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The Legal Protection of the Work Environment in Nuclear Facilities: A Comparative Study between Egyptian and American Laws

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Abstract

This research explores the protection of the work environment in nuclear facilities and their impact on the workers' health. This includes examining the position of the American and Egyptian systems of nuclear safety and security procedures; occupational safety and health procedures; standards and guarantees; the nuclear accidents and compensation for the workers of nuclear facilities.

Keywords: *Nuclear law; Nuclear facilities; Work environment; New pollutants and risks; Nuclear accidents; Social and civil and complementary compensation.*

Introduction

There is no doubt that the aggravation of pollutants in nuclear facilities results in a reduction in production and ultimately puts a negative impact on the country's economic and social development process ([1]). Therefore,

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([1]) The Stockholm Declaration provides: "Both aspects of a man's environment, the natural and the man-made, are essential to his well-being and to the enjoyment of basic human rights and the right to life itself." United Nations Conference on the Human Environment, June 5-16, 1972, Stockholm Declaration of the United Nations Conference *on the Human Environment*, 2, U.N. Doc. AICONF.48/14/rev. 1 (June 16.1972).

most countries have intervened with regulations for the protection of the public environment and the work environment together with other laws such as the nuclear law, in several legislations. The internal legislator intervened to legalize this regulation with deterrent texts and procedures to protect the work environment ([2]); It imposed on employers a general obligation to provide a healthy, safe and secure work environment, coupled with several procedures and measures such as licenses and inspections entrusted to certain administrative authorities. This constitutes a guarantee to monitor the provision of this environment and its freedom from risks. But the legislators stopped at this point and their legislation did not go further than that, so the legislative treatment - especially the Egyptian one - fell short on protecting the nuclear work environment as a qualitative environment of dangerous environments, especially regarding the protection of its human resources, aka workers, which is the subject of research ([3]).

Many legal issues related to the protection of the work environment in nuclear facilities remain problematic for research and regulation. The interest of most legal systems in enacting legislation to protect the environment is recent. This interest was manifested in trying to find various solutions to protect the work environment in nuclear facilities and the mechanisms for activating this protection protocol. These systems found their need in an independent legal regulation of the public environment; they stopped at this point, and did not address dangerous or nuclear facilities.

The Importance of this Research and its Justifications

- The work environment has not attained the protection it deserves for a long time by law.
- Legally securing the work environment in nuclear facilities.

([2]) Ken Silver: *The Energy Employees Occupational Illness Compensation Program*, A New Legislation to Compensate Affected Employees, Mohan Journal, VOL.53, NO.6, JUNE 2005, p.26.

([3]) David M. Bearden: *Environmental Laws: Summaries of Major Statutes Administered by the Environmental Protection Agency*, Congressional Research Service, 7-5700, RL30798, 2013, p.10, OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970, [As Amended Through P.L. 109–236, Enacted June 15, 2006], [Public Law 91–596, December 29, 1970], As Amended Through P.L. 109-236, Enacted June 15, 2006, February 27, 2018.www. crs.gov.

- Identification of environmental pollutants and their jurisprudential and legislative treatment.
- Discussing mechanisms for providing a safe work environment and studying safety and security procedures.

Research Aims

• Identifying the preventive and procedural role played by the concerned authorities to combat the pollution of the work environment.
• Investigate the most important sources of nuclear pollution.
• Demonstrate the efforts and policies of legislation in this field.
• Demonstrate the position of comparative systems.
• Presenting legislative solutions and models.

Section I - Nuclear Work Environment and its Protection

The risks to the work environment have increased. Yet, the search for various sources of nuclear energy and its use in various fields, especially for peaceful purposes, is increasing. Other dangers that are more harmful to the health of the workers and the work environment are emerging, not to mention the various risks of pollution that have increased to the extent of excessive use of chemical, nuclear substances, etc ([4]). Accordingly, the study in this chapter is divided into the following:

Chapter I: Introducing the Nuclear Work Environment and its exposure to Radiation.

Chapter II: Methods and Procedures for Nuclear Safety and Security.

Chapter I Introducing the Nuclear Work Environment and the Radiation Exposure to it

To protect workers from the dangers of nuclear radiation, recommendations were issued by international organizations regarding the rules of prevention, the necessity of prior licensing, and the limits of the radiation dose to which the worker is allowed to be exposed. National Laws were issued adopting these recommendations, and: Egypt's Nuclear

([4]) International Labour Organization: *Mental health in the workplace*, situation analysis United States, Publications of the International Labour Office, CH-1211 Geneva 22, Switzerland, ISBN 92-2-112225-5, First published 2000, p.5.

Law (2010))/ (The American's Energy Policy Act of 2005, Public Law No. 109-58, amended the Atomic Energy Act of 1954), and its executive regulations were issued. Accordingly, the study is divided into the following:

Topic I: The Definition of Nuclear Facilities.

Topic II: The Nuclear Law and the Regulation of the Use of Nuclear Radiation.

Topic I. Introduction to Nuclear Facilities. Defining Nuclear Facilities and Areas of Use of Nuclear Energy

The environment is the space that occupies what surrounds us, so the work environment may be dangerous facilities by nature or according to the materials they use; for example, nuclear facilities (5).

(A) Definition of Nuclear Facilities

Several international conventions have taken the presence of radioactive nuclear material inside a work place as a criterion for its nuclearization, while the Paris Agreement left a supervisory committee with the power to exclude certain types of facilities from the convention's scope of application, in cases where the risks are low (6). Article 1 of the Paris Agreement states: "A nuclear facility means reactors, other than those forming part of a means of transport, plants for preparing or manufacturing nuclear materials, plants for isotope separation from nuclear fuel, radioactive nuclear fuel processing plants and nuclear material storage facilities— except for the storage of these materials during transport - as well as any other facility containing nuclear fuel or

(5) Teall E. Crossen: *Multilateral Environmental Agreements and the Compliance Continuum*, bepress Legal Series, The Berkeley Electronic Press, U.S.A, 2003, p.2. http://law.bepress.com/expresso/eps/36!c 2003. Laure Bertrand, *"Les sources internes: des Lois de protection de la nature à la Charte constitutionelle de l'environnement"*, in Leçons de Droit de l'Environnement, Manuel Gros (Paris: Ellièpses, 2013), p.8.
(6) El-Sayed Eid Nile: *The New Labor Law and Protection of Workers from the Risks of the Work Environment*, Dar Al-Nahda Al-Arabiya, 2004, p. 837.

radioactive products or waste determined by the supervisory committee (7)".

Since the nuclear law is the law that regulates the protection of nuclear facilities from nuclear pollution, the Egyptian Nuclear Law No. 7 of 2010 defined nuclear facilities as: "The institution and its associated buildings and equipment in which nuclear materials are produced, converted, used, traded or stored, or permanently disposed from, excluding uranium and thorium metal extraction and conversion facilities and radioactive waste management facilities".

The nuclear law also stipulates that: "The granting of licenses and permits stipulated in this law shall be in return for payment of the fees indicated in the following: first: nuclear power plants for electricity generation or water desalination: the fee for a single permit is three million pounds, and the operating license fee is one thousandth of the price of the total electric energy produced annually or of the price of the total desalinated water annual (8)".

Therefore, the law gave examples of these facilities: nuclear fuel factories, research and test reactors, critical complexes, nuclear power reactors, nuclear fuel depots, spent nuclear fuel reprocessing plants (9).

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(7) As for the Vienna Convention, its first article states: "nuclear facility means: 1- any nuclear reactor except for the reactor that is supplied by a means of sea or air transportation to be a source of its motive power or any other purpose. 2- any factory that uses nuclear fuel to produce nuclear materials, or any factory. For the preparation of nuclear fuel 3- any equipment intended to store nuclear materials other than the storage necessary in case of transporting such materials.

(8) "..Second: Research and Test Reactors: The fee for a single permit is one hundred thousand pounds, and the fee for operating a license is twenty thousand annually. Third: other nuclear facilities: the fee for a single permit is two hundred thousand pounds, and the operating license fee is one hundred thousand pounds annually. Fourth: radiological facilities: with the exception of licenses for the use of x-ray devices and radioactive isotopes intended for use in the medical field and which are subject to the supervision of the Ministry of Health, the operating license fee is one hundred thousand pounds for the period of the license granted, and the operating license fee for various medical radiological applications is five thousand pounds for the license granted…Fifth: personal licenses for individuals: the licensing fee for the individual for the period of the license granted is ten thousand pounds, and the licensing fee for the individual for various medical radiological applications is one thousand pounds for the period of the license granted".

See Article (32) of the Egyptian Law, Law No. 211 of 2017, amending some provisions of the Law Regulating Nuclear and Radiological Activities, promulgated by Law No. 7 of 2010, Al-Waqa'a Al-Masryah in Issue No. 47 bis "b" issued on November 29, 2017.

(9) Article (2) and Article (3) of the Egyptian Nuclear Law No. 7 of 2010 AD.

While the American Legislator did not define nuclear facilities, but mentioned some types of them. For example, and in several laws, we find many facilities that are not limited to nuclear reactors, but extend in scope to include any facility that deals with nuclear energy sources or those that use nuclear radiation. A case in point is the facilities of the Ministry of Energy that use nuclear energy, centers, laboratories, laboratories and hospitals that deal with radiation and nuclear materials, and mines and tunnels that depend on these radiations.

By comparing the American and Egyptian systems; we find that the Egyptian legislator has done well by setting an explicit definition of the nuclear facility, and specifying the facilities that acquire the status of a nuclear facility, whether they are purely nuclear or related to nuclear activity, while the American legislator did not set a specific definition of the nuclear facility and mentioned pictures of it, and despite that they agreed the two systems have these images as an example; any other facilities can be added to it.

And if we think that it would have been more appropriate for the Egyptian legislator not to exclude from the list of nuclear facilities other facilities for the extraction and conversion of uranium and thorium minerals and radioactive waste management facilities - which the American legislator mentioned - given their seriousness and their own nature and the presence of nuclear elements in such facilities.

Therefore, we can say that the institution or workplace (as a place, buildings, equipment and tools) is described as nuclear when any nuclear materials are used in the production process, and when any nuclear materials used in the workplace are transferred, handled or stored. This means that the association of the word "nuclear" and the word "workplace" lies in what the first requires of a special subjectivity characterized by the danger that affects the second. Thus, when nuclear materials, equipment or waste is present in a work environment, it is described as a nuclear work environment.

(B) Peaceful Uses of Nuclear Energy Sources in Facilities

The progress that many societies have witnessed due to technology has prompted several facilities to expand their activities and use nuclear energy. This energy is used for many peaceful purposes; such as power generation, medical and agricultural uses, archaeology study, space

sciences and other activities in which many facilities are working in the recent times ([10]).

These facilities adapt the nuclear radiation (such as Alpha, Beta and Gamma) emitted by some radioactive elements in order to affect the atoms and compounds of vital substances in humans, animals and plants, modifying their composition, reproduction or growth in benign ways that preserve the integrity of cells and often do not lead to any undesirable negative results. As long as safety precautions are taken into account, in contrast to the use of nuclear energy for military purposes such as the manufacture of nuclear bombs, the activities of these facilities will have no negative consequences ([11]).

There are several uses of a nuclear reactor in the generation of nuclear energy, and electricity. Radioactive isotopes and other radiation techniques are used for many purposes. In the medical field, they can be used for diagnostics, radiotherapy, and sterilization of medical instruments. In the agricultural field, they can be used in land reclamation, and animal production. Radiation can also be used in industry and scientific research… ([12]).

We mention here the multiple uses of peaceful nuclear energy sources regulated by the US Atomic Energy Act: export-licensing systems for highly enriched uranium for use as fuel, scientific research or nuclear tests, as well as the many uses of nuclear reactors, among others. For example, we find the text as follows ([13]): "The Atomic Energy Act of 1954; was

([10]) Veronique Jaworski: *"La Charte constitutionelle de l'environnement face au droit penal"*, Revue juridique de l'environnement, Paris, 2005, p. 177, Vincent Rebeyrol: *L'affirmation d'un 'droit à l'environnement' et la réparation des dommages environnementaux*, Revue juridique de l'environnement, Paris, 2010, p.31.

)[11](https://www.amacad.org/publication/nuclear-liability-key-component-public-policy-decisi -on-deploy-nuclear-energy-southeast/section/5. Ratib Al-Saud: *Man and the Environment,* Dar Al-Hamid, Amman, 2004, p. 100, Abdel-Qader Merbah: *International Law for the Security Use of Atomic Energy*, Kasdi University, Algeria, 2011, p. 19, Amer Tarraf: *Environmental Nuclear Pollution and International Relations*, first edition, Glory of the University Foundation for Studies, Publishing and Distribution, Beirut, 2008, p. 122.

([12]) David M. Bearden: *Environmental Laws,* op.cit, p.10, OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970, [As Amended Through P.L. 109–236, Enacted June 15, 2006], [Public Law 91–596, December 29, 1970], As Amended Through P.L. 109-236, Enacted June 15, 2006, February 27, 2018. El-Sayed Eid Nayel: *The New Labor Law and Protection of Workers,* op.cit, p. 747.

([13]) Nuclear Legislation in OECD and NEA Countries, *Regulatory and Institutional Framework for Nuclear Activities,* OECD 2016. Title 42 contains public health and safety laws, The Atomic Energy Act of 1954 and the Nuclear Waste Policy Act (NWPA). The Code of Federal Regulations (CFR).

determined: The US government is actively developing an alternative fuel or target that can be used in the reactor:

- The design, manufacture or utilization of atomic weapons;
- The production of special nuclear material; and;
- The use of special nuclear material in production of energy…([14])".

We conclude from the text that there are multiple uses of nuclear energy in the United States of America. It is mainly used as a fuel for nuclear reactors, for the production of medical isotopes, and for other commercial and industrial purposes.

