الدراسة السابعة:

International Responsibility for Damage Resulting from the Peaceful Use of Nuclear Energy

Dr. Mohammad Chehade Ismail

Abstract

This study addresses the issue of international responsibility for damage resulting from the peaceful use of nuclear energy, a subject that raises critical legal, environmental, and sovereignty-related challenges under public international law. The central research question explores the extent to which international law successfully regulates peaceful nuclear activities and provides effective mechanisms of accountability in cases of nuclear harm, whether caused by negligence or inherent risk. The study aims to assess the legal framework governing nuclear safety and security, analyze state obligations, and evaluate both fault-based liability and risk-based liability as legal grounds for international responsibility. Particular focus is given to international instruments such as the Paris and Vienna Conventions, as well as liability regimes under space law in cases involving nuclear-powered objects. The findings affirm that while the right to peaceful use of nuclear energy is recognized, it is not absolute and must comply with strict safeguards to prevent transboundary harm. The study highlights the urgent need to revise liability treaties, establish an international compensation fund,

and adopt a precise legal definition of "peaceful use" to avoid conflicting interpretations. Key legal concepts discussed include: peaceful nuclear use, international liability, nuclear damage, risk-based theory, wrongful acts, international safeguards, transboundary compensation, IAEA, state sovereignty, Paris Convention, and Vienna Convention.

Keywords: Nuclear Damage, Peaceful Use of Nuclear Energy, International Responsibility, Risk-Based Liability, International Wrongful Act.

الملخص

يتناول هذا البحث موضوع المسؤولية الدولية عن الأضرار الناجمة عن الاستخدام السلمي للطاقة النووية، بوصفه أحد أكثر المواضيع القانونية إثارة للجدل في القانون الدولي العام، نظرًا لما يطرحه من إشكاليات قانونية وتقنية تتعلق بالسيادة، والسلامة البيئية، والتعويض العابر للحدود. تتمثل الإشكالية الرئيسية في مدى قدرة قواعد القانون الدولي العام على تنظيم هذا النشاط الحساس، وضمان نظام فعال للمساءلة الدولية في حال وقوع أضرار نووية، سواء كانت ناتجة عن الإهمال أو عن طبيعة النشاط نفسه. يسعى البحث إلى تحليل الإطار القانوني الناظم لهذا الاستخدام، واستعراض التزامات الدول في مجالات السلامة والأمن النوويين، وتقييم فعالية نظريتي الفعل غير المشروع ونظرية الخطر كأساس لتحميل الدولة المسؤولية الدولية، خاصة في ظل قصور آليات إثبات الخطأ أو الضرر المباشر. كما يتناول البحث بالدراسة اتفاقيات باريس وفيينا والآليات المرتبطة بها، بالإضافة إلى قضايا المسؤولية في أنشطة الفضاء الخارجي المرتبطة بالطاقة النووية. وقد خلص البحث إلى أن الحق في الاستخدام السلمي للطاقة النووية حق مشروع لكنه غير مطلق، ويخضع لضوابط صارمة أهمها منع الإضرار بالدول الأخرى، وضرورة إشراك المجتمع الدولي في الوقاية والتعويض. كما أظهرت الدراسة الحاجة إلى تطوير النظام القانوني الدولي من خلال تعديل الاتفاقيات الحالية، وإنشاء صندوق دولي لتعويض الأضرار النووية العابرة للحدود، واعتماد تعريف قانوني دقيق لمفهوم

"الاستخدام السلمي". ومن أبرز المصطلحات المحورية التي عالجها البحث: الاستخدام السلمي للطاقة النووية، المسؤولية الدولية، الضرر النووي، نظرية الخطر، الفعل غير المشروع، التعويض، الضمانات الدولية، السيادة، اتفاقية باريس، اتفاقية فيينا، ووكالة الطاقة الذرية الدولية.

الكلمات المفتاحية: الاستخدام السلمي للطاقة النووية، المسؤولية الدولية، الضرر النووي، نظرية الخطر، الفعل غير المشروع.

Introduction

The issue of the peaceful use of nuclear energy stands among the most pressing and controversial matters in contemporary international law, owing to its highly sensitive nature and the multifaceted intersections it presents—political, economic, technical, and legal alike(1). These dimensions render it a subject of significant debate within public international law. In recent decades, developments in global energy demand have prompted both developed and developing states to pursue diversification of energy sources and to seek more efficient and sustainable alternatives(2). Within this context, the peaceful nuclear option has emerged as a strategic choice, directly tied to sustainable development goals and the urgent need to reduce dependence on finite fossil fuels(3).

Peaceful nuclear energy, in fact, offers promising potential across numerous domains, including large-scale electricity generation, advanced medical applications, water desalination, and critical uses in

(1) Scheinman, L, Nuclear non-proliferation: A study in international law and policy. University of Washington Press, 1997, p. 15

(2) International Energy Agency, World energy outlook 2022. IEA Publications, 2022, p. 32

(3) United Nations, Transforming our world: The 2030 agenda for sustainable development. United Nations, 2015, p. 9

agriculture and industry[1]. As such, it has become a cornerstone of scientific and technological advancement in the 21st century[2]. International treaties and United Nations instruments have enshrined the right of states—without discrimination—to develop and use nuclear technology for peaceful purposes, most notably under the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT)[3]. Article IV of the NPT explicitly recognizes this right as one of the treaty's three foundational pillars, alongside nuclear disarmament and non-proliferation, while emphasizing the importance of adhering to the international safeguards regime administered by the International Atomic Energy Agency (IAEA) to ensure the legitimacy of such uses[4].

However, although this right is recognized under international law, it is neither absolute nor unconstrained. Rather, it is governed by a set of stringent legal obligations imposed by general international law and multilateral treaty frameworks[5]. Indeed, nuclear activity—despite its peaceful label—remains inherently hazardous, due to the potential for catastrophic environmental, health, and economic harm, particularly where such consequences transcend the territorial jurisdiction of the state in which the activity originates[6]. Thus, the question of international legal responsibility is inescapably central in this context[7].

---

(1) World Nuclear Association, Nuclear power in the world today, 2024

(2) Weiss, E. B, The promise of nuclear energy: Challenges for the 21st century. Routledge, 2017, p. 76

(3) United Nations, Treaty on the Non-Proliferation of Nuclear Weapons (NPT), Art. IV, 1968, Art. IV

(4) IAEA, International safeguards: History and overview. International Atomic Energy Agency, 2023

(5) Henderson, J, International nuclear law and regulations. Cambridge University Press, 2019, p 118.

(6) Kunz, J, Transboundary nuclear harm and international law. Environmental Policy and Law, 46(4), 20, 2016, p. 204

(7) M. Fitzmaurice & O. Elias (Eds.), Contemporary issues in international law, Oxford University Press, 2020, p. 151

A fundamental legal dilemma arises here: To what extent can traditional rules of state responsibility, which are often premised on establishing fault or internationally wrongful acts, effectively address the unique nature of nuclear harm? Many nuclear-related damages may occur even when the state has exercised due diligence, implemented all necessary safeguards, or where harm results from complex technical failures or circumstances beyond human control(1). Consequently, new legal approaches have emerged—most prominently, the theory of risk-based liability, which holds a state liable solely by reason of harm occurring and a causal connection to the nuclear activity, without the need to demonstrate fault or legal breach(2).

Tragic events such as the Chernobyl disaster of 1986 in the former Soviet Union and the Fukushima nuclear accident in Japan in 2011 laid bare the fragility of the international legal system in dealing with nuclear catastrophes, both in assigning responsibility and in securing adequate compensation mechanisms(3). These incidents have further revealed a significant gap between the sovereign ambitions of states to develop nuclear capacity and their corresponding legal duties to prevent transboundary harm and to adhere to international notification and cooperation obligations(4).

Accordingly, the regulation of the peaceful use of nuclear energy necessitates a comprehensive reassessment of the current legal frameworks, and the development of more effective mechanisms for prevention, accountability, and reparation, striking a delicate balance between the sovereign right to development and the collective right of

(1) Bodansky, D, Nuclear energy and international law: Strict liability and risk, Oxford University Press, 2010, pp. 55-56
(2) O'Keefe, R, Liability for nuclear damage in international law, Routledge, 2015, pp. 78-79
(3) Hasegawa, M. (2012). Legal challenges following the Fukushima nuclear disaster. Journal of Environmental Law, 24(1), 2012, p 110,
(4)Klabbers, J, An introduction to international law (3rd ed.). Cambridge University Press, 2013, p. 167

the international community to a safe and stable environment[1]. In this regard, the question of international responsibility and compensation for nuclear damage is indispensable to the formation of a fair and coherent legal order in the nuclear domain[2].

In light of the foregoing, the central research question that this study seeks to explore is the following:

To what extent does public international law succeed in regulating the peaceful use of nuclear energy and in establishing an effective regime of international accountability for resulting harm, given the legal and technical challenges inherent to this high-risk activity?

This core question gives rise to several subsidiary inquiries, including:

- To what extent is the distinction between peaceful and military uses of nuclear energy clearly articulated in international treaties?
- How effective is the IAEA's system of safeguards and international oversight?
- Are fault-based and risk-based theories of liability adequate legal bases for assigning international responsibility?
- Do existing international instruments—such as the Paris and Vienna Conventions—provide a sufficient legal framework for compensating nuclear damage?

