and technical support to the Operations Divisions. This includes the design, development, testing, calibration, installation, and maintenance of safeguards equipment; monitoring equipment performance and contamination; and the logistics of inspection.

3.3.2.1.5. Office of Analytical Services on Safeguards. This office is responsible for analyzing nuclear materials and environmental survey samples, providing materials related to sampling and quality control, coordinating sample shipping logistics, and cooperating with institutions of member states in the network of analytical laboratories. The office comprises safeguards analytical laboratories, including the Environmental Sample Laboratory and the Nuclear Material Laboratory, including an on-site laboratory in Rokasho, Japan.

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The office also includes the Coordination and Support Section, which is responsible for planning, coordinating, and reporting on the analytical results provided by the network; radiation protection; and quality management; training, and other technical support.

3.3.2.1.6. Office of Information and Communication Systems. Within the safeguards department, the Office of Information and Communication Systems (OICS) is the center of competence in identifying, developing, and maintaining information and communication technology systems, and managing all OICS infrastructures and services to support the administration.

OICS infrastructure management is closely aligned with overall corporate operations, strategies, and goals. This article will introduce the concept and history of the term infrastructure, and then take a deeper dive into the word as it relates to technology.

3.3.3. States Position on Implementing IAEA Safeguards. Fig. 2 shows the States' Position on the Safeguards Agreement with IAEA.

3.3.4. Egypt's Position on Implementation IAEA Safeguards. Based on Egypt's pioneering civilizational role, realizing the danger of nuclear weapons to humanity, and believing in the importance of preventing their spread, Egypt was one of the countries that participated in the consultations for the drafting of the NPT Treaty. And Egypt was one of the first countries that signed it on July 1, 1968, and then ratified it in February 1981 [16].

Fig. 3 shows Nuclear Safeguards System in Egypt.

3.3.4.1. Safeguards Agreement with IAEA. Egypt is obligated to apply nuclear safeguards on its facilities and installations according to the Safeguards Agreement signed with the Agency and which entered into force on April 30, 1982, according to Document No. INFCIRC/302, July 1983 [17].

The aim of implementing safeguards is to detect on time the diversion of large quantities of nuclear weapons or nuclear material from peaceful nuclear activities to manufacture nuclear weapons or from other nuclear explosive devices or for unknown purposes, and to deter such diversion through the risks of early detection. To achieve this stated goal, the agreement required the use of accounting as a preventive measure of fundamental importance, with containment and monitoring as important complementary measures. The technical conclusion of the verification activities carried out by the agency is through a statement regarding the measurement of materials in each area.

The agreement obligated the establishment of a national system for accounting and control of nuclear materials so that:

– the agency, when carrying out verification activities, could take full advantage of the accounting and control system in Egypt overall nuclear weapons;
– the materials would be subject to preventive measures under this agreement and avoid what is unnecessary.

The agreement obligated Egypt to inform the agency when it exports or imports any nuclear materials that could enter the nuclear fuel cycle, and the need to establish a unified inventory of all nuclear materials. But the agreement does not apply to materials during mining or ore processing activities, and the agreement also exempted some materials from being subject to safeguards, according to the request of Egypt, regardless of its origin.

The agreement obligated Egypt to inform the agency with information about:

– the design of existing facilities;
– the need to create records on budget areas that include inventory changes, book inventories, physical stocks, and records of operations, especially those related to large changes in the quantities and composition of nuclear waste.