Second: Radiation and Pollutants in Nuclear Facilities

(A) Radiation Exposure

Nuclear energy sources have provided many services to humanity. At the same time, they are considered the greatest threat to human life, especially workers who work in facilities that use these nuclear energy sources in various fields, such as mining. Exposing these workers to the danger of these radiations causes them serious diseases; such as cancer, chronic skin, neurological and venereal diseases...etc ([15]).

Radioactive Substances, Nuclear Fuel and Equipment

According to the US Atomic Energy Act, the competent authorities, including the Environmental Protection Agency, can issue licenses to transfer, receive, possess, import or export special nuclear materials or radioactive materials. Although the legislation discusses each category separately, there are general provisions regarding any use of nuclear energy sources and radioactive materials. For example, on July 21, 1995, the Board of the Ministry of Energy issued rules on the "import and export of radioactive waste", which were then amended to regulate the export and import of nuclear equipment and materials to comply with the

([14]) "The Energy Policy Act of 2005, Public Law No. 109-58, amended the Atomic Energy Act of 1954 to permit exports of highly enriched uranium to specific countries (Canada, Belgium, France, Germany and the Netherlands) for medical isotope production in reactors that are either utilizing an alternative nuclear reactor fuel or have agreed to convert to an alternative nuclear reactor fuel when such fuel can be used in the reactor.42 USC 2160d".

, p.263.., op.cit*ogramon PrThe Energy Employees Occupational Illness Compensati*) Ken Silver: [15](

principles of the International Atomic Energy Agency's Code of Practice on the Transboundary Movement of Radioactive Waste. Before the amendments, these rules were primarily concerned with the importance of nuclear proliferation in light of safety standards, while the amendments increased controls on radioactive waste and required specific licenses to export or import radioactive waste, including mixed waste, and other measures to ensure nuclear safety ([16]). In addition, "The term "special nuclear material" means plutonium, uranium enriched in the isotopes 233 or 235, any other material which the NRC determines to be special nuclear material… ([17])".

As for Egypt, the Egyptian legislator provided a definition of nuclear and radioactive materials. Given their danger and significant impact on the environment, the Egyptian Nuclear Law No. 7 of 2010 stipulates that: "They are uranium, or any chemical compounds of these two elements in any concentrations or quantities other than those elements and their naturally occurring compounds, as well as polonium with all its compounds."

(B) Pollution Resulting from the Use of Nuclear Energy

One of the things that accompanies the use of nuclear energy is the creation of nuclear pollution, especially in the absence of the required safety measures. The problem of nuclear or atomic energy waste is one of the most important problems that causes the pollution of the work environment, in the forms of equipment damage, fires, injuries to workers, among others ([17]). For example, medical uses of nuclear energy result in radioactive waste that emits Beta and Gamma rays, among others ([18]).

In general, radioactive pollution was known as the ability to change the natural state of the atoms of bodies (physical change), by converting them into charged atoms with an electric charge, i.e. ionizing them. Therefore,

([16]) Nuclear Legislation in OECD and NEA Countries, *Regulatory and Institutional Framework for Nuclear Activities*, OECD 2016. Title 42 contains public health and safety laws, The Atomic Energy Act of 1954 and the Nuclear Waste Policy Act (NWPA). The Code of Federal Regulations (CFR).

([17])"Atomic Energy Act. 42 USC 2073(a)-2073(c). Nuclear Non Proliferation Act (section 7 "Non-proliferation and exports"). Nuclear Legislation in OECD and NEA Countries, Regulatory and Institutional Framework for Nuclear Activities, OECD 2016. Title 42 contains public health and safety laws.

([18]) Abdel-Qader Merbah: *International Law for the Security Use of Atomic Energy*, op.cit, p.19, Amer Tarraf: *Environmental Nuclear Pollution and International Relations,* op.cit, p. 122.

radiation was called ionizing radiation, which leads to disruption of the biological process because of radiation penetration into living organisms and its spread within the elements of the environment. The radioactive pollution of the work environment is every physical change that affects it, due to the spread of radiation or an increase in its quantity; whether this radiation is from materials used in the production process or because some means contain radioactive materials. Therefore, radioactive pollution is the most dangerous type of pollution, as it does not smell or feel; it enters the body without warning and is not discovered until it is too late ([19]).

Impact of Nuclear Pollution on Workers (and Customers) of Nuclear Facilities

Human beings are exposed to serious risks due to nuclear contamination, especially to their health, working conditions and practicing their activities. Examples of these health risks are burns, nausea, intestinal disorders, and leukaemia, among others. They can also get external pollution. It is deposited on the skin or clothing, and acts as an internal contamination when radionuclides are inhaled, ingested, or enter the bloodstream. In addition, workers in nuclear facilities are among the most exposed to radiation. They are exposed to radiation doses that are high enough to cause severe effects such as burning of the skin or acute radiation syndrome. This may fall under the description of work injuries if strips are available ([20]).

([19]) For details, see Hamidani Muhammad: *Administrative Protection of the Work Environment from Pollution by Ionizing Radiation in Algerian Legislation*, Journal of Law for Legal and Economic Research, Faculty of Law, University of Alexandria, 2009, p. 189.
([20]) Report. 5 Nuclear Regulatory Commission, "NRC Certifies GE-Hitachi New Reactor Design," news release, September 16, 2014, www. Nrc. Gov…U.S. Court of Appeals for the District of Columbia Circuit, National Association of Regulatory Utility Commissioners v. U.S. Department of Energy, No. 11-1066, First Edition, United Nations Mine Action Service (UNMAS), USA, September 1, 2007, pp. 10-12.

Topic II. Nuclear Law and Regulation of the Use of Nuclear Radiation

First: International Regulation for the Protection of Nuclear Facilities

The International Atomic Energy Agency is one of the most important international entities that have striven to protect facilities from nuclear radiation and achieve nuclear security. It was concerned with setting international rules for the protection of facilities from radiation and the dangers of nuclear pollution. It developed a safety guide for nuclear reactors and stipulated certain conditions in a nuclear reactor that must be met, so that it can be exploited without risks, together with developing precautions for treating radioactive materials. It also laid out guidelines for monitoring and preventing radioactive pollution affecting workers, individuals and the environment, and the optimal treatment and disposal of radioactive waste. The Agency has made great efforts regarding the peaceful use of atomic energy. As the rules and data related to the handling of fissile materials and waste were developed without notification, the rules and regulations necessary for the handling of radioactive isotopes were issued in 1958, with implemented provisions, to ensure that fissile material is not used for services, equipment, facilities and data provided by it. Among the most important international agreements concluded by the agency is the convention on civil liability for nuclear damage in 1963, and its protocol in 1980([21]).
Accordingly, international agreements have focused on the issue of nuclear safety and environmental protection, among their main objectives. Also, there is the position of the nuclear safety agreement, which determined that the objectives of the agreement are to preserve nuclear facilities from potential nuclear radiation risks in order to protect

([21]) As well as the most important international agreements concluded by the Agency: the Convention on Civil Liability for Nuclear Damage in 1963 and its Protocol in 1988, the Convention on the Prevention of Marine Pollution by Marine Pollutants and Other Things in 1956, the International Convention on Nuclear Safety of September 20, 1994, through which it called for the adoption of basic principles about Safety and security of nuclear facilities, and the Agency's member states report without delay on major accidents in order for the Agency to provide the necessary assistance in case of emergency to protect humans and the environment from atomic radiation. Abdul Sattar Younis al-Hamdouni: *Criminal Protection for the Environment,* op.cit, p. 3.

individuals, society and the environment from the harmful effects of ionizing radiation emanating from these facilities ([22]).

Second: The Internal Legislative Organization for the Protection of Nuclear Facilities

The dangerous nature of nuclear facilities required special legislative rules appropriate to their nature and the gravity of their risks, especially the protection of individuals and property from exposure to them. This necessitated new legal rules to regulate the relations arising from the use of nuclear energy or the disposal of its waste, as the existing legal rules for regulating these relations proved insufficient. This prompted the legislators of many countries to regulate the said relations, through a special law, i.e. the nuclear law, the atomic law, or the Atomic Energy Law ([23]).

Nuclear law is defined as a set of rules regulating the conduct of natural and legal person's activities related to use of fissile materials, ionizing radiation and exposure to natural sources of radiation. It works to protect against the dangers of radiation associated with the peaceful use of nuclear energy and radioactive materials. This law regulates many topics, the most important of which are: nuclear facilities, transporting nuclear materials, radiation protection and radioactive sources used in medicine and industry. Therefore, the nuclear law is defined as a set of legal rules regulating the peaceful uses of nuclear energy and protection against the risks arising from it ([24]).

In the United States, the most important nuclear legislation for governing nuclear facilities is the Atomic Energy Act (1954, 42 USC 2011), which is a comprehensive federal law regulating the acquisition of the use of radioactive materials and Nuclear facilities. This does not mean that there

([22]) For more details see Article 1 of the Nuclear Safety Agreement, 1994.

([23]) See CRS Insight. 4 Senate Committee on Appropriations, *"FY15 Subcommittee Reported Bill and Draft Report,"* July 24, 2014. U.S. Court of Appeals for the District of Columbia Circuit, National Association of Regulatory Utility Commissioners v. U.S. Department of Energy, No. 11-1066, decided November 19, 2013.

([24]) A. M. Ali and A.E. Abd El-Moniem: *The Puplic Opinion Participation in the nuclear, faeilities lieensing regime*: A Study for The Egyptian, nuclear law and other countries laws, A. M. Ali and A.E. Abd El-Moniem, *Egyptian nuclear and radiological regulatory authority (ENRRA)*, Eleventh Arab Conference on The Peaceful Uses of Atomic Energy, Republic of Sudan, 2012, pp.3-4. El-Sayed Eid Nayel: *The New Labor Law and Protection of Workers*, op.cit, p. 753. Ahmed Rashad Mahmoud Salam: *Responsibility for nuclear pollution within the framework of the rules of private international law,* op.cit, pp. 22-24.

are no other laws. In fact, there are other laws besides the Atomic Energy Act for such regulation; they all work to regulate radioactive materials in facilities. States can adopt standards that are stricter than federal standards, governing the use of nuclear activities, as long as they do not violate the general rule of federal law. Under (Article 274), the state may set standards for regulating the various uses of nuclear energy under its regulatory authority ([25]).

In addition, the Egyptian legislator issued Law No. 7 of 2010 regulating nuclear and radiological activities. Egypt is one of the pioneering developing countries interested in using nuclear energy for peaceful purposes. Egyptian legislator - in accordance with Law No. 7 of 2010 regulating nuclear and radiological activities – shall address the role of the Nuclear Control Authority in its application, whether by setting licensing systems for these facilities or issuing periodic reports on the nuclear and radiological situation or the nuclear safety situation in environmental facilities and surrounding areas.

From the above, we can say that the nuclear law, or the Atomic Energy Law, is devoted to both ideas of sustainable development and the treatment of pollution. It aims to preserve uranium stocks and all natural resources that are affected by radiation, in order to protect future generations. It also regulates the use of uranium, taking into account measures to preserve the nuclear environment on the one hand, and to regulate nuclear civil liability, most notably the operator's responsibility for damages to nuclear facilities, on the other hand.

Chapter II. Methods and Procedures for Nuclear Safety and Security

The legislator -in many countries - issued the Environmental Protection Law and the Nuclear Law, in addition to regulating nuclear safety procedures and means in the Labour Law. It contributed to the establishment of what is known as nuclear safety standards in the work environment. Accordingly, the study is divided into the following:

Topic I: The Definition and Application of Nuclear Safety Standards.

Topic II: Means of Nuclear Safety.

([25]) Nuclear Legislation in OECD and NEA Countries, *Regulatory and Institutional Framework for Nuclear Activities,* Title 42 contains public health and safety laws, The Atomic Energy Act of 1954 and the Nuclear Waste Policy Act (NWPA). The Code of Federal Regulations (CFR).

Topic I. The Definition and Application of Nuclear Safety Standards

First: Defining Nuclear Security and Safety

(A) Defining Nuclear Security and Safety in Installations

Undoubtedly, the availability of nuclear security for installations and their activities must be top priority. However, the means and procedures for achieving this may vary from one country to another. In this regard, Article 3 of the Egyptian Nuclear Law states: "nuclear security is to prevent, detect and respond to theft, loss, acts of sabotage, unauthorized entry, and transportation". Furthermore, nuclear security is concerned with preventing illegal and other sinful acts related to nuclear materials or other radioactive materials or their facilities, and breaches related to the security of their documents, information systems and computers. That is, nuclear safety is concerned with providing peaceful operating conditions and preventing accidents or mitigating their effects in a way that protects workers, the public and the environment from radioactive risks unexplained ([26]).

The term "nuclear safety" expresses the set of measures taken to ensure the normal operation of the nuclear facility, and to prevent accidents or reduce accidents or reduce their effects in their various stages: design, construction, commissioning, use, final shutdown, dismantling, and the Egyptian Law adopted this definition. No. 7 of 2010 in Article (3), which defines nuclear security as: "Providing operational conditions, preventing accidents and mitigating their effects in a manner that achieves protection for workers and the public from unjustified radioactive risks ([27])". The Egyptian Nuclear and Radiological Control Authority's support the

([26]) Law No. 2011 of 2017 amending some provisions of the law regulating nuclear radioactive activities promulgated by law No. 7 of 2010, Egyptian gazette in issue No. 47 bis "b" issued on November 29, 2017. John Howard and Frank Hearl: *Occupational Safety and Health*, Ph.D. thesis, Hwayne Huizenga School of Business, Nova Southeastern University, 2004, p.82.