The significance of this research lies in its treatment of a complex and evolving legal topic that sits at the crossroads of state sovereignty, international responsibility, technological development, and

[1] Schmidt, S., & Amann, J, The future of nuclear liability regimes: Balancing development and environmental protection. International Environmental Law Review, 32(2), 2018, p. 88
[2] United Nations Environment Programme, Environmental governance and nuclear safety, UNEP, 2017, p. 45

environmental protection. It addresses a reality in which states are increasingly turning to nuclear energy amidst global energy crises and environmental imperatives, while the legal mechanisms for managing its risks remain fragmented or underdeveloped. This study contributes to filling a critical gap in legal scholarship, offering a timely evaluation of the effectiveness of international legal frameworks in reconciling the sovereign right to peaceful nuclear development with the imperative of safeguarding humanity and the environment—particularly given the persisting disparity in access to nuclear technology between industrialized and developing nations.

From a methodological perspective, this research adopts a critical analytical approach, examining the texts of relevant international treaties, analyzing pertinent legal doctrines and jurisprudence, and reviewing practical experiences and case studies that have exposed shortcomings in the existing legal system. The study also employs a comparative legal method, particularly in its assessment of the Paris and Vienna liability regimes, evaluating their effectiveness in addressing nuclear damage across different legal systems, and engaging with scholarly proposals aimed at reforming and strengthening the international responsibility regime in this field.

1. Legal Framework for the Regulation of Peaceful Uses of Nuclear Energy

The peaceful use of nuclear energy has proven to be an effective means of achieving numerous benefits for states, earning it a prominent position within the sustainable development strategies of developed countries(1). In parallel, developing nations have sought to benefit from

(1) World Nuclear Association, Nuclear power and the environment, 2024.

these peaceful applications, exercising their sovereign right to exploit natural resources and to determine their environmental and developmental policies, in accordance with the Charter of the United Nations and the principles of international law—particularly Principle 2 of the 1992 United Nations Conference on Environment and Development (UNCED) Declaration(1). International treaties have played a pivotal role in affirming this right, while also emphasizing the necessity of granting preferential treatment to developing countries to enable their effective access to the advantages of this technology(2).

However, the right to the peaceful use of nuclear energy is intrinsically linked to legal obligations. The notion of "peacefulness" in this context—as defined by the Treaty on the Non-Proliferation of Nuclear Weapons (NPT)—is limited to non-military uses of nuclear energy(3). Therefore, while the equitable access of all states to such technology is recognized, this right is not absolute and must be exercised within the confines of established legal frameworks(4). Notably, it must not result in transboundary harm. Should such harm occur due to the misuse of nuclear technology, the responsible state incurs international responsibility and is obligated to provide compensation for the resulting damage(5).

(1) United Nations, Rio Declaration on Environment and Development, 1992

(2)IAEA, Technical Cooperation and Developing Countries. International Atomic Energy Agency, 2020.

United Nations, Treaty on the Non-Proliferation of Nuclear Weapons (NPT), 1968, Art. IV

(3) United Nations, Treaty on the Non-Proliferation of Nuclear Weapons (NPT), 1968, Art. IV

(4) Joyner, D. H, Interpreting the Nuclear Non-Proliferation Treaty, Oxford University Press, 2011, p 65.

(5) Bodansky, D, Op.cit, p. 50. - International Law Commission, Draft Articles on Responsibility of States for Internationally Wrongful Acts, with commentaries. United Nations. Retrieved from, 2001, Art. 31.

1.1. The National Authority in the Peaceful Utilization of Nuclear Energy

Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) affirms the inalienable right of all State Parties to access and utilize nuclear technology for a variety of peaceful purposes[1]. This right must be exercised in a manner that ensures a balanced relationship between the entitlements of States and their corresponding obligations, without discrimination or the application of double standards[2]. The peaceful use of nuclear energy is recognized as one of the three fundamental pillars of the NPT, and as such, no undue restrictions should be imposed on the transfer of nuclear materials, equipment, or technology for peaceful purposes to States Parties that are subject to comprehensive safeguards agreements with the International Atomic Energy Agency (IAEA)[3]. Furthermore, any measures that hinder the peaceful use of nuclear energy in a way that contradicts the letter or spirit of the Treaty are considered inconsistent with its objectives[4]. States possessing nuclear technology bear a legal and moral obligation to assist non-nuclear-weapon States in acquiring and benefiting from such technology in a fair and equitable manner[5].This principle reflects the broader objectives of international cooperation and development embedded in both the NPT and the United Nations Charter[6].

---

[1] United Nations, Treaty on the Non-Proliferation of Nuclear Weapons (NPT), 1968

[2] Joyner, D. H, Op.cit, pp. 66–69

[3] IAEA, Safeguards Agreements and Additional Protocols. International Atomic Energy Agency, 2023

[4] Findlay, T, Governing the Atom: The IAEA, the NPT, and Nuclear Disarmament, International Institute for Strategic Studies, 2010, p. 109

[5] Scheinman, L, Op.cit, p. 21. - IAEA., Technical Cooperation and Nuclear Technology Transfer, International Atomic Energy, 2020

[6] United Nations, Charter of the United Nations, 1945, Art. 1(3)

1.1.1. Establishing States' Right to the Peaceful Use of Nuclear Energy

International treaties constitute the fundamental framework regulating the right to the peaceful use of nuclear energy, notably the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which guarantees this right(1). The United Nations Charter also addresses this right within broader legal principles(2). Accordingly, this discussion will examine the right to peaceful nuclear energy use within the context of the UN Charter and General Assembly resolutions, alongside the Security Council's recognition of states' rights to nuclear technology, concluding with an analysis of this right under the NPT framework(3).

International treaties have not explicitly defined the right to peaceful nuclear use, nor was it expressly mentioned in the UN Charter, given the confidential nature of nuclear technology at the time of the Charter's drafting—considered a "pre-nuclear era" document(4). Nevertheless, this right is grounded in the Charter's principles of international peace and security, encompassing economic, social, and cultural dimensions, in addition to the internationally recognized principle of development(5).

The Charter's Preamble and provisions emphasize the importance of economic and social cooperation and the enhancement of living standards worldwide. Peaceful nuclear energy can contribute to sustainable development and improved quality of life, as neglecting developmental needs risks conflicts that undermine stability and progress(6). Globally, nuclear energy plays a critical role in electricity

(1) United Nations, Treaty on the Non-Proliferation of Nuclear Weapons (NPT), 1968
(2) United Nations, Charter of the United Nations, 1945
(3) Joyner, D. H, Op.cit, pp. 55–59
(4) Spector, L. S, The New Nuclear Nations. Vintage Books, 1984, p. 22
(5) United Nations, Charter of the United Nations, 1945, Arts. 1(3), 55
(6) Weiss, E. B,Op.cit, pp. 76–78

generation, serving as an effective solution to energy deficits and supporting development while maintaining acceptable living standards in developing countries, provided its use remains exclusively peaceful[1].

Aligned with this approach, the UN General Assembly, in its Tenth Special Session on Disarmament (1978), stressed the necessity of reducing nuclear weapon risks without hindering the advancement of peaceful nuclear energy uses[2]. It underscored states' rights to implement peaceful programs that support economic and social development. The Assembly also highlighted the International Atomic Energy Agency's (IAEA) role in supporting these uses, fostering international cooperation, enhancing nuclear facility safety, and providing technical assistance to developing countries for sustainable development[3]. The Assembly affirmed states' right to non-discriminatory use of peaceful nuclear technology and placed responsibility on developed countries to assist developing nations in meeting their nuclear energy needs for economic and social advancement[4].

Practical precedents include the UN Security Council's 1981 call upon Israel to refrain from destroying the Iraqi nuclear reactor, affirming Iraq's right to compensation, sovereignty, and the right of states—especially developing countries—to develop peaceful nuclear programs addressing developmental needs while respecting non-proliferation objectives[5]. During the Iranian nuclear crisis, the Security Council reiterated states' rights to peaceful nuclear use and the

(1) World Nuclear Association, Nuclear Power in the World Today, 2024
(2) United Nations General Assembly, Tenth Special Session on Disarmament, 1978
(3) IAEA,Technical Cooperation and Nuclear Technology Transfer. International Atomic Energy Agency, 2020
(4) Findlay, T, Op.cit, pp. 109–111
(5) United Nations Security Council, Resolution 487 (Iraq Nuclear Reactor), 1981, Res. 487

importance of unhindered international cooperation, emphasizing compliance with the NPT and international safeguards(1).

Consequently, developing states hold sovereign rights to plan and implement peaceful nuclear programs supporting sustainable development, conditioned on prohibiting military use and adherence to international safeguards(2).

The IAEA was established to promote the peaceful use of nuclear energy globally, prior to the NPT's adoption, which remains the cornerstone treaty for nuclear non-proliferation(3). The NPT is founded on three pillars: nuclear disarmament, non-proliferation, and the inalienable right of states to peaceful nuclear energy use. The treaty affirms states' rights to research, development, and peaceful utilization, encourages scientific and technological exchange, and obliges developed states to assist non-nuclear states in peaceful uses, restricting nuclear activities to peaceful purposes without specific limitations on technologies such as enrichment or the nuclear fuel cycle(4).