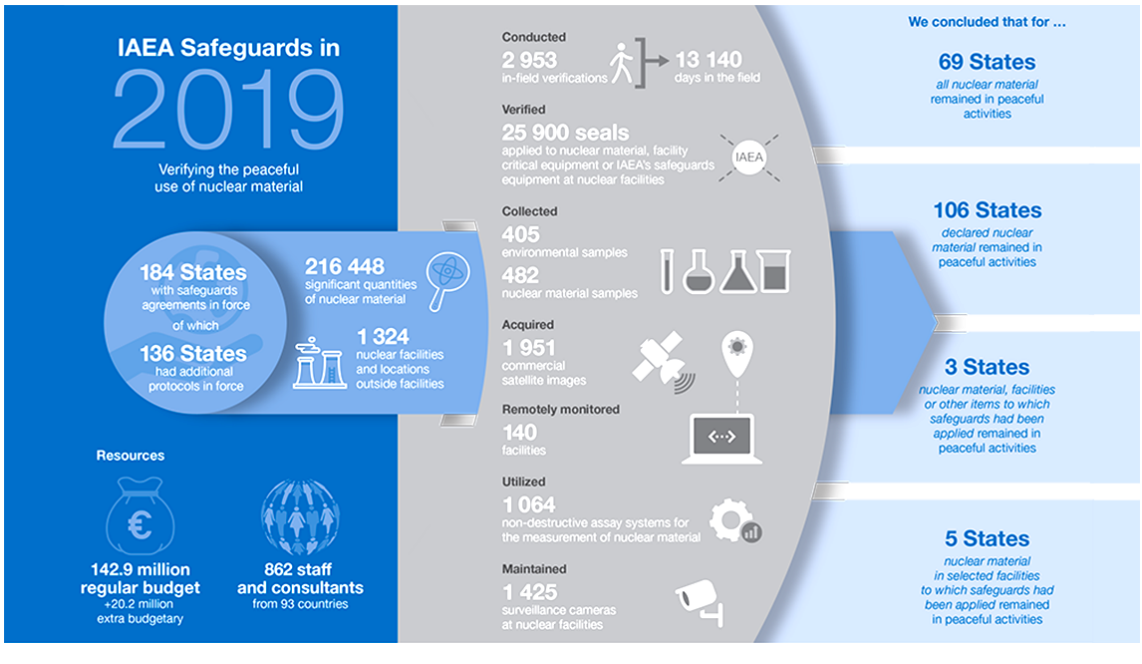

Fig. 2. States' Position on the Safeguards Agreement with IAEA (adapted from IAEA [12])