([27]) This, and some jurisprudence distinguishes between the term "nuclear safety" and the term "nuclear security"; Where the first relates to the safety of persons, funds and environmental property from nuclear activities, while the second means all measures aimed at preventing and detecting theft and preventing sabotage, unauthorized entry, illegal transportation and hostile acts related to nuclear materials and radioactive materials or their installations. Ahmed Rashad Mahmoud Salam: *Responsibility for Nuclear Pollution,* op.cit, p.24.

nuclear security system, in a plan for the main activities related to the nuclear security infrastructure, during:
1) Identifying the main activities for building an effective and sustainable nuclear security system.
2) Providing a comprehensive framework to address national needs to strengthen the national nuclear security system.
3) Identification of the entities responsible for performing and implementing activities related to nuclear security.
4) The plan is considered as a guiding framework in accordance with the International Atomic Energy Agency in the field of nuclear security.
5) Preparing the national plan to prepare for and confront nuclear and radiological emergencies.
6) Equipping the nuclear and radiological emergency management operations room.
7) Supporting the medical preparedness system for nuclear and radiological emergencies.

(B) Definition of Nuclear Safety

Nuclear Safety is a term that means taking all possible measures to prevent nuclear and radiological accidents, and is defined by the International Atomic Energy Agency as: achieving appropriate operating conditions and preventing accidents or mitigating the effects of accidents, thus protecting workers, residents and the environment from unnecessary radiation risks ([28]).
Nuclear safety standards that are more stringent are needed and six main areas for improvement have been proposed:
• Operators must plan for events outside the design rules.
• More stringent standards to protect nuclear facilities from terrorist.
• A stronger international emergency response.
• International reviews of security and safety.

([28]) Public Law 91 - 596 91st Congress, S. 2193 December 29, 1970 As amended by Public Law 101-552, §3101, November 5, 1990, the Senate and House of Representatives of the United States of America in Congress assembled, that this Act may be cited as the "Occupational Safety and Health Act of 1970." http://www.prnewswire.com/news-releases/southern-company-subsidiary-doe-finalizevogtle-nuclear-project-loan-guarantees-246395221.html. 3 See CRS Insight. 4 Senate Committee on Appropriations, "FY15 Subcommittee Reported Bill and Draft Report," July 24, 2014, http://www.appropriations.senate.gov/news/fy-2015-ew-subcommittee-reported-bill-and-draft-report. 5 Nuclear Regulatory Commission, "NRC Certifies GE-Hitachi New Reactor Design," news release, September 16, 2014.

• Binding international standards on safety and security.
• International cooperation to ensure organizational ([29]).

(C) Nuclear Safety Systems in Facilities

The three main objectives of nuclear safety ([30]):
1. Shutting down the nuclear reactor or facility if there is doubt about their danger.
2. Keeping the nuclear energy sources and radioactive materials safe and secure in the event of shutdown.
3. Preventing the release of radioactive materials during accidents to control their dangerous effects.
Therefore, the safety and security of nuclear facilities depends on the quality of maintenance and training, the competence of the operator and labour, and the rigor of regulatory oversight. For example, newer reactors are not always safer than older ones; older reactors are not necessarily more dangerous than newer reactors. A nuclear accident occurred in the United States, in 1979, with a reactor that had started operating only three months before the accident, while the Chernobyl disaster occurred two years later. So new reactor designs are developed with the aim to provide more safety and security over time. These designs contain emergency, nuclear safety and associated cooling systems ([31]).

Safety Standards Regarding the Treatment of Nuclear Pollution in the Work Environment

"Section 5: (a) each employer - (1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical

([29]) Michel Workman: *The effects of cognitive style and communications media on commitment to telework and virtual team innovations among information systems teleworkers,* Ph.D. thesis, Georgia State University, 2000, pp.50-52.
([30]) http://www.prnewswire.com/news-releases/southern-company-subsidiary-doe-finaliz-evo -gtle -nuclear-project-loan-guarantees-246395221.html. 3 See CRS Insight. 4 Senate Committee on Appropriations, "FY15 Subcommittee Reported Bill and Draft Report," July 24, 2014, U.S. Court of Appeals for the District of Columbia Circuit, National Association of Regulatory Utility Commissioners v. U.S. Department of Energy, No. 11-1066, decided November 19, 2013.
([31]) U.S. Department of Labor: *Occupational Safety and Health Administration*, op.cit, p.22. www.osha.gov. www. cadc.uscourts .gov /internet/opinions.nsf/ 2708C01ECFE-3109F85257 C2800 53406E/$file/11-1066- 1466796.pdf.

harm to his employees; (2) shall comply with occupational safety and health standards promulgated under this act, (b) each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this act which are applicable to his own actions and conduct([32])".

With regard to the situation of the Egyptian legislator, the labor law obligates employers to provide means for occupational safety and health in the workplace. This is to ensure the prevention of work risks and damages, such as mechanical risks natural risks, or negative risks arising from damage or danger from their lack of availability, i.e., lack of rescue and of hygiene means, nutrition…etc ([33]).

Accordingly, it is clear that the American legislator has obligated the owner of the nuclear facility - a natural person or a legal person - to observe the controls and regulating procedures in this regard, the implementation of which is monitored by the Atomic Energy Council. This gives the owner of the nuclear facility - when issuing the license - a guide to these standards to protect the resources of the nuclear environment - human and material - whether it is tools used, clothes worn, devices installed or used, among others. As for the Egyptian legislator, he/she set the general principle, which is the obligation of the owner of the facility to provide means of safety and professional security to protect the nuclear environment and its resources from potential dangers.

Ways to Prevent Contamination by Nuclear Radiation

There are preventive and curative measures and procedures that the state uses to protect the work environment in nuclear facilities. These measures are followed in the American system, as follows ([34]):

i. Monitoring facilities, their annexes, and other places that contain radioactive sources or devices that emit nuclear radiation.

([32]) Public Law 91 - 596 91st Congress, S. 2193 December 29, 1970 As amended by Public Law 101-552, §3101, November 5, 1990, the Senate and House of Representatives of the United States of America in Congress assembled, that this Act may be cited as the "Occupational Safety and Health Act of 1970".

([33]) (Sec.3)/ Egyptian Law No. 211 of 2017 amending some provisions of the law regulating nuclear and radiological activities, promulgated by Law No. 7 of 2010, Egyptian Gazette in Issue No. 47 bis "b" issued on November 29, 2017.

([34]) Mark Holt: *Nuclear Energy Policy,* op.cit, pp.12-14. www.crs.gov.

ii. Take measures and procedures for nuclear safety and security within the facilities in order to ensure the establishment of an organization for the prevention of radiation accidents.
iii. Nuclear facilities must keep a numbered and marked daily record in order to monitor the condition of the facility.
iv. Take measures to inform and notify workers who handle nuclear radiation sources.

Finally, the Safety and Security Standards in Nuclear Facilities are numerous, including ([35])

i. The facility owner takes measures to treat and remove nuclear hazards that pollute the work environment, after informing workers about them or if they discover their existence.
ii. Working on developing standards for the use and handling of hazardous materials in nuclear facilities.
iii. Providing personal protective equipment for workers, informing them about this equipment, and inspecting the extent of their commitment to using this equipment in the nuclear work environment.

Topic II. Nuclear Safety

First: The Requirement that Nuclear Facilities Obtain the Necessary Licenses

Nuclear facilities are not considered ordinary as other facilities because of its hazardous nature, resulting from the hazardous nature of nuclear materials and waste. Therefore, no nuclear facility can start operating without obtaining the necessary licenses and ensuring its safety and security of its equipment. For example, in the United States of America the Atomic Energy Board licenses all commercial nuclear power reactors before commissioning, and after ensuring the safety and security of the facilities, in accordance with the Atomic Energy Act of 1954 and the Energy Reorganization Act of 1974. In addition, the authority is delegated to the director of the office of new reactors for the issuance of specific licenses, modifications, certificates, permits and work permits (10/CFR/sec.52). For example, this council has two different methods

([35]) Loc.cit. Tammy McClanahan Johnson: *Factors that affect sales persons' performance in virtual environments,* Ph.D. thesis, University of Phoenix, February 2004, pp.57-58.

for licensing nuclear power plants, which include issuing a permit for the requirements of the nuclear power plant construction facility, followed by an operating license that allows the facilities to operate the plant ([36]).
licensing is carried out in two steps as follows: "10 CFR Part 52: licensing process through:

- Early site permits, which resolve site suitability issues, including suitability of the site for emergency preparedness and the existence of environmentally superior sites.
- Design certification rule making for specific nuclear power plant designs.

Combined licenses, which avoid the need for issuance of a construction permit and a separate operating license ([37])".

Operating License Renewal

The US Atomic Energy act permits the renewal of a nuclear facility operating license, and the procedures and requirements for such renewal and operating licenses are defined (Section/10CFR, Part 54), and a new license may be issued to nuclear facilities after the current operating license expires (10/CFR/54.31) ([38]).
While in Egypt, the Egyptian nuclear law stipulates that: "The granting of licenses and permissions stipulated in this law shall be in return for payment of the fees indicated…, fourth: ... The operating license fee for various medical radiological applications is five thousand pounds for the license granted. Fifth: personal licenses for individuals: the license fee for the individual for the period of the license granted is ten thousand

([36]) "Nuclear facilities owned and operated by DOE are not subject to licensing by the NRC, except for those facilities specifically enumerated in the Energy Reorganization Act of 1974. 42 USC 5842. An explicit exclusion from NRC licensing of utilization facilities of the department of defense is contained in 42 USC 2140". The Energy Policy Act of 1992 added new sections 185(b) and 189(a)(1)(B) to the atomic energy act. nuclear legislation in OECD and NEA Countries, regulatory and institutional framework for nuclear activities, OECD 2016. Title 42 contains public health and safety laws, the atomic energy act of 1954 and the nuclear waste policy act (NWPA). The code of federal regulations (CFR).
([37]) Nuclear legislation in OECD and NEA countries, regulatory and institutional framework for nuclear activities, OECD 2016. Title 42 contains public health and safety laws, The atomic energy act of 1954 and the nuclear waste policy act (NWPA). The code of federal regulations (CFR).
([38]) NRC (2013), "The United States of America National report for the convention on nuclear safety (NUREG-1650).

pounds, and the licensing fee for the individual for various medical radiological applications is one thousand pounds for the period of the license granted ([39]).
Thus, it is clear that the positions of the American and Egyptian regimes are identical, in terms of the requirement that nuclear facilities shall obtain licenses from the specified authorities before starting operation. This is to ensure the safety and security of the facility and to ensure the availability of nuclear safety procedures and means for facilities that use materials of a dangerous nature to this environment and the surrounding environments. Any facility must first obtain a license and then start operating. This means that it is prohibited from using any nuclear materials or disposing of nuclear waste without obtaining prior licenses.

Second: Inspection of Nuclear Facilities

Inspection is an effective way to ensure that the employer complies with the legally defined rules and procedures in the field of occupational safety and health, and obliges the employer to comply with them, voluntarily or compulsorily. It is a well-known mechanism in all legal systems ([40]).

A) Operation and Inspection for Nuclear Safety

The US atomic energy act regulates the subject of nuclear inspection and safety; it required that each operating license and license for any nuclear facility contain detailed provisions relating to safety, security and environmental protection. Then, the licensed facility is subject to a periodic inspection during the period of operation; each site has at least one inspector who devotes his/her full attention to the facility during operation. The US legislator has entrusted the inspection task to the occupational safety and health administration, which is affiliated with the Ministry of Labor. Many agencies or departments working in this field are

([39]) See Article (32) of the Egyptian Law, Law No. 211 of 2017, amending some provisions of the law regulating nuclear and radiological activities, promulgated by law no. 7 of 2010, Al-Waqa'a Al-Masryah in issue no. 47 bis "b" issued on November 29, 2017. And see also the executive regulations, Prime Minister's decision no. 1326 of 2011, issuing the executive regulations law regulating nuclear and radiological activities promulgated by law no. 7 of 2010, official gazette, no. 42 (bis), fifty-fourth year, Dhu al-Qa'dah 28, 1432 AH, corresponding to October 26, 2011 AD.
([40]) Anthony Heyes: *Implementing Environmental Regulation: Enforcement and Compliance, Department of Economics*, Royal Holloway, US, 1995, p.4.

affiliated with it; such as the environment agency, for instance. This administration exercises its oversight jurisdiction in all work environments of all kinds ([41]).

However, it exempted nuclear facilities related to national security from being inspected by the department of labor's department of labor safety and health. This does not mean that these facilities are not subject to any inspection, but rather the opposite. The task of inspection was entrusted to another party, in order to achieve national security. Many special inspections are carried out by the regional offices of the Atomic Energy Board. There are collective inspections that are dealt with by the regional offices or the headquarters of the Atomic Energy Council. The results of the inspection activities of the council are documented in the inspection reports, which reflect the focus on risk assessment and the focus on programs of corrective actions required for the safety and security systems of the nuclear facility. Furthermore, there is a set of procedures and measures available to the council. For example, it may impose civil penalties, or may request modification, suspension or revocation of licenses ([42]).

Also in Egypt, article 33/paragraph 2 of the nuclear law states: "The authority's inspectors shall have the capacity of judicial control officers in

([41]) For example, the United States Council on Chemical Safety, an agency of the Occupational Safety and Health Administration, is allocated a total budget of $11 million in fiscal 2018, with an increase each year, to enable it to perform its role in inspecting and analyzing the root causes of major chemical accidents, and prevention in the future, and one of his tasks is also to work to improve conditions and understand the safety risks to workers and facilities. We also find the environment agency (one of the agencies of the department of occupational safety and health) carrying out inspection tasks and ensuring the implementation of the provisions of the law and the implementation of regulatory decisions regarding environmental protection. This agency has wide powers of inspection and entrusts the inspectors to carry out their supervisory duties in the facilities. Nuclear legislation in OECD and NEA countries, *regulatory and institutional framework for nuclear activities,* OECD 2016. Title 42 contains public health and safety laws, The Atomic Energy Act of 1954 and the Nuclear Waste Policy Act (NWPA). The code of federal regulations (CFR), congress.gov, "H.R.1309 - workplace violence prevention for health care and social service workers act," accessed April 2, 2019. Congress.gov, "H.R.1074 - Protecting America's Workers Act," accessed April 2, 2019. Congress.gov, "S.1082 - A bill to prevent discrimination and harassment in employment," accessed April 11, 2019. Anthony Heyes: *Implementing Environmental Regulation: Enforcement and Compliance,* op.cit, p.4.