The IAEA Statute defines its primary objective as promoting peaceful nuclear energy use in fields of peace, health, and development, supporting member states in research and application without imposing political or economic conditions(5). The Agency provides necessary materials and services while respecting states' rights and applying safeguards to prevent military use(6).

(1) Boese, W, Iran Misses Nuclear Deadline; Security Council Warns. Arms Control Today, 36(8), 2006.- United Nations Security Council, Resolution 1696 (Iran Nuclear Program), UN Doc, 2006, Res. 1696
(2)Bodansky, D, Op.cit, pp. 48–50
(3) IAEA, Statute of the International Atomic Energy Agency, 1957
(4) United Nations, Treaty on the Non-Proliferation of Nuclear Weapons (NPT), 1968, Art. IV.- Joyner, D. H., Op.cit, pp. 61–63
(5) IAEA, Statute of the International Atomic Energy Agency, 1957, Art. II
(6) IAEA, IAEA Safeguards Overview, 2023

Within international law, principles regulating warfare and disarmament have evolved through numerous treaties, and the United Nations was founded to maintain international peace and security. The advent and use of nuclear weapons in World War II intensified the nuclear arms race, prompting the international community to seek restrictions on nuclear arms proliferation, balancing peaceful nuclear use with its military nature[1]. The principle of international responsibility remains fundamental in regulating these weapons' use and safeguarding global security[2].

1.1.2. The Ambiguity Surrounding States' Right to the Peaceful Use of Nuclear Energy

Although numerous international instruments affirm the inalienable right of all States to possess, develop, and use nuclear energy for peaceful purposes, the Treaty on the Non-Proliferation of Nuclear Weapons (NPT)—which forms the primary legal framework for this right—imposes a set of restrictions that many developing countries perceive as obstacles to its effective exercise[3]. The principal ambiguity in the Treaty and the Statute of the International Atomic Energy Agency (IAEA) lies in the absence of a precise definition of "peaceful use" of nuclear energy and the lack of clear delineation regarding the materials, equipment, and activities encompassed by this use, resulting in divergent interpretations of what is permissible[4]. This complexity is

[1] Sloss, D, The Role of Domestic Courts in Treaty Enforcement. Cambridge University Press, 2014, pp. 91–93

[2] International Law Commission, Draft Articles on Responsibility of States for Internationally Wrongful Acts, with Commentaries. Retrieved from, 2001, Art. 31.

[3] United Nations, Treaty on the Non-Proliferation of Nuclear Weapons, 1968.- Joyner, D. H, Op.cit, pp. 45–48

[4] Findlay, T, Op.cit, p. 92. - IAEA, Statute of the International Atomic Energy Agency, 1957, Art. II

further exacerbated by the rapid and ongoing development of nuclear technology.

Divergent interests and political backgrounds have led to the emergence of two main interpretative approaches to the right to peaceful nuclear use as stipulated by the NPT. The broad interpretation, primarily upheld by most developing and Non-Aligned Movement states, recognizes the right of States to develop all aspects of peaceful nuclear technology—including enrichment and reprocessing—subject to IAEA safeguards(1). These States consider denial of such rights as unjustified discrimination and a breach of the principle of equality, emphasizing that possession of the full nuclear fuel cycle ensures their sovereign independence in nuclear programs(2).

Conversely, the narrow interpretation, advocated by advanced industrialized States such as the United States, restricts certain sensitive nuclear activities like enrichment, viewing them as proliferation risks(3). It conditions the right to peaceful use on strict compliance with the non-proliferation regime, focusing on export control initiatives and multilateral fuel supply alternatives to obviate the need for indigenous enrichment(4).

The enduring challenge lies in achieving an equitable balance between States' rights to peaceful technological development and the prevention of nuclear use for military purposes. The NPT's imposed restrictions and conditions are viewed by developing countries as

(1) IAEA, Technical Cooperation and Nuclear Technology Transfer, 2020. Goldschmidt, P, Multilateralizing Nuclear Fuel Cycles: Time to Start Thinking Outside the Box. Carnegie Endowment for International Peace, 2009.
(2) ElBaradei, M, Towards a safer world. The Economist, 2004, p. 3
(3) U.S. Department of State, Proliferation Security Initiative: Statement of Interdiction Principles, 2004
(4) Nuclear Suppliers Group, NSG Guidelines, 2023

hindrances to effectively exercising this right[1]. The ambiguity surrounding the definition of "peaceful use" persists, with no clear distinction between peaceful and military uses—whether direct, as in nuclear weapons, or indirect, such as operating military facilities powered by nuclear energy[2]. Moreover, international agreements and the IAEA have not precisely defined the scope of safeguards over such uses, complicating the differentiation between peaceful and non-peaceful applications, especially amid technological advances and the convergence of different nuclear uses[3].

Article III, paragraph 2, of the NPT requires all Parties not to supply any non-nuclear-weapon State with source or special fissionable material, equipment, or devices intended for processing or use in the production of fissionable material, unless such materials and equipment are subject to IAEA safeguards[4]. However, the Treaty text does not explicitly specify which materials and equipment fall under these safeguards, leaving room for varied interpretations and causing tensions between nuclear-weapon States and developing countries regarding technology transfer[5]. Additionally, the intervention of nuclear supplier groups, such as the Zangger Committee and the London Club, has defined sensitive materials and equipment, effectively controlling nuclear technology and reflecting imbalances in international relations[6].

Separately, the issue of withdrawal from international treaties—bilateral or multilateral—has become a contentious legal matter, as

(1) Joyner, D. H, Op.cit, pp. 51–53
(2) Findlay, T, Op.cit, pp. 112–115
(3) IAEA, IAEA Safeguards Overview., 2023
(4) United Nations, Treaty on the Non-Proliferation of Nuclear Weapons, 1968, Art. III.2
(5) Goldschmidt, P, Op.cit, p 46. - Spector, L. S, The New Nuclear Nations, 1984
(6) Nuclear Suppliers Group, NSG Guidelines, 2023

evidenced by the United States' withdrawal from the Anti-Ballistic Missile Treaty and North Korea's withdrawal from the NPT(1). Pursuant to the 1969 Vienna Convention on the Law of Treaties, States may withdraw provided they notify other parties and the Security Council three months in advance(2). The NPT permits withdrawal if a State determines extraordinary events have jeopardized its supreme national interests, but does not clarify the Security Council's role in assessing such claims, making the involvement of the IAEA—possessing extensive information on States' nuclear programs—essential(3).

Withdrawal raises serious security concerns, potentially encouraging other States to follow suit and thereby threatening the stability of the non-proliferation regime(4). Accordingly, NPT conferences have called for expeditious Security Council responses to withdrawal notifications, affirming that peaceful use obligations persist post-withdrawal. Some States have proposed limiting the rights of withdrawing States by extending IAEA safeguards over previously supplied nuclear materials and equipment(5).

Ultimately, the right to the peaceful use of nuclear energy remains a fundamental but not absolute right, subject to international rules designed to maintain the Treaty's balance and continuity and to ensure that this right is not exploited for military purposes that threaten international security(6).

(1) Pomper, M. A., & Dalton, T, Nuclear power, nuclear proliferation, and international security, Arms Control Today, 36(10), 2006, p 202
(2) United Nations, Vienna Convention on the Law of Treaties, 1969, Art. 56
(3) Joyner, D. H, Op.cit, pp. 94–96
(4)Sokolski, H, Falling Behind: International Scrutiny of the Peaceful Atom, Strategic Studies Institute, 2008, pp. 33–35
(5)IAEA, IAEA Safeguards Overview, 2023
(6)Bodansky, D, Op.cit, pp. 66–69. - Sloss, D, Op.cit, pp. 211–213

1.2. The International Framework of Obligations Related to the Peaceful Uses of Nuclear Energy

The use of nuclear energy for peaceful purposes is recognized as lawful under international law, provided that it is conducted within the territorial boundaries of the State and with appropriate measures to prevent any transboundary harm(1). The risk arises from the fact that peaceful nuclear fuel cycle technologies can also be employed in the manufacture of nuclear weapons, raising concerns regarding the reprocessing of fuel and its diversion to military purposes(2). To prevent such misuse, safeguards established by the International Atomic Energy Agency (IAEA) have been implemented, aimed at the early detection of any deviation from peaceful use, monitoring nuclear materials, and verifying compliance with international obligations.(3)

1.2.1. Compliance with International Obligations Regarding the Peaceful Uses of Nuclear Energy

The peaceful use of nuclear energy is recognized as a legitimate right of States, grounded in multiple international treaties; however, it remains subject to international legal restrictions and safeguards aimed at preserving global safety and security(4). Consequently, nuclear safeguards systems have emerged as legal mechanisms to regulate such

(1) United Nations, Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, with Commentaries. International Law Commission. Retrieved from, Art. 3.- Bodansky, D, Op.cit, pp. 54–56

(2) ElBaradei, M, Reflections on nuclear control. IAEA Bulletin, 46(2), 4–7, 2004. - Goldschmidt, P, Op.cit, p 68

(3) IAEA, IAEA Safeguards Overview: Comprehensive Safeguards Agreements and Additional Protocols. International Atomic Energy Agency, 2023.

(4) United Nations, Treaty on the Non-Proliferation of Nuclear Weapons, 1968.- Joyner, D. H, Op.cit, pp. 45–48

use and prevent its diversion to military purposes[1]. Understanding the concept and objectives of these safeguards is essential, despite the absence of a precise definition in international texts[2].