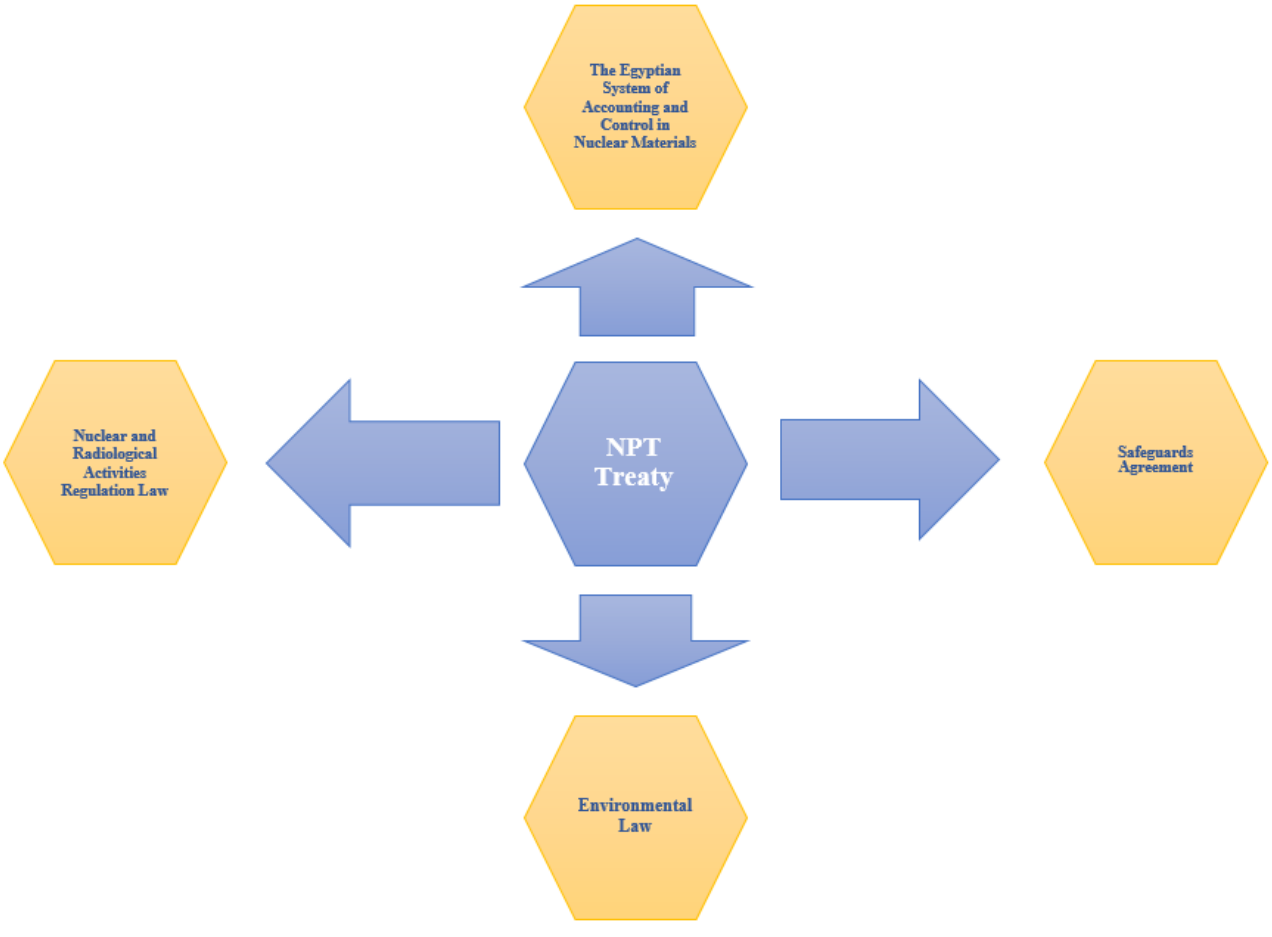

Fig. 3. Nuclear Safeguards System in Egypt (adapted by the author)

3.3.4.2. The Egyptian system for accounting and control of nuclear materials. The Egyptian system of accounting and control of nuclear materials subject to the agreement on the application of safeguards associated with the NPT Treaty between the Arab Republic of Egypt and the IAEA issued by presidential decree No. 152 of 2006 obligated the nuclear bodies to do the following:

– providing the head of the (Regulatory) authority with data and information related to the circulation of nuclear materials within the Arab Republic of Egypt or in any place under its control or supervision, as well as data and information on imports and exports of these materials;

– provide the head of the (Regulatory) authority with all the data and information necessary to fulfill the agency requirements mentioned in the agreement, including the design information;

– early notification to the head of the (Regulatory) authority of the design information, and of any change that occurs to this information.

The Egyptian system for accounting and control of nuclear materials considered «nuclear materials subject to the safeguards application agreement» as hazardous materials and wastes in implementing the provisions of the Environmental Law promulgated by Law No. 4 of 1994, and its implementing regulations [18].

3.3.4.3. The Nuclear and Radiological Activities Regulation Law. The Nuclear and Radiation Activities Regulation Law No. 7 of 2010 mandated the Nuclear and Radiological Regulatory Authority to carry out all regulatory work with nuclear and radiological activities [19]. Articles 25–62 specify:

– the rules and standards for licensing nuclear and radiological installations;

– procedures for inspecting them, the requirements that must be met by the licensee;

– controls for issuing permits and licenses to construct, operate and exit nuclear facilities from service, starting with the site acceptance permit through the construction permit, and permission to conduct pre-tests;

– the operation, fuel loading;

– access to criticality permits for nuclear reactors and critical complexes;

– facility operation licenses;

– exit permit expiry.

Articles 63–96 have also defined mechanisms and controls for confronting nuclear and radiological emergencies, controls for immediate reporting of nuclear and radiological accidents, and controls for reporting to the International Atomic Energy Agency in the event of a nuclear or radiological accident whose danger extends beyond the state's borders.

The ENNRA has also become responsible for implementing all the work of the Egyptian system for accounting and control of nuclear materials in a manner that ensures the inventory and control it inside Egypt.

The ENNRA has also the fulfillment of the basic technical requirements under the safeguards application agreement.

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3.3.4.4. Egyptian Environmental Law. Egyptian Environmental Law No. 4 of 1994 obligated the necessity of assessing the environmental impact of establishments, provided that it includes a statement of the proposals needed to address the negative environmental impacts.

The owner of the facility to keep a record showing the effect of the facility's activity on the environment, with the possibility that the EEAA could follow up the environmental record and matched reality.

The EEAA Take the necessary samples and conducting the appropriate tests to demonstrate the effect of the facility's activity on the environment and the extent of its commitment to the standards set for protecting the environment.

The EEAA identified specific mechanisms and controls for the emergency plan necessary to face environmental disasters [20].

In the implementation of the law, and under the Egyptian system of accounting and control of nuclear materials; The NMA has taken many measures to implement safeguards on its facilities and activities.

The NMA should prepare integrated environmental plans, obtain the necessary licenses for its facilities, activities, and nuclear and radiological practices, and implement all requirements and standards necessary to obtain them.

Given that achieving these requirements and standards requires carrying out many legal, environmental, technical, and technical studies, collecting data, information, designs, engineering, and technological drawings for all the Authority's facilities and activities, which calls for the establishment of a scientific unit for this purpose (Fig. 4).