([42]) Nuclear Legislation in OECD and NEA Countries, *regulatory and institutional framework for nuclear activities,* OECD 2016. Title 42 contains public health and safety laws, The Atomic Energy Act of 1954 and the Nuclear Waste Policy Act (NWPA). The Code of Federal Regulations (CFR).

proving what is considered a violation of the provisions of this law and its executive regulations and the decisions implementing them." The legislator also obligated the ministry of manpower to establish a body to inspect facilities in the field of occupational safety, and health and work environment to ensure the effectiveness of legal texts, decisions and regulations aimed at protecting workers and their safety from risks. Yet, establishments whose work is related to national security are excluded from inspection, by the Occupational Safety and Health Authority, taking into account the nature of the work of these establishments and the confidentiality they require. Such establishments are subject to the inspection apparatus of the Ministry of Military Production, in accordance with the Prime Minister's resolution no. 982 of 2003, regarding the identification of facilities whose work is related to national security. Its first article states that: "The Ministry of Military Production shall inspect the following facilities," specifying (16) facilities, all of which are subject to the inspection body of the Ministry of Military Production ([43]).

Thus, the American and Egyptian systems have agreed on the obligation to inspect all nuclear facilities and other facilities that use or deal with radioactive materials, with a distinction between the authorities entrusted with the task of inspection. That is, they entrusted sovereign bodies with the task of inspecting nuclear facilities related to national security, and perhaps this is due to the paramount importance of these facilities that calls for maintaining the confidentiality of their equipment and information, while they assigned the regular inspection bodies to carry out their mission for the rest of the nuclear facilities.

([43]) The Egyptian legislator organized the inspection in the field of occupational safety and health and the work environment in chapter five of book five of labor law no. 12 of 2003, in articles 224, 225, 226, as well as article 232. See in detail law no. 2011 of 2017 amending some provisions of the law regulating nuclear radioactive activities promulgated by law No. 7 of 2010, Egyptian gazette no. 47 bis "b" issued on November 29, 2017, Egyptian Gazette No. 137, dated 06/21/2003, also see Fatima Mohamed Al-Razzaz: *Protecting the work environment and securing Safety of the Worker in Egypt,* Journal of the Union of Arab Universities for Legal Studies and Research, No. 20, 2004, p. 258.

(B) Entities Responsible for Supervising and Regulating Nuclear Activities:

Environmental Protection Agency in the US System:

The environmental protection agency plays a vital and important role regarding the protection and security of the environment in general, and the work environment in particular, starting with granting licenses to facilities; following up on that; withdrawing the license and suspending it temporarily or permanently; developing guiding models for procedures and instructions related to occupational safety and health as well as always monitoring facilities. For example, it does the following ([44]):

i. Restricting establishments in the use of PCBs with certain controls, and restricting establishments to sales of elemental mercury...
ii. Adding five restrictions to address specific concerns for asbestos, radon, lead, among others.
iii. Providing assistance in declaring the efficiency of nuclear energy sources.
iv. Monitoring how to control unreasonable risks previously known or discovered, and monitoring the implementation of such use.

Considering the possibility of nuclear damage from the use of hazardous materials at different times: during the manufacturing, processing, transportation or disposal of waste, the import and export stages, or other stages required by the nature of the work in the facility. The US environmental protection agency expands its oversight role to include these stages; you do the following ([45]):

1) Control over manufacturing and processing…
2) Control over emissions or releases of hazardous materials.
3) Oversight on the number, duration and effects of occupationally exposed persons (nuclear plant workers).
4) Monitoring the extent of non-occupational human exposure.

([44]) (The Toxic Substances Control Act (TSCA, 15 U.S.C. 2601 ET seq). For more information, CRS Report RL33152, The National Environmental Policy Act (NEPA): *Background and Implementation, Federal Environmental Pesticide Control Act of 1972,* P.L. 92-516, Section2. Jerry H. Yen, *Analyst in Environmental Policy, Environmental Policy Section,* Resources, Science, and Industry Division, Congressional Research Service, p.55. Sven-Erik Kaiser, U.S. EPA, Office of Congressional and *Intergovernmental Relations, personal communication,* p.62, December 16, 2011.

)[45](David M. Bearden: *Environmental Laws:* Summaries of Major Statutes Administered by EPA, op.cit, pp.67-68. www.crs.gov. An explanation of EPA's "Environmental Impact Statement (EIS) Rating System Criteria" is available at http://www.epa.gov/compliance.

5) Monitoring the similarity of the dangerous or nuclear substance in the facility to any other substance found in the general environment.
6) Monitoring the existence of data related to the environment or the health effects of nuclear and radiological materials, and information that may be obtained through nuclear tests.
7) Oversight regarding the availability of facilities and workers to conduct tests for the suitability of using dangerous substances.

National Institute for Occupational Safety and Health (NIOSH)

The national institute for occupational safety and health of the US department of labor/department of energy plays a vital role in protecting and securing the nuclear work environment ([46]). Among the functions entrusted to this council are ([47]):

i. Working on developing guidelines to be followed in any facility whose workers are exposed to radiation.
ii. Determining and estimating the safe and permissible radiation doses for workers to be exposed to, and whether there is a possibility that these doses may endanger the health of workers.
iii. Allocating records and a database for workers and facilities that deal with nuclear materials.
iv. This list is published in the federal register and is updated.

Entities Responsible for Oversight and Regulation in Egyptian Law (for Nuclear Facilities)

The nuclear law stipulates: "The ministries of defense, interior, and foreign affairs, and other relevant ministries of civil aviation, transport, the Suez Canal Authority, the general intelligence service, the atomic energy authority, and other relevant authorities, each within its jurisdiction, are responsible for taking measures necessary to ensure safe handling and protection of radioactive materials, in the framework of international transport, in accordance with the provisions stipulated in the

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op.cit, *mpensation Program,lness CoThe Energy Employees Occupational Il*) Ken Silver: [46](pp.267-268. L David M. Bearden: *Environmental Laws: Summaries of Major Statutes Administered by EPA*, op.cit, pp.67-68.

([47]) The President Executive Order no.13179 (65 FR 77487) December 7, 2000. And see also: Executive order 13179: Providing compensation to America's nuclear weapons workers. federal register,65(238),77487-77490. Retrieved April 15, 2005 fromhttp://frwebgate4.

international agreements regulating the use of nuclear energy in the Arab Republic of Egypt. The nuclear law stipulates that: "The authority's inspectors shall have the capacity of judicial control officers to prove violations of the provisions of this law, its executive regulations and the decisions implementing them ([48]).

C) Nuclear and Radiological Regulatory Authority and its Environmental Role

The nuclear and radiological control authority was established - as an independent body enjoying legal personality and with complete independence despite its affiliation with the council of ministers - in accordance with article (11) of the law regulating nuclear and radiological activities promulgated by law no. 7 of 2010. Law entrusts it entrusted with carrying out all regulatory work and supervisory tasks for all nuclear and radiological activities for the peaceful uses of atomic energy to ensure the safety of humans, property and the environment from the dangers of exposure to ionizing radiation. For example:
1- Issuing, amending, suspending, renewing, withdrawing and canceling all types of licenses for nuclear and radiological facilities and activities and personal licenses for those dealing with ionizing radiation in accordance with the law.
2- Coordination with other governmental and non-governmental agencies in the areas of the commission's work. 3- Contacting the regulatory and supervisory authorities in foreign countries and international organizations to enhance cooperation and exchange of regulatory and supervisory tasks.
4- Inspection of sites where or through which products or services directly related to safety is supplied, in accordance with the regulations in force in this regard.

D) Administrative Sanctions for Nuclear Facilities Violation of Nuclear Safety and Security Rules and Measures

There are administrative sanctions that are applied to the violations of the nuclear safety and security rules and measures of these facilities:

([48]) See article (9/1) and article (33) of the Egyptian Law, Law No. 211 of 2017, amending some provisions of the law regulating nuclear and radiological activities, promulgated by Law No. 7 of 2010, The Egyptian Gazette in Issue No. 47 bis "b" issued in 29, 2017.

1- Withdrawal or suspension of the nuclear facility's license. There is no doubt that the administrative authority has the right to withdraw the license granted to the nuclear facility or suspend it, when necessary, depending on whether it has committed violations in the application of the provisions of the nuclear Law or nuclear safety and security measures. It is the right of the licensing body to issue a decision to cancel the license. In the event that a source of nuclear radiation is used and in violation of the law, the license can be withdrawn and the relevant authorities shall be notified, in order to issue a suspension of the activity. The administrative authority may also temporarily suspend the license for committing any of the aforementioned violations.
2- Administrative fine: it is a sum of money imposed by the competent department on the perpetrator of the environmental violation. By law, the perpetrator is obligated to pay the fine. This fine is easy to impose. It applies to those who violate the nuclear safety and security rules and measures in nuclear facilities
3- Seizing the dangerous tool: preventing its use or confiscating it. It is a provision that is approved by many countries in order to suppress the dangerous tool, i.e. the source of nuclear pollution. Thus, the competent department, in the event of pollution resulting from the lack of secrecy of the radioactive nuclear source, removes the dangerous tool and confiscates it.

Section II. Nuclear Accident in Facilities and Compensation for Nuclear Accident

Among the most important risks that threaten the security of installations are those resulting from nuclear accidents. This is due to the negative effects they leave behind on the work environment, including the material and human resources. These effects are not limited to the work environment only, but they extend to its neighbors from other environments. Additionally, when the nuclear accident is on a small scale, in contrast to the accident on a large scale, its harmful effects may extend to other neighbouring countries ([49]). This section is divided into the following:
Chapter I: The Nature of the Nuclear Accident.
Chapter II: Compensation for the Nuclear Accident.

([49]) Ken Silver: *The Energy Employees Occupational Illness Compensation Program,* op.cit, p.262.

Chapter I. The Nuclear Accident Concept

The nuclear accident has its own nature, which gives it a special character. This is because of its dangerous effects on people, workers of nuclear facilities or others, such as facility customers, or other persons outside the facility's scope. Moreover, the nuclear accident may affect production tools and equipment in nuclear facilities. Accordingly, the study is divided into the following:
Topic I: Definition of the Nuclear Accident.
Topic II: Nuclear Damage.

Topic I. Definition of the Nuclear Accident

First: Defining the Nuclear Accident and Its Related Terms

A nuclear accident has several definitions. In the US Law, the Price-Anderson act, 42 USC 2014q. defines a "nuclear accident" as any occurrence, including an extraordinary nuclear occurrence, within the United States, causing, within or outside the United States, bodily injury, sickness, disease, or death, or loss of or damage to property, or loss of use of property, arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of special nuclear source, or by-product material. The Price-Anderson act was amended in 1966 to introduce the concept of an "extraordinary nuclear occurrence", in order to strengthen the protection of the public by eliminating, in appropriate circumstances, certain legal defenses that would normally be available under state tort laws. An extraordinary nuclear occurrence is essentially an event causing off-site significant release of nuclear material or significant increase in radiation levels, and in respect of which the federal government determines that there has been, or will be, substantial damage to persons or property. Any determination by the NRC or the secretary of energy, in this respect, is final and conclusive. The elimination of the specified defenses effectively results in strict liability. An extraordinary nuclear occurrence determination can also preclude the use against a claimant of any issue or defense based on state statute of limitations, if the claim was brought within three years from the date on which the claimant

first knew, or should reasonably have known, of this injury or damage and the cause (50).

In addition, the Egyptian legislator mentioned that the nuclear accident - in nuclear law 7/2010 in article 1, paragraph 8 - is "The accident, disaster, or series of accidents whose causes are due to a single origin and result in an unregulated leakage of nuclear radiation that results in nuclear damage." Whereas the 1963 Vienna convention (M1) defined a nuclear accident as "every act or series of actions arising from the same source and resulting in nuclear damage." As for the Paris convention (M1), a nuclear accident is defined as "every act or series of actions resulting from radioactive or radioactive explosive and toxic materials or from any dangerous materials from nuclear fuel, products, waste or radiation and resulting in damage".

We deduce from the previous definitions that the act must be caused by nuclear materials, which are used or transferred to the account of a nuclear workplace. The common feature of most nuclear accidents is that they are caused by radioactive nuclear materials or dangerous materials from nuclear fuel or nuclear waste. Thus, the term "nuclear" is associated with any substance or product that causes the nuclear accident. The construction or operation of nuclear reactors, in the production of nuclear fuel and during the operation of a nuclear reactor, may also be associated with nuclear contamination. Water is used in large quantities to cool nuclear reactors, and then these quantities are thrown into the seas or rivers, which leads to their contamination with radioactive materials. That is, the environment in which this reactor is used, or the surrounding environments, may be affected by radioactive materials (51). If this environmental damage drains material resources, then it is not more susceptible to be protected from the harm caused to workers because of nuclear accidents (52).

(50) Nuclear Legislation in OECD and *NEA Countries, Regulatory and Institutional Framework for Nuclear Activities,* OECD 2016. Title 42 contains public health and safety laws, the atomic energy act of 1954 and the nuclear waste policy act (NWPA). The code of federal regulations (CFR).

(51) For more information see NEA (2018), "Decree no 2017-508 of 8 April 2017 revoking the licence to operate fessenheim nuclear power plant", Nuclear Law Bulletin, No. 100,2009, p.93. National environmental policy act of 1969, 42 united states code (USC) 4321 et seq. (NEPA), Oglala Sioux Tribe v. US Nuclear Regulatory Commission, 896 F.3d 520 (DC Cir. 2018) Nuclear Law Bulletin N°. 101, Volume 2018/2, Legal Affairs 2018, p. 71.