Although international treaties do not explicitly define nuclear safeguards, their concept is derived from various provisions, referring to legal and technical measures that ensure the exclusive use of nuclear energy for peaceful purposes[3]. These safeguards have evolved through multiple frameworks, notably the International Atomic Energy Agency (IAEA) system, which constitutes the global supervisory framework for nuclear activities, alongside regional systems such as EURATOM and the Treaty of Tlatelolco, as well as bilateral agreements and national regulatory measures overseeing internal control[4].

In addition, non-binding political commitments have emerged in the form of assurances by nuclear-armed States not to threaten non-nuclear States. While these do not carry legal obligations, they reflect an international orientation towards nuclear non-proliferation and the maintenance of international peace and security[5]. These safeguards are distributed across international, regional, and bilateral regimes, all aimed at promoting the peaceful use of nuclear energy and preventing its military exploitation.

The IAEA serves as the cornerstone of this system, monitoring safeguard implementation through support for scientific research, technology transfer, and personnel training[6]. It also enforces controls

(1) IAEA,. (2023). IAEA Safeguards Overview, 2023
(2) Findlay, T,Op.cit, pp. 74–75
(3) IAEA, The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, 2002.
(4) IAEA, History of Safeguards, 2018.- Goldschmidt, P, Op.cit, p 71
(5) Sokolski, H. (Ed.), Falling Behind: International Scrutiny of the Peaceful Atom. Strategic Studies Institute, 2008, pp. 41–42.
(6) IAEA, IAEA Safeguards Overview, 2023

to prevent the military use of nuclear materials and technologies, despite political challenges that hinder some of its efforts[1]. Similarly, the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) plays a pivotal role in curbing nuclear weapons proliferation by imposing stringent obligations on non-nuclear States while preserving the privileges of recognized nuclear-weapon States[2]. However, the NPT faces criticism regarding inequalities and insufficient security guarantees for non-nuclear States.

Furthermore, regional safeguards systems such as EURATOM, the European Atomic Energy Community, and the Treaty of Tlatelolco focus on preventing military use within their respective areas, in addition to bilateral agreements that have evolved from limited cooperation to imposing clear conditions preventing military exploitation of nuclear materials[3]. Despite the multiplicity of these safeguards and their diverse mechanisms, the absence of a unified international supervisory framework and disparities in their implementation undermine their effectiveness, complicating the assurance of peaceful nuclear energy use.

Notably, following World War II, the United States proposed placing peaceful nuclear activities under international supervision through initiatives like the Baruch Plan; however, the Soviet Union and other States rejected this proposal, perceiving it as an attempt to restrict national nuclear energy programs. Over time, international safeguards have evolved, particularly within the IAEA framework, whose Statute

---

(1) Findlay, T, Op.cit, pp. 87–90

(2) United Nations, Treaty on the Non-Proliferation of Nuclear Weapons, 1968.- Scheinman, L. Op.cit, p. 60

(3) IAEA, The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, 2002.- Goldschmidt, P, Op.cit, p 75

may be amended by a majority vote of its members. Additionally, both the NPT and the Treaty of Tlatelolco allow for amendments to maintain a balance of power and keep pace with international developments[1].

International safeguards encompass various documents and procedures established by the IAEA to ensure the peaceful use of nuclear energy. Initially limited in scope during the 1960s, these safeguards have since developed into a comprehensive system linked to the NPT, imposing full control over the nuclear fuel cycle in non-nuclear-weapon States[2]. Nevertheless, major nuclear-weapon States remain outside this system, affecting its overall efficacy.

Following the 1991 Gulf War, the IAEA expanded its authority to include additional investigations and inspections designed to ensure transparency and prevent undeclared nuclear activities, alongside imposing reporting requirements for nuclear materials, designs, and unusual operational incidents[3].

The "Programme 93+2" comprises two main parts: the first, implemented in 1996, involves legal authority-based safeguards execution measures such as collecting information on nuclear facilities, increasing inspections, and employing advanced verification technologies[4]. The second part depends on additional legal authority granted by States to the Agency through protocols and includes measures such as expanded declarations and complementary access, permitting inspections of multiple sites and sample collection for verification[5].

---

[1] Findlay, T, Op.cit, pp. 98–101
[2]IAEA, IAEA Safeguards Overview, 2023
[3] IAEA, Strengthened Safeguards System: Programme 93+2., 1997
[4] IAEA, Strengthened Safeguards System: Programme 93+2., 1997.- Findlay, T, Op.cit, p. 116
[5]Joyner, D. H, Op.cit, p. 138

Inspections are typically conducted with at least 24 hours' prior notice, while surprise inspections require additional State authorization(1). Inspectors are carefully appointed, enjoy defined rights and duties, and benefit from legal immunities to ensure effective performance of their tasks. States are obligated to cooperate fully and adhere to inspection schedules(2).

Nonetheless, the IAEA's capability to detect undeclared nuclear activities remains limited, as it requires Security Council support to inspect undeclared sites, raising ongoing debates concerning the effectiveness of the international safeguards system.(3)

1.2.2. Ensuring Compliance with the Legal Framework for Nuclear Safety and Security in Peaceful Uses of Nuclear Energy

The Chernobyl disaster of 1986 exposed significant weaknesses in international law regarding nuclear use, particularly in the areas of notification and safety, prompting the international community to review relevant treaties and establish more stringent standards to ensure nuclear safety(4). Similarly, the September 11, 2001 attacks underscored the critical need to enhance preventive measures against nuclear terrorist threats(5).

In response to these challenges, international agreements were concluded aiming to update liability rules and strengthen nuclear safety

(1) IAEA, Strengthened Safeguards System: Programme 93+2, 1997
(2) IAEA, IAEA Safeguards Overview, 2023
(3)Sloss, D, Op.cit, pp. 191–193
(4) IAEA, Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts., 2006. - Sands, P, Principles of International Environmental Law (2nd ed.). Cambridge University Press, 2003, pp. 308–310
(5)Fischer, D, History of the International Atomic Energy Agency: The First Forty Years. IAEA, 2003; UNSC, 2001a

and security, while promoting international cooperation in this field[1]. Nuclear and radioactive materials pose risks to international peace and security despite advances in safety procedures within nuclear facilities. Responsibility for safety remains with the State where nuclear activities are conducted, exercised through regulatory legislation and supervisory bodies, alongside international coordination to address disasters and terrorist threats[2].

The concept of nuclear safety focuses on protecting individuals and the environment from radiological hazards by regulating the design, construction, operation, and licensing of nuclear facilities[3]. This is distinct from nuclear security, which concerns preventing theft, sabotage, and addressing security threats[4]. Since 1962, the International Atomic Energy Agency (IAEA) has established fundamental nuclear safety standards, developed in cooperation with international organizations, based on four main principles: establishing an effective governmental regulatory body; ensuring the safety of workers and the public; protecting the environment from harmful radiation; and implementing compensation systems for affected parties alongside licensing regimes for facilities[5].

International agreements serve as essential instruments for ensuring nuclear safety and security. These include the Early Notification Convention (1986), which obligates States to promptly notify the IAEA and neighboring States in the event of a nuclear incident to mitigate

(1) IAEA, 2023.- Pelzer, N, International Nuclear Law: History, Evolution and Outlook. Nuclear Energy Agency, OECD, 2009
(2)Bodansky, D, Op.cit, p 97.
(3) IAEA, IAEA Safety Glossary: Terminology Used in Nuclear Safety and Radiation Protection. Vienna: International Atomic Energy Agency, 2018
(4) IAEA, Nuclear Security Fundamentals. Vienna: International Atomic Energy Agency, 2022
(5) IAEA, Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts, 2016

harm, while encouraging international cooperation as evidenced during the Fukushima incident[1]. Additionally, the Assistance Convention (1986) governs mutual support among States during nuclear emergencies. The Convention on Nuclear Safety (1994) mandates States to enact legislation ensuring facility safety and environmental protection. The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (1997) addresses the safe handling of nuclear waste in a manner that supports sustainable development[2].

Following the events of September 11, 2001, the threat of nuclear terrorism intensified, prompting States to enhance nuclear security and tighten controls over radioactive materials[3]. The United Nations Security Council responded by issuing significant resolutions, including Resolution 1373, which requires States to prohibit support for terrorism[4], and Resolution 1540, which forbids the transfer of chemical, biological, and nuclear weapons to non-state actors and emphasizes the importance of security legislation[5]. The Council also established committees to support implementation and foster international coordination in combating these threats[6].

In 2005, the United Nations General Assembly adopted an international Convention on the Suppression of Acts of Nuclear Terrorism, which includes clear definitions of nuclear crimes and imposes obligations to protect nuclear materials and enforce IAEA

[1]IAEA, IAEA Action Plan on Nuclear Safety: Progress Report, 2015; OECD-NEA, 2013
[2]IAEA, Treaties and Conventions, 2023
[3] Carlson, J., Nuclear Terrorism: Global Response Strategies. Australian Journal of International Affairs, 59(3),2015,pp 319–333
[4] UNSC, Resolution 1373 (2001). United Nations Security Council, 2001a
[5] UNSC, Resolution 1540 (2004). United Nations Security Council, 2004
[6] UNSC, Resolution 1540 (2004). United Nations Security Council, 2004

standards. The Convention aims to prevent terrorists from acquiring nuclear weapons and materials and to ensure their security[1].