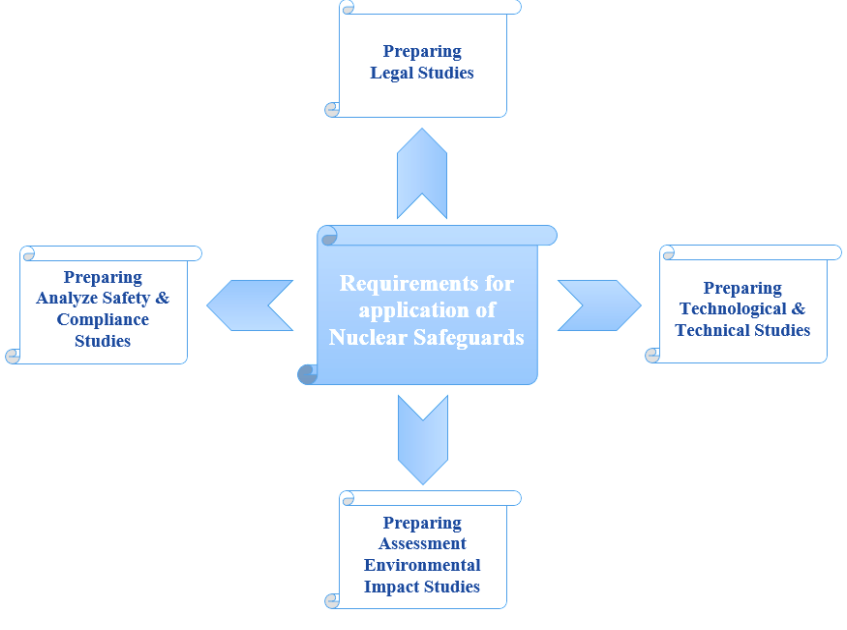

Fig. 4. Requirements for Application of Nuclear Safeguards (adapted by the author)

3.3.5. Discussion of the research results. The NMA is the national authority entrusted with research, detection, and exploration of nuclear raw materials, their exploitation, manufacture, and regulation of their circulation, import, and export.

The NMA under the decision of its establishment issued by Republican Decree No. 196 of 1977 is responsible for managing and operating the processing and mining facilities.

The NMA shall have a prominent role in imposing physical protection on these materials to protect them during use, storage, or internal transportation.

The NMA take all security and legal measures and precautions to prevent their seizure and retrieval in the event of any seizure.

The authority is required to obtain the necessary license to practice these activities and to be subject to those activities. Activities to be monitored by the Nuclear and Radiation Supervisory Authority [21].

The Nuclear and Radioactive Activities Regulation Law obligated the licensee to engage in any nuclear or radiological activity to carry out many tasks.

Among them the establishment of the appropriate administrative structure, the management of the work, and its implementation on an ongoing basis.

Within the framework of the established rules for the protection of people, property and the environment from any risks associated with the practice of work.

The law also obligates the licensee to submit to the Authority all the information, documents, and documents it requires related to the safety and security of the facility.

The implementation of nuclear safeguards work under the terms and requirements of the license, and to submit to the Authority a report on any accident in the facility,

Whether it occurred during an operation or the conduct of maintenance and decommissioning work, especially what is related to the security and safety of the facility or that which is likely to result in radiological effects to humans, property, or the environment.

Establishment of a nuclear security system for its nuclear or radiological facility or for the nuclear materials and radioactive sources affiliated with and possessing them [22].

Through the research, the importance of implementing the nuclear safeguards system on nuclear and radiological activities, and the many positive effects involved in adopting them are discussed.

Also, Egypt's commitment to international standards issued in the matter of nuclear safety and security is confirmed.

Its keenness to move forward with its nuclear program and establish an infrastructure, a strong nuclear infrastructure for this nuclear program are confirmed.

The study was limited to proposing the necessary controls and requirements for licensing nuclear and radiological activities related to mining and processing.

The study did not address nuclear and radiological activities related to converting nuclear materials into nuclear fuel, or nuclear and radiological activities related to the operation of nuclear reactors. Thus due to the deviation of those activities from the activities of the Nuclear Materials Authority, which are the subject of the study.