)52(Nuclear tests are explosions that take place above the ground, and they result in large quantities of radioactive dust loaded with fission products, and spread in the atmosphere

Second: Forms of the Nuclear Accident

Failure of Nuclear Power Plants

There are concerns that human or mechanical error in any nuclear facility could lead to significant harm to people and the environment. Nuclear power plants and operating nuclear reactors contain large amounts of radioactive fission products that can pose a direct radioactive hazard if dispersed, contaminating soil and plants, and ingested by humans and animals. Human exposure to workers and others in surrounding environments at sufficiently high levels can cause short-term illness and long-term death from cancer and other diseases. In addition, it is impossible for a nuclear reactor to explode like a nuclear bomb. Nuclear reactors can also fail in a variety of ways. If the instability of the nuclear material causes unexpected behavior, it can lead to an uncontrolled discharge of energy. Normally the reactor's cooling system is designed to be able to handle excess heat. However, if the reactor experiences a loss of coolant it could lead to overheating and this event is called a nuclear meltdown (53).

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of the areas where these experiments are conducted, and due to the wind, radioactive dust falls and pollutes the water. As for the explosions that take place under the surface of the earth, some nuclear radiation leaks into the groundwater, and it also contains a large number of radioactive isotopes (uranium elements). As for nuclear reactors, they are dangerous and destructive radiation for human health, animals, plants and the environment in particular. It detrimentally affects the environment and its life with the possibility of radioactive contamination for subsequent generations of humans. Nuclear waste is a material that contains some radioactive isotopes resulting from the use of nuclear energy, which is classified as dangerous waste in view of its gravity and the consequent damage. Radioactive or nuclear waste is generated at all stages of the nuclear fuel cycle and the majority of waste is produced at the beginning of the cycle, which includes mining, fuel processing time, and when water and impurities are discharge. Therefore, it is considered radiation at the end of the cycle, which usually includes operating reactors, burying waste in deep spaces under the surface of the earth, or disposing of it by or at sea by ships and industrial facilities that are considered a dangerous source of dumping them. See: David M. Bearden: *Environmental Laws:* Summaries of Major Statutes Administered by the Environmental Protection Agency, op.cit, p.10, OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970, [As Amended Through P.L. 109–236, Enacted June 15, 2006], [Public Law 91–596, December 29, 1970], As Amended Through P.L. 109-236, Enacted June 15, 2006, February 27, 2018. www.crs.gov. Muhammad Nasr Al-Din Mansour: *Ensuring Compensation for the Injured Between the Rules of Individual Responsibility and Considerations of Social Solidarity,* first Edition, Dar Al-Nahda Al-Arabiya, 2001, p. 290.

(53) David M. Bearden: *Environmental Laws: Summaries of Major Statutes Administered by the Environmental Protection Agency,* op.cit, p.10, OCCUPATIONAL SAFETY AND

Routine Emissions of Radioactive Materials (the Subjective Nature of the Use of Nuclear and Radioactive Materials)

The nuclear industry has an excellent safety record and deaths per megawatt-hour, which is the lowest of all major energy sources. The past six decades have shown that nuclear technology does not tolerate error. Yet, nuclear power is perhaps the prime example of so-called "high-risk technologies" because "no matter how effective conventional safety devices are, there are some kinds of inevitable accidents, which are 'normal to the system'". That is, there is no escape from system failure and the possibility of catastrophic accidents and their consequent economic costs, which must be taken into account when setting nuclear policy and regulations. The Chernobyl disaster was a nuclear accident that occurred on April 26, 1986, at the Chernobyl nuclear power plant in Ukraine. An explosion and fire released large amounts of radioactive contamination into the atmosphere that spread throughout most of the western Soviet Union and Europe. It is considered the worst nuclear power plant accident in history and is one of only two classified at level 7 on the international table of nuclear events (the other is The Fukushima nuclear disaster, the accident raised concerns about the safety of the nuclear power industry, slowing its expansion for a number of years ([54]).

Accidents Caused by Radiation

A radiation accident is defined as any unintended event including operating errors, equipment failures or other mishaps whose actual or potential consequences cannot be ignored from the point of view of prevention or safety, and could lead to potential exposure or to unusual exposure conditions. Statistics have shown that radiation accidents have various causes, as follows ([55]):

We can say that these accidents have revealed the gravity and seriousness of nuclear accidents, which necessitates a review of the treatment of many

HEALTH ACT OF 1970, [As Amended Through P.L. 109–236, Enacted June 15, 2006], [Public Law 91–596, December 29, 1970], As Amended Through P.L. 109-236, Enacted June 15, 2006, February 27, 2018.

([54]) Mark Holt: *Nuclear Energy Policy,* op.cit, pp.8-10. Bagley S. Biklen: *The beryllium "double standard" standard,* op.cit, p.769.

([55]) Suzan Moawad Ghoneim, *International Legal Systems to Ensure the Use of Nuclear Energy for Peaceful Purposes,* New University House, 2011, p. 677.

dangers by regulatory means, especially with regard to inspection and control. Nuclear accidents have confirmed that the radioactive nuclear pollution of the environment does not know the geographical boundaries of facilities, but also of countries; no facility or any country alone can be certain that all safety and security measures are taken, nor is it certain of its ability to provide the desired protection for both human and material resources.

Topic II. Nuclear Damage

First: The Concept of Nuclear Environmental Damage

The Nuclear damage is defined as loss to persons or any loss or damage to property arising out of or resulting from radiation exposure, radioactive, toxic, explosive effects, or other dangerous properties of nuclear material or radioactive waste produced in any nuclear facility or dispatched from or to it ([56]). We can define nuclear damage as the loss or damage that affects a person or his/her money and is the result of violations or nuclear radiation. Perhaps the nuclear environmental damage is characterized by a subjectivity that distinguishes it from others, and the most prominent features of this subjectivity are ([57]):

- The danger that appears to individuals: this reflects the danger of nuclear radiation or nuclear waste and waste itself.
- Its danger to the facilities and their material resources, as well as to the general environment: as the nuclear damage resulting from nuclear materials or waste has a seriousness that threatens the work environment and the surrounding environments.
- Its lingering effects: as the effects of nuclear environmental damage may not appear immediately after its occurrence; rather, its effects may be slackened later for a period of up to several years.
- Widening of its range: the environmental damage is extensive; it does not stop at the borders of the facility or the country in which the accident occurred. A nuclear accident in an atomic facility that will not only affect its workers, but also extend to other individuals, and the range may expand in favorable weather conditions to extend beyond workers and surrounding people.

([56]) C. Stoiber et autres, *Manuel de droit nucléaire,* agence internationale de l'energie atomique, Vienne, 2006, p. 121. Mark Holt: Nuclear Energy Policy, op.cit, p.8. Ahmed Rashad Mahmoud Salam: *Responsibility for Nuclear Pollution,* op.cit, p. 62.
([57]) Loc.cit.

Therefore, we can say that nuclear damage is not limited to nuclear facilities only, but also extends to neighboring environments. For example, the immune system of an infected individual is greatly affected by exposure to nuclear radiation and dealing with it. Eventually, many individuals developed lung diseases compatible with chronic beryllium disease, and their diagnosis proved this. The families of many workers also demanded compensation in cases where the worker died, in January 1993 – the date of exposure to radioactive beryllium in places affiliated with the Ministry of Energy([58]) .

Second: Nuclear Damage to People

Nuclear damage may badly affect people. In other words, the biological effects on humans, caused by exposure to radiation cause harm to living cells. For example, exposure to radiation can hinder the processes of cell division, disrupting its function, or changing the structure of genes around reproductive cells. Moreover, exposure to X-rays causes hair loss and redness of the skin. Cases of lung cancer appeared among uranium and cobalt miners. The workers in the fields of nuclear radiation suffered from severe burns and leukemia, and the rate of differentiated cancers increased among workers who use radioactive materials, e.g. workers in chemical factories, watches and glass products, among others ([59]).
Since nuclear damages are serious and extensive, the American Energy Employees Occupational Illness Compensation act has given examples of what negative effects nuclear damages may have. These negative effects include but are not limited to total or partial disability, permanent loss or loss of function of body parts, damage to lungs (i.e. black lung), as well as any diseases related to exposure to radiation or other toxic substances ([60]).
We conclude from this legislative treatment of the American law - which the Egyptian law lacks - that the law guarantees compensation to the person suffering nuclear damage in most cases without requiring that the nuclear damage be included in occupational diseases. It is sufficient for a medical committee to decide that the damage is nuclear damage resulting from radiation or toxic substances or something else, and it is desirable for the Egyptian legislator to follow the American law in terms of

([58]) Ken Silver: *The Energy Employees Occupational Illness Compensation,* op.cit, p. 276.
([59]) El-Sayed Eid Nayel: *The New Labor Law and Protection of Workers,* op.cit, pp. 767-768.
([60]) Energy (DOE): *Its contractor, or subcontractor facilities*, the Act was passed on October 30, 2000, and became effective on July 31, 2001. The Department of Labor (DOL) manages claims filed under the Act.

deciding the principle of compensation for all occupational damages and not requiring such diseases to be included in the occupational diseases table.

Accordingly, the work environment has become a fertile field for human resources to be exposed to the dangers of pollutants, which makes them vulnerable to many physical damages ([61]):

Physical damages are damages to the human body, and their effects appear on workers, early or late. The criterion for distinguishing here between the two types of damage is the time factor. Thus, if the period between radiation exposure and the appearance of symptoms of infection was short, then, the damage was immediate. However, if this period was prolonged, the damage was delayed or indolent. The difference between the two types of damage lies in the latency or incubation period. In other words, it is the period during which the radiation lies within the cell, as it is the period of conflict between the body's natural immunity and the harmful effect of radiation, which may be immediate or lingering damage ([62]).

Damage resulting from acute exposure (immediate damage) occurs if the worker is exposed in the work environment to ionizing radiation, whatever its source, and on one time. It also leads to bad damage, most notably the death of the worker, which may be in several minutes or seconds. Examples of such damages include skin injuries such as redness or darkening, atrophy of brain cells and bone marrow cells, which are highly sensitive to nuclear radiation. Additionally, injury to the digestive system can be caused by exposure to a very strong radiation dose, which causes death within minutes, hours, or days. We also seek here intestinal pain, which appears in the form of nausea, dizziness, severe diarrhoea and bleeding, because of circulatory imbalance and blood contamination, so that the main centre of the nerves of the affected person is affected. Other diseases of the reproductive organs, such as infertility, are also detected ([63]).

As for the damages resulting from the chronic exposure (i.e. the indolent damage resulting from the accumulation of radiation during the service life), these are considered the most prevalent among workers in work

([61]) Mark Holt: *Nuclear Energy Policy,* op.cit, pp.8-10.

([62]) Saeed Saad Abdel Salam: *The problem of compensation for technological damages,* Dar Al-Nahda Al-Arabiya, p. 59, *Hamidani Muhammad: Administrative protection of the work environment from pollution by ionizing radiation,* op.cit, p. 190.

([63]) El-Sayed Eid Nayel: *The New Labor Law and Protection of Workers from the Risks of the Work Environment,* op.cit, p. 771.

environments, in which radioactive and nuclear materials are used, and radioactive contamination appears. The latter is expected in such environment. Irrespective of how small and ineffective the radiation level in the work environment is the worker's continuous exposure to radiation inside this environment during his/her work period is expected. As a result, the amount of radiation accumulates in the worker's body, which ultimately leads to biological/physical damages to the worker, even after a long period from the date of his/her first exposure to radiation, in the form of multiple diseases. Examples of these damages include leukemia, blindness, lung cancer, breast cancer, bone cancer, and liver cancer. Apart from the damage that may befall the workers themselves due to their handling of radioactive materials, there are other damages that not only affect them, but also affect others ([64]).

Third: Nuclear Damage to Things (Money)

The work environment, like other environments, contains material resources in addition to its human resources. Therefore, the environmental damage extends in its scope to affect the two types of resources of this environment. That is, human resources and material (things) together. The exposure of entities to doses of nuclear radiation greater than the permissible limit results in great damage, whether these entities are real estate or movables. The gravity of the damage to entities depends on the size of the radiation dose, the degree of sensitivity of the substance of the entity to radiation, and the type of substance. For example, metals are the least affected by nuclear damage ([65]).
Examples of nuclear damage to objects include complete deterioration and destruction of production materials, equipment and tools and damage to petroleum products and raw materials. The entity may remain intact but it absorbs nuclear radiation, is unusable and constitutes a source of danger. It has to be noted that removing radioactive contamination from

([64]) Genetic damage; which means the damage that is reflected or returned to subsequent generations, as a result of each damage or prejudice to the genes that carry the hereditary characteristics of any of the parents. These damages may appear in the form of infertility. Saeed Saad Abdel Salam: *The problem of compensation for technological damages*, op.cit, p. 59, Hamidani Muhammad: *Administrative protection of the work environment from pollution by ionizing radiation*, op.cit, p. 190.
([65]) Mark Holt: *Nuclear Energy Policy*, op.cit, pp.8-10. www.crs.gov.

entities requires great experience and mechanisms that take a long time and heavy expenses, which exceed the value of the entity itself (66).

Topic II. Compensation for a Nuclear Accident

If we dealt with the procedures and rules related to the safety and security of nuclear facilities, and the effects of the nuclear accident on the human resources of the facility and its workers, causing them nuclear damage, then this necessitates addressing compensation for the nuclear accident. If the injury is covered according to the Social Insurance Law, the injured has social compensation - as it is a work injury - in addition to recourse to the person who caused the damage with complementary civil compensation, but if the injury is not covered by social compensation and the injury is nuclear, the injured may recourse under special provisions for civil liability or what is known exceptional nuclear responsibility.