2. Legal Liability for Damages Resulting from the Peaceful Use of Nuclear Energy

International responsibility is considered one of the most complex topics in international law, due to its theoretical ambiguity and the conflicting nature of national interests[2]. Although such responsibility does not diminish the sovereignty of states, invoking sovereignty does not exempt a state from its obligations under international law, thereby necessitating its accountability for harmful acts[3].

The International Law Commission continues to seek the codification of rules governing international responsibility, which are predominantly derived from customary law, in the absence of a unified definition of responsibility—despite general agreement that it arises from an internationally wrongful act that causes damage to another international subject[4]. The establishment of such responsibility requires the fulfillment of three elements: the wrongful act, the occurrence of damage, and a causal link between the two.

With regard to nuclear damage, the specific risks associated with nuclear activities necessitate a specialized legal regime that goes

[1] UN, International Convention for the Suppression of Acts of Nuclear Terrorism, General Assembly Resolution A/RES/59/290, 2005

[2] Crawford, J, State Responsibility: The General Part. Cambridge University Press, 2013, pp. 1–5

[3] Brownlie, I, Principles of Public International Law (7th ed.). Oxford University Press, 2008, pp. 435–437

[4] ILC, Draft Articles on Responsibility of States for Internationally Wrongful Acts, with Commentaries. Yearbook of the International Law Commission, 2001, Vol. II (Part Two), 2001.- Pellet, A, The Definition of Responsibility in International Law. In Crawford, J., Op.cit, pp. 22–25

beyond general rules, in order to ensure protection without impeding the peaceful use of nuclear energy[1]. Given the inherent difficulty in proving fault in cases of nuclear contamination, legal scholars such as Charlier have advocated for the adoption of the risk theory as the legal basis for compensation—where responsibility is established upon the existence of a causal link, without the need to prove fault[2].

The 1986 Chernobyl disaster highlighted the importance of this approach, as nuclear damage often transcends national borders and requires a more flexible and equitable legal framework[3]. According to Pierre-Marie Dupuy, states engaging in nuclear activities implicitly bear responsibility for potential risks, thereby reinforcing the need for a specialized legal regime that effectively and fairly addresses liability for nuclear damage[4].

2.1. The Principle of Wrongful Act as the Basis for International Liability for Nuclear Damage

The theory of international responsibility has evolved beyond the traditional fault-based approach, giving rise to a new trend that emphasizes the internationally wrongful act as the foundation of responsibility, irrespective of intent or fault on the part of the state[5]. One of the foremost proponents of this view is Anzilotti, who argued

(1) Pelzer, N, Op.cit, p 48.- Sands, P, Op.cit, p. 498
(2) Charlier, 1982. - Faure, M., & Fiore, K, Civil Liability and Financial Security for Offshore Oil and Gas Activities, European Journal of Risk Regulation, 1(1), 93–101, 2009, pp. 97–100
(3) IAEA, Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts, 2006
(4) Dupuy, P.-M, The International Law of State Responsibility: Revolution or Evolution? Michigan Journal of International Law, 10(1), 105–130, 1991, pp. 117–120
(5) Crawford, Op.cit, 2013, pp. 80–84

that the breach of an international obligation gives rise to a duty of reparation, akin to the principles found in civil liability[1].

This principle has been upheld by international tribunals in various cases, such as the Bernadotte case[2] and the Corfu Channel case[3], where it was affirmed that the violation of an international obligation entails responsibility, and that reparation constitutes the direct legal consequence of such a breach[4]. Furthermore, international arbitral bodies and doctrinal projects have reinforced the notion that any act or omission contrary to a binding rule of international law gives rise to an obligation to make reparation[5].

The scope of responsibility extends to include various forms of satisfaction, such as formal apologies or the payment of compensation, and may escalate to more severe measures, including the severance of diplomatic relations or the imposition of restrictions[6]. This understanding has been supported by international practice—for example, the United Nations' request that Israel hold accountable those responsible for the assassination of its envoy, or the People's Republic of China's demand for an apology from the United States following a violation of its airspace[7].

Obligations are thus distributed between the responsible state, which must provide reparation and satisfaction, and the injured state, which

[1] Anzilotti, D, Cours de droit international. Paris: Sirey, 1928, as cited in Pellet, 2010, p. 28
[2] UNSC, Resolution 73 on the Assassination of Count Bernadotte, 1949
[3] ICJ, Corfu Channel Case (United Kingdom v. Albania), Merits, Judgment of 9 April 1949. I.C.J. Reports 1949, p. 4, 1949
[4] ICJ, Corfu Channel Case (United Kingdom v. Albania), Merits, Judgment of 9 April 1949. I.C.J. Reports 1949, p. 4, 1949, p. 23
[5] ILC, Draft Articles on Responsibility of States for Internationally Wrongful Acts with Commentaries, United Nations, 2001
[6] Crawford, J, Op.cit, pp. 144–150
[7] Christenson, G. A, China and the United States: The Collision of Spy Plane EP-3 and International Law. ASIL Insights, American Society of International Law, 2001

must assert its rights. The international community is also expected to support the enforcement of these obligations[1]. Despite the consolidation of this theory, the complexity of contemporary harm—particularly that arising from nuclear activities—poses new challenges[2].

Given their inherently hazardous nature, peaceful nuclear activities are typically subject to the direct oversight of the state or public authorities. Most domestic legal systems attribute state responsibility for harm resulting from such activities, whether conducted directly by the state or through subordinate entities[3]. This responsibility also extends to nuclear activities carried out by international organizations or foreign experts operating within the territory of the state[4].

2.1.1. International Liability Mechanisms for Damage Arising from the Peaceful Use of Nuclear Energy under the Principles of Unlawful Acts

Although international law recognizes the right of states to use nuclear energy for peaceful purposes, this right is conditional upon not causing harm to other states. Even when the nuclear activity is lawful in its objective, it may become an internationally wrongful act if exercised in a manner that exceeds acceptable limits or causes damage to other states, thereby constituting an abuse of rights and giving rise to international responsibility[5]. This is particularly evident in cases

(1)Simma, B., Khan, D. E., Nolte, G., & Paulus, A, The Charter of the United Nations: A Commentary (3rd ed.). Oxford University Press, 2011, pp. 1056–1060
(2)Pelzer, N, Op.cit, p 56.- Sands, P, Op.cit, pp. 498–501
(3) Faure, M., & Fiore, K, Op.cit, pp. 93–100
(4) IAEA, Nuclear Law: The Global Debate on Liability and Safety. Vienna: International Atomic Energy Agency, 2023.
(5) International Court of Justice (ICJ), Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996.

involving the transboundary spread of radioactive substances or nuclear fallout, where principles of international law affirm state liability—even in the absence of binding judicial rulings against nuclear-weapon states(1).

Doctrinal opinions have diverged regarding the legal basis of state responsibility for nuclear damage. Some scholars invoke the principle of abuse of rights, others rely on the theory of risk, while a third view advocates for a combined approach(2). Accordingly, the abuse of rights principle can be considered a foundational rule for international accountability concerning nuclear testing damages, especially when such activities involve other violations such as environmental degradation or infringement of freedom on the high seas(3).

Moreover, the principle of good neighbourliness in international law obliges states to adopt necessary measures to prevent harm arising from peaceful nuclear activities that may affect neighbouring countries(4). This includes strict regulation and continuous monitoring to ensure safety and prevent radiation leaks or environmental contamination(5). When damage results from negligence or omission, the responsible state incurs international liability, particularly given the cross-border consequences of radioactive pollution(6). International law, in this context, underscores the obligation to respect the principle of non-abuse

(1) Trail Smelter Arbitration (U.S. v. Canada), 3 R.I.A.A. 1905, 1941; Sands, P, Op.cit, p 486
(2) Faure, M., & Fiore, K, Op.cit, p 93–101
(3) Nuclear Tests Case, Australia v. France, 1974
(4)International Court of Justice (ICJ), Pulp Mills on the River Uruguay (Argentina v. Uruguay), Judgment, 2010
(5)Handl, G, State Liability for Accidental Transboundary Environmental Damage by Private Persons. American Journal of International Law, 74(3),2007, po 525–556.
(6) Birnie, P., Boyle, A., & Redgwell, C, International Law and the Environment (3rd ed.). Oxford University Press., 2009

of rights, thereby requiring the responsible state to offer reparation and satisfaction when unlawful harm occurs(1).

Pollution, especially nuclear pollution, poses a global threat that transcends national boundaries, prompting international regulatory efforts. Despite the Geneva Convention on the High Seas, which prohibited the dumping of radioactive waste at sea, it was deemed insufficient—leading to the convening of the 1972 Stockholm Conference, the first major global forum for environmental protection with broad participation(2). This conference paved the way for the adoption of additional international agreements aimed at preventing marine pollution and halting the disposal of hazardous materials(3).

With the advancement of technology and industry, environmental protection has become a pressing necessity, as pollution now represents a transboundary and global risk, necessitating international cooperation. International legal instruments and constitutional texts have increasingly recognized the human right to a healthy environment, albeit with varying definitions. The Stockholm Conference introduced a comprehensive concept of the environment encompassing both physical and social resources available to human beings(4).