3.3.6. Recommendations. It is proposed to establish a unit to apply the nuclear safeguards system to nuclear

and radiological facilities, activities, and practices at the Nuclear Material Authority so that it would [23]:

– collecting all engineering and technological data, information, designs, and drawings for all nuclear and radiological facilities, activities, and practices existing at the authority under the safety standards written about equipment, tools, devices, supplies, and tasks;
– collecting all engineering and technological data, information, designs, and drawings for all nuclear and radiological facilities, activities, and practices of the authority to be established in the future under the safety standards defined in advance by the knowledge of the proposed project/unit;
– classification and coding of all data and information collected about all the facilities, activities, and practices of the authority to be a reference and a technical and scientific guide to the safety and security standards for this equipment;
– preparing all legal rules, regulations, and instructions related to the procedures for operating, stopping, or disrupting the operation of all nuclear and radiological installations, activities, and practices in the authority under the safety standards defined in advance with the knowledge of the proposed project/unit. Preparing all legal rules, regulations, and instructions related to procedures for the acquisition, use, storage, and safe transportation of nuclear materials under the safety standards set in advance by the knowledge of the proposed project/unit;
– preparing all the legal rules, regulations, and instructions related to the procedures that must be followed to confront ordinary and extraordinary «emergency» nuclear accidents under the safety standards set in advance by the knowledge of the proposed project/unit;
– preparing all legal rules, regulations, and instructions related to defining the rights, duties, and responsibilities of the persons in charge of the operation, under the safety standards set in advance by the knowledge of the proposed project/unit;
– follow-up, examination, control, and verification of the extent to which those in charge of the operation follow and observe safety standards and identify the problems that resulted from the violation of these rules, the responsibilities arising from that, and the persons responsible for that;
– to revise and develop the legal rules, regulations, and instructions related to safety standards defined in advance, and from time to time, according to the extent of the work need for this development, and to avoid the negative aspects that may mar those rules during implementation [24];
– possession of all documents, documents, reports, and records related to permits and licenses to establish and scrap nuclear and radiological facilities, activities, and practices related to the exploration, evaluation, and treatment of nuclear materials;
– possession of all documents, documents, reports, and records related to permits and licenses to possess, produce, use, trade, and transport nuclear materials and radioactive sources;
– possession of all documents, documents, reports, and records related to permits and licenses for handling, managing, burial, and disposing of radioactive waste and waste;
– possession of all documents, documents, reports, and records related to licenses for persons practicing nuclear and radiological activities;
– controls of inspection, monitoring, measurement, and periodic testing procedures for these establishments to ascertain the extent of their compliance with the operating requirements and requirements issued to them;
– mechanisms of procedures for implementing nuclear and radiological contingency plans; In terms of preparing for it, confronting it, and reporting it;
– procedures controls for cases of destruction, loss, or theft of nuclear materials, or nuclear waste or waste;
– provide the supervisory authority with all documents and documents necessary for the inspection procedures carried out by the supervisory authority and coordinate with it in this regard;
– standards for operating, organizing, and scraping mining facilities for exploration, evaluation, processing, and manufacture of nuclear materials considering the requirements and requirements issued by the regulatory authority;
– the necessary standards for the extraction, handling, transportation, storage, and operation of nuclear materials considering the requirements and requirements issued by the supervisory authority;
– the necessary standards for handling, managing, burying, and disposing of radioactive waste and waste considering the requirements and requirements issued by the supervisory authority;
– the necessary measures to prevent the access, destruction, loss, or theft of nuclear materials, residues, or radioactive wastes, considering the requirements and requirements issued by the supervisory authority;
– measures necessary for nuclear and radiological contingency plans; In terms of preparing for it, how to confront it and report it if it occurs, considering the requirements and requirements issued by the supervisory authority [25].

4. Conclusions

In the course of the research, it is concluded that it is important to:

– the preparing technological, technical, and legal studies for all nuclear material mining and processing sites, including equipment, machinery, tools, devices, sources, and supplies, by collecting data, information, designs and engineering and technical drawings for all nuclear and radiological facilities and activities;
– the practices of the authority, its classification, coding;
– the analysis under the specified safety standards.

Research results will be useful to prepare:

– legal studies related to rules, regulations, and instructions under the standards set by the supervisory authority;
– the necessary physical and radiological studies to analyze safety and adherence to the basic objectives and nuclear safety standards for all nuclear sites;
– environmental studies related to assessing the environmental impact of the activities carried out by the authority in all nuclear sites, establishing an environmental management system, conducting environmental audits, and preparing records of the environmental situation, under local and international requirements and standards.

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Conflict of interest declaration

The author declares that he has no known competing financial interests or personal relationships that could appear to influence the work presented in this paper.

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