First: The Extent to which a Nuclear Accident is considered a Work Injury and Compensation for it

Workers for nuclear damage international conventions took care of this matter in order to ensure that the injured obtains his/her right.

International Regulation of Worker Compensation for Nuclear Damage

There are obvious international efforts to provide security and protection for workers, from the damages of a nuclear accident. The international convention on civil liability for nuclear damage was keen to remove and prevent any conflict between the social security system and the compulsory nuclear security. In accordance with its provisions, it referred to the social security law of each of its member states to determine the

(66) The damage that must be compensated includes the loss of things, as radioactive pollution leads to them becoming temporarily or permanently unusable or permanent, despite their ostensible survival of their characteristics and material components in certain cases. The compensation is the value of the damaged thing on the day of the accident or the cost of purifying it from pollution and returning it to the state it was in before the pollution, although this cost is often greater than the value of the damaged thing itself. El-Sayed Eid Nayel: *The New Labor Law and Protection of Workers from the Risks of the Work Environment,* op.cit, p. 784. Report: Department of Energy, No. 11-1066, decided November 19, 2013, www. cadc. Us courts.gov...

rights of social security beneficiaries and the rights of recourse that the social security workplace can exercise against the nuclear operator. Article 6 of the Paris convention states: "If compensation for damage provokes the application of a national system of medical or social security or compensation for work injuries and occupational diseases, the rights of the beneficiaries of this system and the rights of recourse that can be exercised against the operator are regulated, according to the law of the state party or the regulations of the government body that established the system ([67]).

Accordingly, the insured worker who suffers from nuclear damage has the right to two compensations: compensation for work injuries, the provisions of which are regulated by the social security law, and civil compensation, if its conditions are met.

(A) Social Compensation: (Internal Organization of Compensation for Injury under the Social Security Law)

The social security law guarantees the insured a social compensation in the event that he/she sustains a physical injury from the injuries he/she specified, and this injury is related to work, at the same time the injury has negative repercussions on the worker's ability to work temporarily or permanently. If the injury can appear in several forms, a work accident, a road accident, an occupational disease or stress and exhaustion; the nature of the injury to nuclear damage may not take all these forms, which calls for addressing firstly: the nature of the injury to nuclear damage, and secondly: the limits of social compensation, as:

([67]) Article (9/1) of the Vienna convention states: "without prejudice to the provisions of this convention, if the provisions of the national or general health insurance systems, social insurance, social security, workers' compensation or occupational disease compensation include compensation for nuclear damages. The laws of the contracting party from which these systems are in effect or the regulations of the government agencies that established these systems determine the eligibility of the beneficiaries of these systems to obtain compensation determined by this agreement and to have recourse under these systems to the operator.

See CRS Insight. 4 Senate Committee on Appropriations, "FY15 Subcommittee Reported Bill and Draft Report," July 24, 2014, http://www.appropriations.senate.gov/news/fy-2015-ew-subcommittee-reported-bill-and-draft-report. 5 Nuclear Regulatory Commission, "NRC Certifies GE-Hitachi New Reactor Design," news release, September 16, 2014, http://www.nrc.gov/reading-rm/doc-collections/news/2014/.

(1) Nature of Nuclear Damage

For the sake of social compensation for a nuclear injury, it is necessary to determine the nature of this injury in light of the provisions on work injuries. Compensation for a nuclear injury requires determining the nature of this injury, in light of the provisions of work injury security. Is it a work accident or an occupational disease? undoubtedly, considering the injury suffered by nuclear workers (who are exposed to atomic radiation) as occupational diseases makes it much easier for these workers to obtain compensation, even if it is a specific social compensation in a lump sum, but it does not require proof from the workers ([68]).

Thus, conditioning the injury as a work injury ensures its social coverage. If it resulted from an accident, and the worker practiced a specific profession and if the disease is one of the diseases witnessed by work relations, this leads to the sufficiency of the requirement that the act be sudden, distinguishing between a work accident and an occupational disease. If the accident is like this, then this condition will definitely be fulfilled ([69]).

Moreover, the nuclear damage can arise from a work accident as well as from an occupational disease, according to the time taken by the act causing it. The injured worker shall be compensated for the nuclear accident as a work accident. This compensation occurs when, for instance, a defect occurs in the radioactive source used in the facility, and this occurred during the worker's work or because of work, causing wounds or injuries to the worker's body, thus constituting an attack on the physical integrity of the human being (in terms of health, both physical and nervous). The injury is compensated as an occupational disease, when the worker is exposed to nuclear radiation and suffers from a nuclear damage that gradually forms because of the accumulation property inside his/her body. The worker is compensated if this disease is one of the diseases listed in Table No. 1, accompanying the law, and if the worker is practicing one of the professions that cause this disease according to the table - and proves this as matter of fact that can be proven by all means. – This is in addition to the appearance of symptoms of the disease during

([68]) Mark Holt: *Nuclear Energy Policy,* op.cit, pp.8-10. www.crs.gov.

([69]) For details see: Muhammad Hussein Mansour: *Social Insurance,* Mansha'at al-Maaref, Alexandria, N.d, p. 213, Samir Abdel-Sayed Tanago: *Social Insurance System,* Manshayat Al-Maaref, Alexandria, without publication year, Ola Farouk Salah Azzam: *Explanation of the new Egyptian Social Security Law,* No. 148 of 2019, a comparative study between the American and French laws, 2020, A.D., Arab Renaissance House, p. 77.

the establishment of the work relationship, or within a calendar year from the date of the worker's termination of service. This condition is derived from the text of the law.

As for the American system, it depends on the method of comprehensive coverage of occupational diseases. This does not mean that it does not require any conditions regarding compensation. A causal relationship between the worker's disease and the occupation he/she performs must exist. That is, this disease should be related to the occupation, and the occupation is the cause of its infliction on the worker. This is regardless to whether this disease is one of the traditional diseases that all workers are exposed to, or one of various diseases that have emerged among some workers, such as repetitive stress and pressure diseases and diseases of the spine ([70]).

By comparing the position of the American and Egyptian laws regarding social compensation for nuclear work injury, we find the superiority of the first over the second in regulating this issue. As this injury is considered an occupational disease, it is compensated according to the comprehensive coverage system when it is proven by a medical report that it is related to the profession, while the Egyptian law stipulated that this injury should be included in the list of occupational diseases and also stipulated that it be related to the profession. In American law, the criterion is in the extent to which the disease is related to the profession the worker performs, according to the medical report and not the open table, which often lacks the organization of these diseases. Therefore, it is recommended that the Egyptian legislator follow the American legislator's method and take the comprehensive coverage method for social compensation for nuclear damage as a work injury.

Although the American system has adopted the method of comprehensive coverage in compensation for diseases, so that every disease whose occupational origin is proven by a medical report is compensated. However, regardless of whether this disease is recognized or not, the US Congress still aims to overcome the lack of uniformity between state employee compensation programs for occupational diseases and other programs. This is particularly a controversial problem that

([70]) Mark Holt: *Nuclear Energy Policy,* op.cit, pp.8-10. www.crs.gov. Andrew M. Robinson and others: *The contemporary British workplace,* op.cit, pp.90-92, Sandi Mann and others: op. cit, p. 669. (The trial court: In lavish V. Cerber Electronics,). Jalal Muhammad Ibrahim and others: *Explanation of the Labor and Social Security Law,* d.n., d.t., p. 635, *Hussam al-Din al-Ahwani: Explanation of the Social Security Law,* d.n., 2006, p. 157. Ahmed Hassan Al-Borai: *Al-Wajeez in Social Law, Labor and Social Security Law,* op.cit, p. 143.

concerns atomic workers in rural areas (where some of the largest weapons Facilities are located). This has been resolved since October 2000. It created standardized federal regulations for nuclear radiation-related cancer and chronic beryllium disease, under which are workers who deal directly with atomic radiation, contractors who deal with government-owned nuclear weapons facilities, and some employees of large companies in industry and construction that use nuclear energy benefit, including employees at nuclear weapons laboratories ([71]).

(2) Limits of Social Compensation

Social compensation is considered arbitrary legal compensation. The legislator drew the features of social compensation and set a standard for, which revolves around the wage and injury and the resulting effects. This compensation is determined haphazardly in a predetermined way, linked to the security contribution wage; therefore, the only element of damage covered by this compensation is the negative repercussions of the injury on the income. The judge does not have a discretionary power about it, in contrast to the civil compensation; the latter covers all the elements of damage and the judge has discretion in it. Social compensation has two forms, the first: compensation in kind, which consists in treatment and medical care, i.e. caring for and treating the injured until he makes a full recovery or his/her condition is stabilized. The second is financial compensation; it is the monetary compensation, i.e. the wage compensation paid to the insured during the period of treatment and medical care before his/her condition is stabilized, and compensation for the injury if the condition of the injured is stabilized and there is no permanent disability or death ([72]).

Accordingly, the social compensation for nuclear injuries in the Egyptian system is estimated arbitrarily and faces the negative repercussions of the work injury on the worker's ability to earn. In contrast to the divergent situation in the American system, the social security law establishes adequate compensation covering all elements of damage suffered by workers who contracted certain diseases. The compensation for

([71]) Ken Silver: *The Energy Employees Occupational Illness Compensation Program*, A New Legislation to Compensate Affected Employees, MOHN JOURNAL, VOL.53, NO.6, JUNE 2005, pp.268-269.www..dol.gov/esa/regs/compliance/owcp/eeoicp/Statistics/Statistics.htm.

([72]) For details, see Hassan Abdel Rahman Quddus: *Compensation for Work Injury,* Dar Al-Jamaa Al-Jadida, 2000, pp. 361-362.

occupational diseases act provides for arbitrary compensation for energy employees: the text: "The Energy Employees Occupational Illness Compensation act is a compensation program that provides a lump-sum payment of $150,000 and prospective medical benefits to employees of the department of energy and its contractors and subcontractors as a result of cancer caused by exposure to radiation, or certain illnesses caused by exposure to beryllium or silica, as well as for payment of a lump-sum of $50,000 and prospective medical benefits to individuals under section 5 of the Radiation Exposure Compensation Act ([73])".
By comparing the situation in the American and Egyptian systems regarding social compensation for nuclear injuries, we find that the two systems agree that this compensation is estimated arbitrarily in the social insurance law. Insurance paid by the social insurance authority. However, the two systems differed in this specific compensation; As the American law has set it at an amount that often covers all or most of the elements of the damage, and this legislator did well, while the Egyptian legislator specified it with compensation that covers only some elements of the damage and depends on social insurance contributions, which are simple and limited and vary in different cases.

(3) Inadequacy of Traditional Rules of Social Law (Recourse to Civil Liability Rules to Compensate the Injured)

Given the special nature of nuclear damage, the traditional rules of social law are in turn insufficient to provide adequate reparative protection for the injured person. Because of the gravity and seriousness of the nuclear damage and the difficulty of ascertaining whether the damage was caused by nuclear waste or nuclear radiation on the one hand, it is difficult to prove the nuclear damage, and even if proven, the injured worker receives arbitrary social compensation, which is specific and non-abrasive for all elements of nuclear damage ([74]).
In view of the insufficiency of the traditional rules for compensating the victims and the injured, it was necessary to adopt a special system for this compensation that faces that imminent danger, which results in harm that has its own character. These traditional rules are not sufficient to

([73]) National Defense Authorization Act for Fiscal Year 2002 (Public Law 107-107; Section 3151(b)) and the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005. https://www.cdc.gov/niosh/ocas/ocaseeoi.html.
([74]) Ken Silver: *The Energy Employees Occupational Illness Compensation Program,* op.cit, pp.270-271.

counteract that kind of harm from a preventive and legislative standpoint, especially the rules of social law that set a lump sum for workers' compensation for nuclear damage. In addition, if the rules of civil law allow the injured to obtain arbitrary indefinite compensation, at the same time, they require proof of error, damage and causation, for example. Furthermore, if the nuclear reactor has caused a leak, its guard must prove that the damage resulted from a foreign cause, force majeure, or a mistake from the injured or from others ([75]).

(B) Complementary Compensation in Accordance with the Provisions of Civil Liability in the Field of Nuclear Damage

(1) Workers' Compensation According to the General Rules for Supplementary Compensation in Civil Liability

The general principle is that if the social compensation does not compensate for all the elements of the damage, then the injured person has the right to recourse to the one who caused the damage with complementary compensation, in order to make up for the full damage. If the injury was a nuclear work injury, the injured may claim supplementary civil compensation from the person responsible for compensating this nuclear damage. That is, the damage was caused by an act constituting a nuclear accident by the use of nuclear material ([76]).

([75]) In fact, many allegations of cancer were made by workers at a facility where nuclear radiation was used as well as employees, accountants and secretaries who worked near or passed through radiation work areas, demanding compensation for the disease. The workers of the facility were compensated for an occupational disease; because they are considered atomic workers. As for the others referred to, they were not compensated for their cancer; if they could not prove that radiation exposure from this facility caused their injury.
http://www.prnewswire.com/news-releases/southern-company-subsidiary-doe-finalize-vogtle-nuclear-project-loan-guarantees-246395221.html. 3 See CRS Insight. 4 Senate Committee on Appropriations, "FY15 Subcommittee Reported Bill and Draft Report," July 24, 2014, http://www.appropriations.senate.gov/news/fy-2015-ew-subcommittee-reported-bill-anddraft-report. 5…

([76]) Nuclear Regulatory Commission, "NRC Certifies GE-Hitachi New Reactor Design," news release, September 16, 2014, http://www.nrc.gov/reading-rm/doc-collections/news/2014/.