The international obligation not to pollute the environment is not a novel principle, but its significance was reaffirmed in the 1992 Rio Conference, which emphasized the sovereign right of states to exploit their natural resources in accordance with environmental policies that

(1) United Nations, Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration), 1972
(2) Freestone, D, The Road from Stockholm to Johannesburg: The Development of the Law of Sustainable Development, Environmental Law Review,2001, 3(1), p 9.
(3) United Nations, Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration), 1972
(4) United Nations, Rio Declaration on Environment and Development, 1992

also protect other states from resulting harm[1]. Consequently, states are required to adopt preventive measures and engage in international cooperation to combat pollution[2].

Given the increased reliance on nuclear energy and the environmental hazards it entails, international bodies have intensified efforts to limit nuclear pollution. The Stockholm Conference played a pivotal role in this regard. One of the most pressing issues associated with the peaceful use of nuclear energy is the disposal of radioactive waste, where ocean dumping became a widespread practice[3]. This method, however, demands extreme caution and technical precision to avoid marine contamination, as inadequate containers may corrode or explode, resulting in radiation leakage—particularly dangerous given the long half-life of certain radioactive substances[4].

2.1.2. Legal Consequences of International Liability for Illicit Nuclear Activities

International responsibility obliges the State to cease internationally wrongful acts and to provide reparation for the material and moral damage resulting therefrom, including, where appropriate, symbolic compensation for moral injury suffered by the affected party[5]. One of

[1] Boyle, A, State Responsibility and International Liability for Injurious Consequences of Acts Not Prohibited by International Law. International and Comparative Law Quarterly, 46(1),1995, pp 1–26.
[2] IAEA, Environmental Consequences of the Chernobyl Accident and Their Remediation. Vienna: International Atomic Energy Agency, 2005
[3] IAEA, Environmental Consequences of the Chernobyl Accident and Their Remediation. Vienna: International Atomic Energy Agency, 2005.
[4] IAEA, Management of Waste Containing Tritium and Carbon-14. IAEA Technical Reports Series No. 421. Vienna: IAEA, 2007
[5] International Law Commission (ILC, Draft Articles on Responsibility of States for Internationally Wrongful Acts. United Nations General Assembly Resolution 56/83, 2001, p. 86

the primary consequences of this responsibility is the obligation of the State to terminate any ongoing harmful conduct in order to end the violation, without prejudice to the right to compensation or to restitution in integrum(1).

The International Law Commission (ILC) has emphasized that, in cases of continuing breaches, the State must immediately cease the wrongful act and, where necessary, provide appropriate assurances and guarantees of non-repetition(2). This principle was affirmed by the International Court of Justice (ICJ) in various cases, notably the Hostages Case (United States Diplomatic and Consular Staff in Tehran)(3).

Cessation of the wrongful act constitutes a fundamental step towards restoring compliance with international obligations. It is distinct from restitutio in integrum, which aims to restore the situation as it existed prior to the breach(4). This obligation is particularly significant in the field of environmental protection, where the prevention of escalating or irreparable harm is crucial. For instance, the prohibition on the dumping of radioactive waste into the sea under the Protocol for the Protection of the Mediterranean Sea against Pollution highlights the necessity of immediate cessation measures beyond mere financial compensation(5).

Restitution may involve practical and legal measures to repair the damage, including, where necessary, the amendment of domestic

(1) Crawford, J, Op.cit, 2013, p. 247
(2) International Law Commission (ILC), Draft Articles on Responsibility of States for Internationally Wrongful Acts. United Nations General Assembly Resolution 56/83, 2001, pp. 125–126
(3) International Court of Justice (ICJ), United States Diplomatic and Consular Staff in Tehran (United States v. Iran), Judgment of 24 May 1980, 1980, p. 44
(4) Crawford, J, Op.cit, 2013, p. 245
(5) UNEP/MAP, Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources, adopted in Athens on 17 May 1980. Article 6, 1980, art. 6

legislation[1]. Where restitution is materially impossible or entails a manifestly disproportionate burden, monetary compensation may be granted. Nuclear damage provides a prominent example in this regard, as radioactive contamination spreads across wide areas, making restitution virtually unfeasible in practical terms[2].

Conversely, financial compensation requires the responsible State to pay a sum equivalent to the material and moral damage suffered, whether direct or indirect. The amount of compensation is determined either by mutual agreement or by international adjudication, while maintaining a balance between the interests of the State and justice for the injured party, so that neither underestimation nor inflation of the injury occurs[3].

Accordingly, a State incurs international responsibility for damage arising from its unlawful nuclear activities and is obliged to cease the harmful conduct immediately, to restore the situation to its original state where possible, or to compensate for the damage, whether material or moral[4]. Furthermore, the State is bound to adopt preventive measures, engage in international cooperation to prevent transboundary harm, and offer satisfaction to injured parties when required. Failure to fulfill these obligations constitutes a breach of international law and exposes the State to international legal accountability.

---

(1) International Law Commission (ILC), Draft Articles on Responsibility of States for Internationally Wrongful Acts. United Nations General Assembly Resolution 56/83, 2001, pp. 95–96; Shelton, 2005, p. 211

(2) Dupuy, P. M, Op.cit, p. 118.- Sand, P. H, Op.cit, p. 168

(3) International Law Commission (ILC), Draft Articles on Responsibility of States for Internationally Wrongful Acts. United Nations General Assembly Resolution 56/83, 2001, p. 88.- Pelzer, N, International Pooling of Operators' Funds: An Option to Increase the Amount of Financial Security to Cover Nuclear Liability? Nuclear Law Bulletin, 91, 29–50, 2013, p. 38

(4) Birnie, P., Boyle, A., & Redgwell, C, Op.cit, p. 140

2.2. The Risk-Based Theory as a Foundation for International Liability for Nuclear Damage

The theory of risk emerged in response to the limitations of the fault-based theory and the theory of internationally wrongful acts in addressing damage resulting from modern activities such as nuclear energy and outer space exploration(1). This theory is based on the principle that a legal person may be held liable for the damage itself, provided that a causal link exists between the damage and the activity, without the need to establish fault or negligence(2). Its primary objective is to ensure compensation for victims, even in the absence of fault, particularly in the context of ultra-hazardous activities with transboundary effects. It also seeks to promote the adoption of preventive measures to avert potential harm(3). This approach reflects the evolution of international law in adapting to contemporary challenges and safeguarding the collective interests of the international community.

2.2.1. Application of Risk-Based Liability Principles to States' Peaceful Nuclear Activities

Despite a state's adoption of all necessary preventive measures, nuclear damage may still occur due to the expansion of nuclear facilities. In such cases, the state that operates or authorizes such activity bears responsibility to provide fair compensation to affected

(1) OECD Nuclear Energy Agency (NEA),International nuclear third party liability (Issue Brief No. 4), 1993. - World Nuclear Association, Liability for nuclear damage. Retrieved from World Nuclear Association, 2024

(2) OECD Nuclear Energy Agency (NEA), International nuclear third party liability (Issue Brief No. 4), 1993; World Nuclear Association, 2024, "strict liability"

(3) World Nuclear Association, Liability for nuclear damage. Retrieved from World Nuclear Association, 2024. -International Atomic Energy Agency (IAEA), Nuclear Security Fundamentals. Vienna: International Atomic Energy Agency, 2022

parties. To regulate this responsibility and ensure the protection of rights without hindering the development of the nuclear industry, several international conventions have been concluded with the support of the International Atomic Energy Agency (IAEA) and the European Nuclear Energy Agency(1).

Among the most notable of these is the 1960 Paris Convention, which establishes the liability of the nuclear operator for damage arising from nuclear incidents occurring at installations or during the transport of nuclear material—even when transiting non-contracting states. The Convention adopts the principle of strict liability, meaning that the operator is held liable without the need to prove fault, provided that financial security exists to cover compensation claims, thereby offering a high degree of protection to victims(2).

The 1962 Brussels Convention governs the liability of operators of nuclear ships, imposing strict liability for damage caused by incidents involving nuclear fuel or waste during maritime transport. It excludes certain types of damage, such as damage to the vessel itself or to nuclear fuel before or after the transfer of liability. The Convention includes exemptions in cases of war or armed conflict and requires the flag state to assume liability when the operator's financial guarantees are insufficient—thereby strengthening victim protection(3).

The 1963 Vienna Convention, later revised in 1997, regulates civil liability for nuclear damage at installations. It expands the scope of liability and improves victim compensation. The Convention holds the operator liable with specific exceptions and places a duty upon the state

(1) OECD–NEA, International Nuclear Third Party Liability (Issue Brief No. 4). OECD Nuclear Energy Agency, 1993

(2) OECD/NEA, Exposé des Motifs of the Paris Convention. OECD Nuclear Law Committee, 2020.- World Nuclear Association, Liability for Nuclear Damage, 2024

(3) OECD/NEA, Paris and Brussels Liability Conventions: Explanatory Texts. Paris: OECD Publishing, 2015

to cover damages if insurance is insufficient. Jurisdiction lies with the courts of the state where the incident occurred or where the nuclear installation is located(1).

The 1971 Brussels Convention further establishes the strict liability of operators for nuclear damage arising from the maritime transport of nuclear materials. It includes exemptions where liability is already governed by the Paris or Vienna Conventions or by similar national legislation. It does not affect the liability of ship operators for damage related to nuclear fuel or waste and sets a cap on the amount of compensation(2).