The Rule in Combining the Two Compensations (Social and Civil)

According to the general principle, a person may not be compensated twice for the same damage, and the person responsible for the occurrence of the damage may not evade paying part of the compensation, but the injured person has the right to the full compensation that compels the damage. If the injured is an insured worker, in accordance with the work injury security, he/she is entitled to the arbitrary compensation stipulated in the social security Law. That is, the injured is entitled to "social compensation". The supplementary compensation - it means the financial value that represents the difference between the arbitrary compensation obtained by the injured worker from the Social Security Authority and the full compensation according to the rules of civil liability - recourse takes place in accordance with the rules of civil liability, which based on the complementary compensation system guaranteed by the rules of civil liability, if certain conditions are met. The most important of such conditions is that the nuclear damage was caused by a nuclear accident that constitutes a work injury ([77]). Thus, the insured worker who suffers nuclear damage has the right to social compensation for work injuries, and civil compensation under the special exceptional scheme of nuclear liability, or according to the general rules of civil liability depending on the type of compensation ([78]).

In the Egyptian system, which regulates two types of compensation; The first is social compensation under the social insurance law, which is considered arbitrary and insufficient specific compensation, as well as supplementary compensation, which is compensation under the civil law that covers all elements of damage, and the victim returns to this compensation if his injury is a work injury; the injured person begins with social compensation and then completes it with civil compensation until he covers all the elements of his damage. In contrast to the situation in the American system, according to which the social security act covers all or most of the elements of the damage, although it is predetermined, and the injured is entitled to it if his condition is considered a work injury.

(2) Estimation of Civil Compensation for Nuclear Damage

([77]) El-Sayed Eid Nayel: *The New Labor Law and Protection of Workers from the Risks of the Work Environment,* op.cit, p. 784.

([78]) Public Law 91 - 596 91st Congress, S. 2193 December 29, 1970 As amended by Public Law 101-552, §3101, November 5, 1990, the Senate and House of Representatives of the United States of America in Congress assembled.

The rule in estimating compensation is that the judge decides on compensation equivalent to the damage caused to the aggrieved party. The loss he/she suffered and the gain he/she missed, provided that these damages are a natural result of the injury([79]).

Elements of Damage Covered by Supplemental Compensation

Supplementary compensation covers the elements of damage sustained by the worker that were not covered by social compensation, and this requires the judge - who is on his way to determine supplementary compensation - to determine the value of the financial compensation and then deduct from this value what is equivalent to the value of the social compensation. Supplementary compensation covers compensation for physical damages that were not covered by social compensation, such as infertility, hair loss, nail cracking, genetic mutations, impotence and premature aging. These damages do not cause the worker to be unable to work and are not covered by social security. It also includes compensation for damages to the worker in case of the birth of a deformed or unviable child due to exposure to nuclear radiation, compensation for damages arising from dismissal from the job for fear of exposure to new radiation doses or other diseases, as well as compensation for financial damages. The aggrieved party shall return to the previous elements of the nuclear operator within the limits of the financial limitation of his/her liability ([80]). In sum, there is a great discrepancy in the legal status of the injured worker working in the nuclear facility and the position of the injured worker working outside it. While the latter can claim civil compensation to the nuclear operator without restriction or condition, it is required for the former to prove the fault of the employer. Therefore, it is advisable to consider the worker with nuclear damage from a third party always, so

([79]) Hammam Muhammad Mahmoud Zahran: *Labor Law, Individual Employment Contract,* New University House, Alexandria, 2007, p. 759, Ola Farouk Salah Azzam: *Termination of the Unimplemented Work Contract, Comparative Study,* Journal of Law and Economics, Faculty of Law, Cairo University, No. 90, Year 2017, p. 438.

([80]) El-Sayed Eid Nayel: *The New Labor Law and Protection of Workers from the Risks of the Work Environment,* op.cit, p. 851, Hassan Qadous: *Compensation for work injury,* op.cit, p. 456.

that he can obtain full compensation without the need to prove the fault of the employer ([81]).

Thus, the insured worker who suffers nuclear damage has the right to social compensation for work injuries, and according to the general rules of civil liability depending on the type of compensation, if a condition is considered a work injury. Or civil compensation under the special exceptional scheme of nuclear liability ([82]).

Topic II. Nuclear Civil Liability and Compensation for Nuclear Damage Rules

An accident inflicted on the worker may cause him a nuclear bodily injury, which is not, however, compensable by reason of his departure from the concept of compensable work injury; the conditions for entitlement to compensation for this accident were not met. However, this does not mean that the worker is not compensated at all, but rather does not compensate him socially and civilly. But is the employer or the employer compensated for it? And what is this person? What is the nature of his responsibility? What are the pillars of exceptional nuclear responsibility, and other questions that raise controversy regarding the exceptional responsibility of the nuclear operator, as follows:
We refer before that to two things: the first; compensating the injured person for nuclear damage is in accordance with the provisions of international agreements, the most important of which is the Vienna convention on compensation for nuclear damage, the provisions of which are binding and followed in both the Egyptian and American systems; those who objectively place this responsibility on the shoulders of the nuclear facility user or the nuclear operator, and therefore they have matched the provisions. And the two of them; compensation for nuclear damage under the rules of nuclear civil liability is civil compensation for

([81]) El-Sayed Eid Nayel: *Social Security Solutions,* op.cit, p. 132. U.S. Court of Appeals for the District of Columbia Circuit, National Association of Regulatory Utility Commissioners v. U.S. Department of Energy, No. 11-1066, decided November 19, 2013, http://www.cadc.uscourts.gov/internet/opinions.nsf/2708C01ECFE-3109F85257C280053406E/$file/11-1066- 1466796.pdf.
([82]) Public Law 91 - 596 91st Congress, S. 2193 December 29, 1970 As amended by Public Law 101-552, §3101, November 5, 1990, the Senate and House of Representatives of the United States of America in Congress assembled.

damage that is not considered a work injury or accident, and therefore is not considered supplemental social or civil compensation.

First: Acknowledgment of the Responsibility of the Nuclear Operator

One of the well-established principles in the legal arenas is to compensate the worker for the damage he sustains in connection with his work, as a civil compensation, if his conditions are met and the conditions for social compensation are not met. The basis for his/her return for civil compensation varies according to the type of injury. That is, he/she benefits from the provisions of exceptional nuclear liability, which are established by international agreements, if the nuclear damage resulted from an exceptional nuclear accident for the use of nuclear materials in a nuclear facility. The person responsible for compensating the nuclear damage is the operator of the nuclear facility.

Both Egyptian and American legislator focused nuclear responsibility and established it objectively on the shoulders of the nuclear operator, i.e. the one who is solely responsible according to the principle of "focusing on compensation for damages arising from the nuclear accident." The legislator did not consider the general rules of civil liability that necessitates proving the error, so the injured party is obligated to sue the operator of the facility alone and not others. Thus, the nuclear operator is obligated - under international agreements such as the Vienna convention, and national legislation - to secure a working environment, to maintain and provide a financial guarantee covering its liability for nuclear damage. The state in which the nuclear facility is located also determines the value of the security or guarantee and the nature of its conditions, and the insurer or guarantor may not suspend the security or financial guarantee or terminate it without prior notification to the competent authority of the date in accordance with the form established by law ([83]).

([83]) On the limits of liability of the nuclear operator; The Vienna convention imposed only a minimum amount of "five million dollars per nuclear accident", and there was no upper limit on the liability of the nuclear operator. Thus the state may impose on him unlimited liability, and the state may reduce the minimum by no less than five million SDRs if the facility presents limited risks provided that the state provides a guarantee of the normal amount of liability. El-Sayed Eid Nayel: *The New Labor Law and Protection of Workers from the Risks of the Work Environment,* op.cit, p. 816.

Second: The Nature of the Nuclear Operator's Responsibility

The responsibility of the nuclear operator has three characteristics: the objective nature, the focused nature, and the "notably strict and exclusive liability for the operator([84]):

(A) The Operator's Liability for Nuclear Damage is of an Objective Nature

The liability of the nuclear operator is not based on fault, according to nuclear liability agreements, but rather on an objective basis. That is, it is a responsibility without fault. We find the text of article (4/1) of the Vienna convention that "the operator's liability for nuclear damage, in accordance with the provisions of this Agreement, is objective." article (2/1) of the Brussels convention stipulates that "the operator of a nuclear ship is objectively responsible for: all nuclear damage arising from a nuclear accident caused by nuclear fuel or radioactive waste relating to this ship." It is sufficient for the nuclear operator to be responsible for the existence of a causal relationship between the nuclear accident and the damage, regardless of whether or not the fault is established. The basis for nuclear responsibility here is damage, not fault. The injured is not obligated to prove the nuclear operator's fault, and his right to compensation arises as soon as the accident occurs, and this right is confirmed when he proves the causal relationship between the accident and the damage. Nor does the nuclear operator absolve himself of his/her responsibility by proving that he/she did not make a mistake in operating the facility; the nuclear operator remains responsible even if the cause of the accident remains ([85]).

Furthermore, nuclear activities are characterized by their dangerous nature because they constitute a source of extreme danger, and the nuclear operator bears the objective responsibility. Therefore, it is appropriate to implement the idea of the created danger or the consequence of the activity. They are compatible with the subjectivity of these activities.

([84]) David M. Bearden: Environmental Laws: *Summaries of Major Statutes Administered by EPA,* op.cit, pp.67-68. Nuclear Legislation in OECD and NEA Countries, Regulatory and Institutional Framework for Nuclear Activities, OECD 2016. Title 42 contains public health and safety laws, The Atomic Energy Act of 1954 and the Nuclear Waste Policy Act (NWPA). The Code of Federal Regulations (CFR).

([85]) El-Sayed Eid Nayel: *The New Labor Law and Protection of Workers from the Risks of the Work Environment,* op.cit, p. 784.

(B) The Operator's Liability for Nuclear Damage is of a Focused Nature

The nuclear legislator focused on the obligation to compensate on the nuclear operator of the facility alone and excluding other persons, even if they were responsible for the accident, in accordance with the general rules of civil liability. The goal of the legislator is to focus the responsibility on the person of the nuclear operator, in order to avoid the difficulties facing the injured in the event of the multiplicity of persons who are responsible but not jointly liable, and to avoid the multiplicity of financial guarantees of liability for nuclear damage. This made this responsibility consistent with justice. This is because the nuclear exploiter is the one who reaps the fruits of the nuclear materials that generate danger, and the one who has the means to protect against their dangers, and the concentration of responsibility achieves the interest of those affected. Thus, he/she assigns them a known person to claim compensation, and this person does not evade his/her responsibility by raising someone else's liability ([86]).

(C) The Liability of the Operator for Nuclear Damage is of a Limited Nature

The Vienna convention (M5) stipulates that: "The state in which the nuclear facility is located may limit the responsibility of the nuclear operator to no less than five million US dollars for each nuclear accident". The liability of the operator of the nuclear ship is 1,500 million francs for each nuclear accident. As specified in article (7/1) of the Paris agreement, the total compensation that can be paid for damage arising from a single nuclear accident cannot exceed the maximum limit of liability established in accordance with this article. 2: The maximum is fifteen million European units of account, equivalent to 15 million US dollars. Thus, according to the provisions of the US atomic energy act, the operator is responsible for compensating the nuclear damage, and if any person - natural or legal - participates in causing the damage, the operator is still primarily responsible for compensating this damage. If the origin is that the operator's liability is always covered by an equal amount of money,

([86]) Ken Silver: *The Energy Employees Occupational Illness Compensation Program,* A New Legislation to Compensate Affected Employees, op.cit, pp.270-271. Muhammad Abd al-Latif: *Nuclear Energy and the Law,* World of Thought Magazine, Issue 5, Volume 41 in 2013, p. 93.

which is in the interest of the affected, then the compensation requests submitted by them are covered financially, but if the operator's liability is not specified, international agreements obligate him to provide security or financial guarantee within the limits of the minimum liability ([87]). We find that the Egyptian nuclear law stipulates that the state is obligated to compensate if it is proven that the operator is unable to pay more than the value of the security or guarantee without prejudice to its right of recourse against it ([88]).

Third: The Elements of Exceptional Nuclear Responsibility

The establishment of exceptional nuclear liability, three conditions are required: the nuclear accident, the damage, and the causation relationship, as follows ([89]):

A) Nuclear Accident

A nuclear accident, according to article 1 of the Paris convention, article 1 of the Vienna convention, and (M 1/8) of the Brussels convention, means every event (or facts of a single origin) that has caused damage as long as this event or damages - or some of them - have resulted. Regarding the radioactive properties or the combination of toxic, explosive or other hazardous properties of nuclear fuel, radioactive products or waste, or of radiation emitted from any other source of radiation located within a nuclear facility. It is clear that a nuclear accident may arise from a single incident that does not take a long period to occur - such as the explosion of a nuclear facility, or from a series of incidents brought together by one source, so that it is impossible to separate any incident from the other.

([87]) Public Law 91 - 596 91st Congress, S. 2193 December 29, 1970 As amended by Public Law 101-552, §3101, November 5, 1990, the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Occupational Safety and Health Act of 1970." David M. Bearden: *Environmental Laws:* Summaries of Major Statutes Administered by EPA, op.cit, pp.67-68. An explanation of EPA's *"Environmental Impact Statement (EIS) Rating System Criteria"* is available at www.crs.gov.

([88]) Refer to article 91 of the Egyptian nuclear law 7/2010. We note here that the 1997 Vienna convention (article 13 of it), has been amended to reconsider the value of compensation; where it became the minimum (300 million Special Drawing Units) for each nuclear accident.

([89]) El-Sayed Eid Nayel: *The New Labor Law and Protection of Workers from the Risks of the Work Environment*, op.cit, p. 784.

Successive events constitute one incident and not several successive incidents, such as the case of an extended radioactive leak ([90]).

Conditions of a Nuclear Accident

It is clear from civil liability agreements that two conditions are required for the existence of a nuclear accident. The first condition: the accident is related to the exploitation of a nuclear facility: It is required for the beginning of the application of the rules of nuclear civil liability that the occurrence of the accident is linked to the exploitation of a nuclear facility. That is, it may have resulted from nuclear materials used in a nuclear facility for generation; or the accident occurred during the transportation of these materials for the facility's account; or while they were being stored for using them in power generation. The second condition: Intervention of radioactive nuclear materials: It is required that the nuclear accident be due to the interference of nuclear materials, with the radioactive properties of these materials ([91]).

B) Damage

The nuclear liability agreements define the damages that the nuclear operator is obligated to compensate in aggregate as "damage to persons and damage to money".

(1) Civil Compensation for Damages to Persons

The subjectivity of civil nuclear responsibility requires the adoption of legislation different from the existing one. This allows for the possibility of compensating the injured and the injured in full for all the elements of

([90]) See CRS Insight. 4 Senate Committee on Appropriations, "FY15 Subcommittee Reported Bill and Draft Report," July 24, 2014, Nuclear Regulatory Commission, "NRC Certifies GE-Hitachi New Reactor Design," news release, September 16, 2014, www .nrc .gov..

([91]) Nuclear material means: (i) nuclear fuel; It is any material other than natural uranium that can produce energy by spontaneous sequential nuclear fission outside the reactor, either alone or after mixing it with another substance. (ii) radioactive products and wastes; It is any radioactive material produced during the production or use of nuclear fuel, or any material that becomes radioactive as a result of exposure to the radiation emitted during this production or use. Nuclear materials do not include natural uranium; it only poses dangers when it passes inside a nuclear reactor, when it is considered a nuclear fuel. See Mark Holt: *Nuclear Energy Policy,* op.cit, pp.15-17. www.crs.gov.

the damage, while relieving the injured from the burden of proof or mitigating it. The adoption of the traditional rules of liability leads to the departure of the majority of the nuclear environmental damage from the scope of the lawsuits because it is not possible to say and prove that we are dealing with direct environmental damage. Therefore, the general rule is that the nuclear operator is obligated to compensate for the bodily harm caused to natural persons. Physical harm is any weakening of the financial liability of a natural person, resulting from compromising his/her physical or psychological integrity. Accordingly, compensation includes all damage resulting from the deprivation of a person's life or harm to his/her physical, mental or sexual health or his/her ability to have children. Examples are death, all injuries, wounds and diseases that affect a person such as (e.g. cancer, skin diseases, genetics and others ([92]).
Some legislation addressing the issue of nuclear civil liability was limited to the rules of civil law, while we find some legislation that is specific to the use of nuclear energy. Civil liability is part of its provisions in special texts, in this nuclear law, in The United States of America and Egypt. For example, (art.88 /T) of the Egyptian nuclear law states: "If the nuclear accident arose due to an act or omission that occurred with the intent to cause damage, he/she has the right to recourse against the individual whose act or omission caused that intent ([93]).

C) The Causal Relationship

In order for the exceptional nuclear liability to occur, the injured must prove that the damage he sustained was due to the nuclear accident; proving a causal link is a necessary condition for entitlement to compensation. The problem of nuclear causation is part of the problem of causation in civil liability; therefore, the general rules of civil law adhere to it. The damage must also be direct; that is, it is linked to the accident with an influential causal relationship. If this relationship does not exist, it is an indirect damage, and the nuclear operator is not obligated to compensate

([92]) Mark Holt: *Nuclear Energy Policy,* op.cit, p.20. www.crs.gov.
([93]) Public Law 91 - 596 91st Congress, S. 2193 December 29, 1970 As amended by Public Law 101-552, §3101, November 5, 1990, the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Occupational Safety and Health Act of 1970." Egyptian Law No. 2011 of 2017 amending some provisions of the Law Regulating Nuclear and Radiological Activities promulgated by Law No. 7 of 2010, Egyptian Gazette in Issue No. 47 bis "b" issued on November 29, 2017.

for it. The effects of radiation exposure are divided into two types of effects ([94]).

(2) Civil Compensation for Damages to Property

Compensation for damage to nuclear facilities, funds located on the site of this facility, or means of transport that transport nuclear materials or hazardous waste, civil liability and consequently civil compensation for it may be established, provided that it is directly related to the operation of the nuclear facility ([95]). Here we address some of the questions that may be raised in this regard as follows:

The question arises about whether the compensation is for financial or economic damages resulting from nuclear pollution?

Examples include the damage caused by the cessation of trade exchange with the areas that have been exposed to nuclear contamination, the culling of agricultural and animal products or the prohibition of their consumption, as well as the loss resulting from the evacuation of people and the evacuation of the contaminated area. If the economic damages arise from actual contamination of the products with nuclear radiation, then the evacuation is justified. However, if the economic damage arose from mere precautionary measures taken by the state towards the areas where radioactive contamination is likely to reach, despite the uncertainty that pollution actually occurred in these areas, here the nuclear accident is an indirect cause of these damages and therefore does not enter into compensation according to the rules of nuclear liability ([96]).

The question also arises about whether the compensation is for the damage caused to the nuclear facility itself or to its property and material resources?

([94]) Mark Holt: *Nuclear Energy Policy,* Congressional Research Service 7-5700, RL33558, October 15, 2014, pp.23-24. (Price Anderson: 42. U.S.C. 2210, Nuclear Legislation in OECD and NEA Countries, Regulatory and Institutional Framework for Nuclear Activities, Title 42 contains public health and safety laws. Ahmed Rashad Mahmoud Salam: *Responsibility for Nuclear Pollution*, op.cit, p. 52.

([95]) Jerry H. Yen, *Analyst in Environmental Policy, Environmental Policy Section*, Resources, Science, and Industry Division, Congressional Research Service, p.55. Sven-Erik Kaiser, U.S. EPA, *Office of Congressional and Intergovernmental Relations,* personal communication, p.62, December 16, 2011. For more information, see CRS Report RL33152, The National Environmental Policy Act (NEPA): Background and Implementation, Federal Environmental Pesticide Control Act of 1972, P.L. 92-516, Section 4(c).

([96]) https://www.amacad.org/publication/nuclear-liability-key-component-public-policydecisi on- deploy-nuclear-energy-south east/section/5.

The damage may occur to the facility itself or to any property located nearby and is being used or intended for use in the purposes of that facility. In that case, it is excluded from the compensation: 1: damage incurred by either of them in accordance with article 4/5/a of the Vienna convention of 1963, as well as if the damage occurred to the means of transport. 2: in charge of transporting the nuclear materials that are the subject of the accident. Perhaps the reason for this exclusion lies in the fact that the operator is insured by the facility and its assets and property. There is no need, then, to include such damages within the scope of his/her obligation to compensate, in order to prevent competing with the excluded damages for damages incurred by others and to ensure that the maximum compensation is not affected ([97]).

Conclusion

The research dealt with the issue of legal protection of nuclear facilities by addressing two chapters, the first of which presented an introduction to the nuclear facility and its pollutants, their effects, how to protect them, nuclear safety standards, procedures and measures, while the second dealt with the nuclear accident and its social or civil compensation. The most important thing dealt with is the entitlement of the worker with nuclear damage to the right to social compensation, and the worker's recourse to civil compensation is based on the rules of exceptional liability. The research reached several results and recommendations as follows:

Results

- The work environment in nuclear institutions is a part of the general environment, and it represents a qualitative environment characterized by danger that requires a special kind of legislative protection.
- A nuclear facility is the facility itself and its associated buildings and equipment in which nuclear materials are produced, converted, used, handled, stored or finally disposed of.
- To protect workers from the dangers of nuclear radiation, recommendations were issued by international organizations regarding the

([97]) Suzan Moawad Ghoneim, *International Legal Systems to Ensure the Use of Nuclear Energy for Peaceful Purposes,* New University House, 2011, p. 677.

rules of prevention, the necessity of prior licensing, and the limits of the radiation dose to which the worker is allowed to be exposed.
- There are multiple uses of nuclear energy; it is used as fuel for nuclear reactors, for the production of medical isotopes and for other commercial and industrial purposes.
- Nuclear pollution is any pollution resulting from the use of nuclear materials or ionizing radiation or dealing with hazardous waste, which clearly affects the work environment.
- The concept of health, security and safety standards is not precisely defined by most laws, but it seeks to preserve the human element and the material element together and surround it with an atmosphere full of industrial security, safety and nuclear safety.
- The responsibility of the nuclear operator is an objective, focused and limited one. The American and Egyptian legislators have been keen to provide great protection to the injurer's right to compensation, based on an absolute responsibility that is not based on the idea of error, and bears the nuclear operator accountable even if he is not mistaken.
- According to the American atomic energy law, the responsibility is focused on the nuclear operator, so that the injured person returns the operator to compensate him/her for the damage, but it also allows the injured party to file a lawsuit against any other individual who contributed by mistake to the accident.
- If the injury is not covered by social compensation and the injury is nuclear, the injured may recourse under special provisions for civil liability or what is known exceptional nuclear responsibility.

Recommendations

- It is recommended by the Egyptian nuclear law that facilities for extracting and converting uranium and thorium minerals and radioactive waste management facilities should not be excluded from the list of nuclear facilities.
- Nuclear facilities must comply with all nuclear safety and security standards; in particular, they comply with the limits and doses of exposure to nuclear materials and safety standards, to prevent hazards such as physical hazards from equipment.

- Ensuring the existence of an effective nuclear safety and security system in all facilities to constitute a general system for dealing with the prevention of work-related injuries and illnesses, as well as the protection of workers' health.
- We appeal to the Egyptian legislator to amend article 65 of the Egyptian social security law, so that the period of the year specified as a period of security for occupational diseases is canceled and this period is left to a specialized medical committee, as is the approach of the American legislator.
- Encouraging the role of the concerned facilities that have many tasks related to scientific research in the field of using atomic energy or activities, i.e. in which nuclear materials are used.
- Developing applications of nuclear techniques and their multiple uses to make the best use of them.
- Establishing the department of atomic energy, which is concerned with granting licenses related to the possession or use of radioactive nuclear materials in various fields, especially industrial and medical. And to monitor nuclear facilities.
- Governments take measures to tighten control over emissions of power plants to reduce emissions, and to ensure the introduction of cleaner fuel standards in nuclear facilities.

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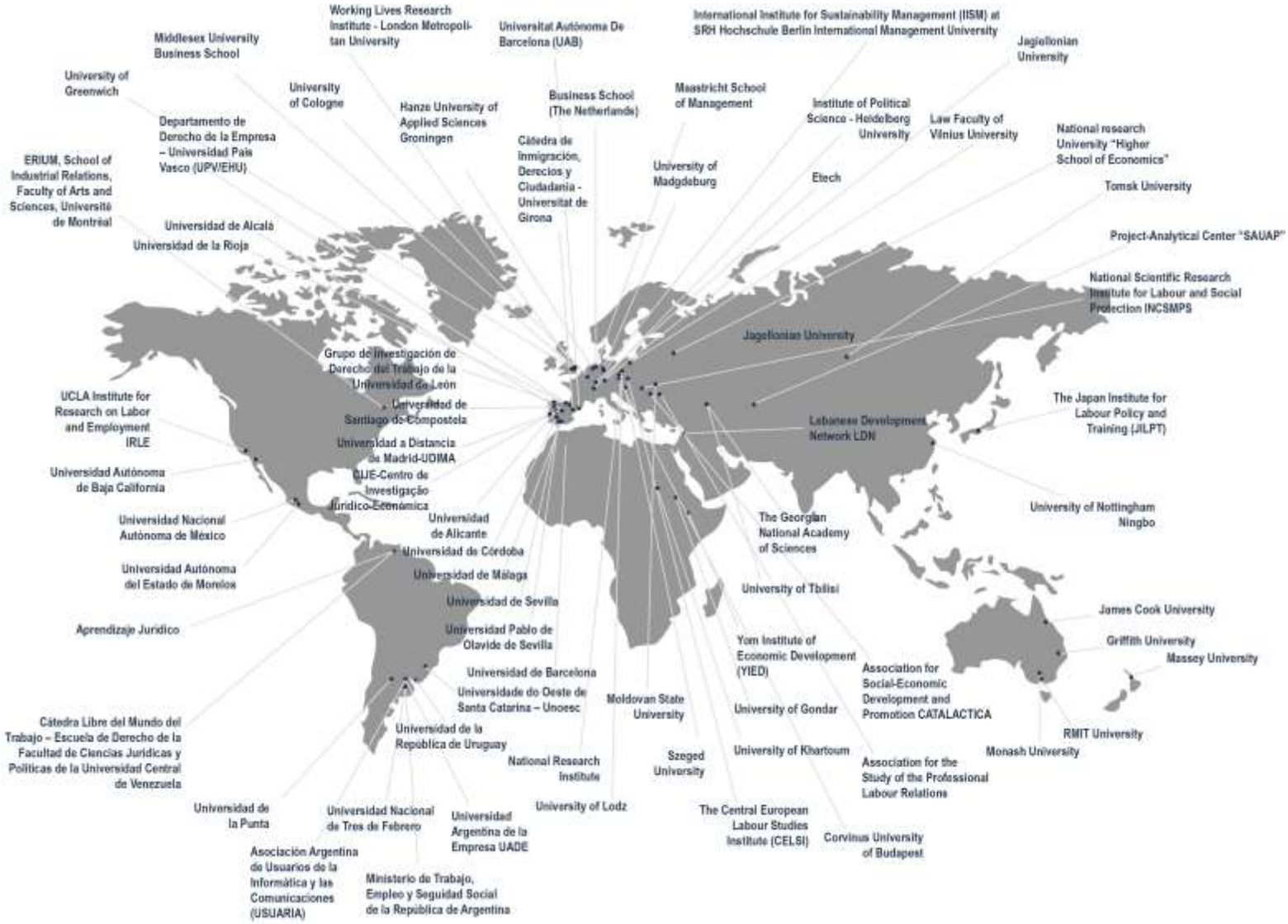

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