With the development of space activities, the 1967 Outer Space Treaty and the 1972 Convention on International Liability established clear rules imposing liability on states for damage caused by their space activities, including nuclear damage that may affect other states or natural or legal persons(3).

In this context, liability is grounded in the theory of risk, which does not require proof of fault or wrongful act but focuses on the occurrence of harm, its connection to the activity, and its attribution to the state. International liability is triggered when transboundary harm results from a nuclear activity, regardless of fault, provided that the damage is substantial, concrete, and causally linked to the activity—forming the basis for compensating victims. Nonetheless, proving indirect damage remains challenging(4).

(1) IAEA, Vienna Convention and Protocol on Civil Liability for Nuclear Damage: Status and Commentary. International Atomic Energy Agency, 2023
(2) OECD/NEA, Paris and Brussels Liability Conventions: Explanatory Texts. Paris: OECD Publishing, 2015
(3) UN, Convention on International Liability for Damage Caused by Space Objects, 1972
(4) OECD–NEA, International Nuclear Third Party Liability (Issue Brief No. 4). OECD Nuclear Energy Agency, 1993

Liability for nuclear damage is based on the nature and inherent risk of the activity rather than the magnitude of the resulting harm. It applies to activities that present a high probability of causing substantial harm, even in the absence of a specific harmful event. Scholars differ in defining "risk"; some view it as the likelihood of a harmful incident, while others define it as an activity likely to cause serious damage due to its nature, the materials used, or its location.

The risk must be foreseeable and tangible, measured by the characteristics of the activity, materials, and resulting waste. The International Law Commission (ILC) has emphasized that risk must include the likelihood of significant transboundary harm and must be evaluated objectively, such that its probability is expected or should reasonably be known. Moreover, an activity initially considered non-hazardous may become hazardous over time due to scientific developments or the discovery of latent dangers(1).

Attributing harm to the state from which the hazardous activity originates constitutes a cornerstone of the risk theory and is based on the principle of territorial sovereignty. It does not require a functional relationship between the actor and the state. The state is liable for acts that occur within its jurisdiction or under its control, including those conducted in maritime or outer space zones that affect other states(2).

In the context of nuclear damage, the state bears responsibility for compensation, especially where the operator's financial guarantees are inadequate or where the operator is a public entity. The state must allocate the necessary resources for compensation. Given the difficulty of proving causation, the principle of probability is often applied to

(1) Crawford, J, Op.cit, 2013, p 86.
(2) Pelzer, N, Op.cit, p 78.

facilitate the entitlement to compensation. Some conventions also allow compensation for damage resulting from mixed nuclear and non-nuclear incidents(1).

2.2.2. Legal Consequences of Liability for Damages Arising from Internationally Permissible Nuclear Activities

When a State incurs international responsibility due to a particular activity, it is obliged to undertake a set of preventive and remedial measures aimed at mitigating the resulting damage, especially when such damage is transboundary in nature. These obligations include preventing or minimizing harm to the greatest extent possible, notifying potentially affected States, cooperating and consulting with them, and providing appropriate compensation in the event that damage occurs(2).

In the context of nuclear activities, the State bears responsibility for regulating and licensing existing or planned nuclear installations in accordance with stringent standards ensuring environmental safety, taking into account the geographic location of the facility and its proximity to the borders of other States. The State's compliance is assessed based on its practical conduct rather than the mere enactment of legislation(3).

International jurisprudence holds that a State engaging in hazardous nuclear activities is obliged to notify States that may be affected and provide them with relevant information, in implementation of the early

(1) OECD–NEA, International Nuclear Third Party Liability (Issue Brief No. 4). OECD Nuclear Energy Agency, 1993. - Faure, M., & Fiore, K. Op.cit, pp 93–101,

(2) International Law Commission, Draft Articles on Responsibility of States for Internationally Wrongful Acts. United Nations, 2001, Arts 30–31.- OECD–NEA, International Nuclear Third Party Liability (Issue Brief No. 4). OECD Nuclear Energy Agency, 1993, pp. 2–4

(3) Crawford, J, Op,cit, 2013, pp. 305–307. - IAEA, Enhancing National Legal Frameworks for Nuclear Safety and Liability. Vienna: IAEA, 2020

notification principle established by the 1986 Convention on Early Notification of a Nuclear Accident. Draft international legal instruments have imposed a duty on the operating State to promptly inform concerned States, afford them an opportunity to assess risks, and grant the affected State the right to request information and initiate consultations on preventive measures, including the possibility of temporarily suspending the activity.

Furthermore, States aware of the potential transboundary damage resulting from their nuclear activities have a duty to cooperate with other States, particularly those affected, either through direct coordination or via international organizations. This duty is enshrined in the 1986 Convention on Assistance in the Case of a Nuclear Accident and in draft articles on international responsibility. Cooperation includes the exchange of technical and preventive information related to nuclear activities, subject to exceptions for national security or trade secrets, provided the principle of good faith is observed(1).

In this regard, consultations constitute a fundamental mechanism for coordinating preventive measures and are based on balancing the interests of the State conducting the nuclear activity with those of other States potentially affected, thereby requiring respect for each State's sovereignty and the avoidance of harm(2).

In cases where damage occurs, compensation represents a central consequence of international responsibility, whether the damage arises from an unlawful act or from a lawful but risk-based activity.

(1)IAEA, Convention on Early Notification of a Nuclear Accident. Vienna: IAEA, 1986. - OECD–NEA, International Nuclear Third Party Liability (Issue Brief No. 4). OECD Nuclear Energy Agency, 1993, pp. 4–5

(2) IAEA, Convention on Early Notification of a Nuclear Accident. Vienna: IAEA, 1987. - International Law Commission, Draft Articles on Responsibility of States for Internationally Wrongful Acts. United Nations, 2001, Art 32

Compensation usually takes a monetary form but may sometimes involve restitution to the prior state of affairs. International conventions, such as the Paris and Vienna Conventions, delineate the scope of compensable damage, including bodily injury and property damage resulting from the radioactive, toxic, or explosive characteristics of nuclear materials(1).

To limit the burden on nuclear facility operators, these conventions establish caps on liability to avoid unlimited exposure that could lead to insolvency. In this context, the 1997 Protocol on Supplementary Compensation created a multi-tiered financial system involving contributions from States and operators, alongside an international fund covering damages exceeding the established limits. Nuclear energy-producing States bear the largest share of this fund, with a portion allocated for compensating damage to non-nuclear States(2).

Despite these measures, compensation amounts often prove insufficient to cover the consequences of major nuclear disasters, as evidenced by the Chernobyl and Fukushima catastrophes, compelling some States to provide additional compensation motivated by national solidarity. Given the difficulties in proving causation in nuclear damage cases, particularly where effects emerge after long latency periods, international conventions have adopted the standard of probable or inseparable damage from the nuclear incident as a basis for compensation claims(3).

(1) Crawford, J, Op.cit, 2013, pp. 308–310

(2) OECD/NEA, Paris and Brussels Liability Conventions: Explanatory Texts. OECD Publishing, 2015. - IAEA, Vienna Convention and Protocol on Civil Liability for Nuclear Damage: Status and Commentary. Vienna: IAEA, 2023

(3) OECD/NEA, Paris and Brussels Liability Conventions: Explanatory Texts. OECD Publishing, 2015. - IAEA, Enhancing National Legal Frameworks for Nuclear Safety and Liability. Vienna: IAEA, 2020

Liability grounded in the risk theory relies on three interconnected elements: first, the occurrence or likelihood of transboundary damage; second, the inherent nature of the nuclear activity entailing foreseeable risks; and third, the attribution of the activity to a specific State(1). Accordingly, the State conducting the activity bears a legal obligation to undertake preventive measures, engage in international cooperation, and compensate victims upon the occurrence of damage.

Conclusion

The peaceful use of nuclear energy is a fundamental and internationally recognized right of States under international law. However, this right entails substantial challenges and responsibilities that demand stringent international regulation and ongoing oversight of nuclear activities.

While nuclear technology offers significant benefits in areas such as energy production, medicine, and industry, its inherent risks—often transcending national borders and potentially threatening the security of neighboring States and the global environment—necessitate clear and enforceable rules on international liability.

To this end, the development of robust international safeguards and monitoring mechanisms, as provided by the International Atomic Energy Agency (IAEA), alongside comprehensive international treaties that define the liability framework for nuclear damage, is imperative. Such measures ensure that nuclear energy is utilized in accordance with international legal principles and the collective interest in protecting human safety and the environment.

(1) Crawford, J, Op.cit, pp. 262–263. - Faure, M., & Fiore, K, Op.cit, pp. 95–98

Imposing international responsibility on States engaged in nuclear activities that cause damage—whether through negligence or the nature of the activity itself—is a critical deterrent against conduct that could lead to severe consequences.

Notable incidents, including the fall of nuclear-powered satellites and disasters like Chernobyl, underscore the vulnerabilities within the international system regarding fair compensation. These events highlight the urgent need for enhanced international cooperation and strict adherence to legal standards to prevent recurrence.

Moreover, some States' practices of disposing nuclear waste in the high seas infringe upon the rights of other States and violate international obligations. This reality emphasizes the importance of respecting the Law of the Sea and protecting the marine environment.

Accordingly, it is essential to continue developing international legal norms governing liability for nuclear damage and to strengthen enforcement and compensation mechanisms. Equally important is balancing States' rights to the peaceful use of nuclear energy with safeguarding the international community from its risks.

Establishing an effective, accountable international legal regime that achieves this balance is the optimal path to ensuring the safe and sustainable use of nuclear energy, thereby benefiting humanity without compromising human safety or environmental integrity.

Based on the findings of this study, the following recommendations are proposed to strengthen and operationalize the international legal framework for the peaceful use of nuclear energy:

1. Revising the Paris and Vienna Conventions to expand the scope of protection and ensure more effective and comprehensive compensation for affected parties.

2. Establishing an international compensation fund for transboundary nuclear damage, with contributions from nuclear-capable States proportional to their nuclear activities.
3. Adopting a unified and precise definition of "peaceful use of nuclear energy" in international legal instruments to minimize conflicting interpretations among States.
4. Enhancing the role of the IAEA beyond monitoring and safeguards to include dispute resolution and provision of technical and financial compensation mechanisms.
5. Facilitating equitable access to nuclear technology for developing countries, within legal frameworks that guarantee safety and prevent nuclear proliferation.

References

1- Books

- Anzilotti, Dionisio, Cours de droit international. Paris: Sirey, 1928, as cited in Pellet, 2010
- Birnie, Patricia, Boyle, Alan, & Redgwell, Catherine, International Law and the Environment (3rd ed.). Oxford University Press., 2009
- Bodansky, Daniel, Nuclear energy and international law: Strict liability and risk, Oxford University Press, 2010
- Brownlie, Ian, Principles of Public International Law (7th ed.). Oxford University Press, 2008
- Crawford, James, State Responsibility: The General Part. Cambridge University Press, 2013
- Findlay, Trevor, Governing the Atom: The IAEA, the NPT, and Nuclear Disarmament, International Institute for Strategic Studies, 2010
- Fischer, David, History of the International Atomic Energy Agency: The First Forty Years. IAEA, 2003
- Henderson, Janne E, International nuclear law and regulations. Cambridge University Press, 2019

- Joyner, Daniel H, Interpreting the Nuclear Non-Proliferation Treaty. Oxford University Press, 2011
- Klabbers, Jan, An introduction to international law (3rd ed.). Cambridge University Press, 2013
- Fitzmaurice, Malgosia & Elias, Olivia, Contemporary issues in international law, Oxford University Press, 2020
- O'Keefe, Roger, Liability for nuclear damage in international law, Routledge, 2015
- Sand, Peter H, Principles of International Environmental Law (2nd ed.). Cambridge University Press, 2003
- Scheinman, Lawrence, Nuclear non-proliferation: A study in international law and policy. University of Washington Press, 1997
- Simma, Bruno, Khan, Daniel-Erasmus, Nolte, Georg, & Paulus, Andreas, The Charter of the United Nations: A Commentary (3rd ed.). Oxford University Press, 2011
- Sloss, David, The Role of Domestic Courts in Treaty Enforcement. Cambridge University Press, 2014
- Spector, Leonard S, The New Nuclear Nations. Vintage Books, 1984
- Weiss, Edith Brown, The promise of nuclear energy: Challenges for the 21st century. Routledge, 2017

2- Articles

- Boese, Wade M, Iran Misses Nuclear Deadline; Security Council Warns. Arms Control Today, 36(8), 2006.
- Boyle, Alan, State Responsibility and International Liability for Injurious Consequences of Acts Not Prohibited by International Law. International and Comparative Law Quarterly, 46(1),1995
- Carlson, John., Nuclear Terrorism: Global Response Strategies. Australian Journal of International Affairs, 59(3),2015
- Christenson, Gary A, China and the United States: The Collision of Spy Plane EP-3 and International Law. ASIL Insights, American Society of International Law, 2001
- Dupuy, Pierre-Marie, The International Law of State Responsibility: Revolution or Evolution? Michigan Journal of International Law, 10(1), 1989
- ElBaradei, Mohamed, Reflections on nuclear control. IAEA Bulletin, 46(2), , 2004.

- ElBaradei, Mohamed, Towards a safer world. The Economist, 2004
- Faure, Michael, & Fiore, Karine, Civil Liability and Financial Security for Offshore Oil and Gas Activities, European Journal of Risk Regulation, 1(1), 2009
- Freestone, David, The Road from Stockholm to Johannesburg: The Development of the Law of Sustainable Development, Environmental Law Review,, 3(1), 2001
- Goldschmidt, Pierre, Multilateralizing Nuclear Fuel Cycles: Time to Think Outside the Box. Carnegie Endowment for International Peace, 2009
- Handl, Gunther, State Liability for Accidental Transboundary Environmental Damage by Private Persons. American Journal of International Law, 74(3),2007
- Hasegawa, Makoto, Legal challenges following the Fukushima nuclear disaster. Journal of Environmental Law, 24(1), 2012
- Kunz, Josef, Transboundary nuclear harm and international law. Environmental Policy and Law, 46(4), 20, 2016
- Pomper, Miles A., & Dalton, Thomas., & Dalton, T, Nuclear power, nuclear proliferation, and international security, Arms Control Today, 36(10), 2006
- Schmidt, Sonja, & Amann, Julian, The future of nuclear liability regimes: Balancing development and environmental protection. International Environmental Law Review, 32(2), 2018

3- International Treaties & Conventions

- IAEA, Convention on Early Notification of a Nuclear Accident. Vienna: IAEA, 1986
- IAEA, Convention on Early Notification of a Nuclear Accident. Vienna: IAEA, 1987
- IAEA, Vienna Convention and Protocol on Civil Liability for Nuclear Damage: Status and Commentary. International Atomic Energy Agency, 2023
- UN, Convention on International Liability for Damage Caused by Space Objects, 1972
- UN, International Convention for the Suppression of Acts of Nuclear Terrorism, General Assembly Resolution A/RES/59/290, 2005
- UNEP/MAP, Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources, 1980
- United Nations, Charter of the United Nations, 1945

- United Nations, Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration), 1972
- United Nations, Rio Declaration on Environment and Development, 1992
- United Nations, Treaty on the Non-Proliferation of Nuclear Weapons, 1968
- United Nations, Vienna Convention on the Law of Treaties, 1969

4- UN General Assembly & Security Council Resolutions

- United Nations General Assembly, Tenth Special Session on Disarmament, 1978
- United Nations Security Council, Resolution 1696 (Iran Nuclear Program), 2006
- United Nations Security Council, Resolution 487 (Iraq Nuclear Reactor), 1981
- UNSC, Resolution 1373, 2001
- UNSC, Resolution 1540, 2004
- UNSC, Resolution 73 on the Assassination of Count Bernadotte, 1949

5- ICJ & Arbitration Cases

- ICJ, Corfu Channel Case (U.K. v. Albania), 1949
- International Court of Justice (ICJ), Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996
- International Court of Justice (ICJ), Pulp Mills on the River Uruguay (Argentina v. Uruguay), Judgment, 2010
- Nuclear Tests Case, Australia v. France, 1974
- Trail Smelter Arbitration (U.S. v. Canada), 3 R.I.A.A. 1905, 1941

6- Reports

- IAEA, Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts, 2016
- IAEA, Enhancing National Legal Frameworks for Nuclear Safety and Liability, 2020
- IAEA, Environmental Consequences of the Chernobyl Accident and Their Remediation, 2005
- IAEA, History of Safeguards, 2018

- IAEA, IAEA Action Plan on Nuclear Safety: Progress Report, 2015; OECD-NEA, 2013
- IAEA, IAEA Safety Glossary, 2018
- IAEA, International Safeguards: History and Overview, 2023
- IAEA, Management of Waste Containing Tritium and Carbon-14, 2007
- IAEA, Nuclear Law: The Global Debate on Liability and Safety, 2023
- IAEA, Nuclear Security Fundamentals, 2022
- IAEA, Safeguards Agreements and Additional Protocols, 2023
- IAEA, Statute of the International Atomic Energy Agency, 1957
- IAEA, Strengthened Safeguards System: Programme 93+2, 1997
- IAEA, Technical Cooperation and Developing Countries, 2020
- IAEA, Technical Cooperation and Nuclear Technology Transfer, 2020
- IAEA, The Structure and Content of Agreements Between the Agency and States..., 2002
- IAEA, Treaties and Conventions, 2023
- International Energy Agency, World Energy Outlook 2022, IEA Publications
- Nuclear Suppliers Group, NSG Guidelines, 2023
- OECD Nuclear Energy Agency (NEA), International Nuclear Third Party Liability (Issue Brief No. 4), 1993
- OECD/NEA, Exposé des Motifs of the Paris Convention, 2020
- OECD/NEA, Paris and Brussels Liability Conventions: Explanatory Texts, 2015
- OECD–NEA, International Nuclear Third Party Liability, 1993
- U.S. Department of State, Proliferation Security Initiative: Statement of Interdiction Principles, 2004
- United Nations Environment Programme, Environmental Governance and Nuclear Safety, 2017
- United Nations, Transforming our world: The 2030 Agenda for Sustainable Development, 2015
- World Nuclear Association, Liability for Nuclear Damage, 2024
- World Nuclear Association, Nuclear Power in the World Today, 2024