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Article

The development of international civil liability legal regime for nuclear damage and their inspiration for domestic law-making

Jiu Liu[1], Han Wang[1], Yi Liu[1], Yuetong Gao[1], Le Shen[2,*], Jingyi Wu[3]

[1] College of Humanities and Social Sciences, Harbin Engineering University, Harbin 15001, China
[2] School of Law, Anhui University, Hefei 230601, China
[3] Department of Political Economy, King's College London, London WC2R 2LS, UK
*** Corresponding author:** Le Shen, nine699@hrbeu.edu.cn

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Abstract: As International Atomic Energy Agency has stated in its Handbook on Nuclear Law, "Even in situations for which the highest standard of safety has been achieved, the occurrence of nuclear accidents cannot be completely excluded." Therefore, the international legal framework for nuclear damage compensation liability has been evolving since the establishment of Nuclear Energy Agency of Organization for Economic Co-operation and Development (OECD NEA) and International Atomic Energy Agency (IAEA). Over the years, various international treaties have been enacted to address the compensation of nuclear damage and to establish liability regimes for nuclear incidents. To date, these treaties have established a series of legal principles of nuclear damage liability, such as the sole liability principle, the strict liability principle, the financial guarantee principle etc., which have been developing since establishment. This paper offers an overview of the historical development of the principles of these international treaties for nuclear damage liability and thus draws upon both primary and secondary sources, including treaties, official documents, academic literature, and reports by international organizations. Including the legislation study methodology, comparative methodology is also adopted in this paper to analyze the changes and trend of these principles. The paper reveals that the Paris Convention, which was established in 1960, was the first attempt to establish a comprehensive legal regime for nuclear damage liability. Most of the principles of this Convention have been inherited by subsequent international treaties and domestic legislations. With the awareness of protecting public's rights having been significantly strengthened, the range of compensation has been broader, the matters of immunity from liability for operators of nuclear power plants have been reduced, the limitation of the compensation amount has been higher etc. In conclusion, the international legal regime for nuclear damage liability has been showing a shift from protecting the development of the nuclear industry to a joint protection of both public health and rights and the nuclear industry, which should be paid attention to and deeply learnt by domestic legislators of all states for the establishment and perfection of their domestic legislation in this field.

Keywords: nuclear damage; liability; compensation; international regime; principles

Nuclear energy is considered a safe, low-carbon, and clean source of energy, playing a significant role in optimizing energy structures and reducing greenhouse gas emissions. However, the development and utilization of any energy source come with inherent risks. The civil nuclear industry carries the potential for radioactivity and other hazards. Despite placing great emphasis on the prevention of safety risks associated with the nuclear industry throughout its development and establishing a comprehensive prevention and response system, the risk of nuclear accidents cannot be entirely eliminated.

As early as the 1950s, countries developing civil nuclear industries recognized the necessity of creating a stronger, fairer, and more universally applicable nuclear damage compensation mechanism, aimed at safeguarding the interests of nuclear accident victims and promoting the worldwide advancement of civil nuclear industries. Specifically, there was a consensus that establishing an international regime for nuclear liability would streamline the process of initiating legal actions and enforcing judgments, mitigating the obstacles posed by disparate national legal systems (IAEA International Law Series No. 3, 2017). The first international treaty in the field of nuclear damage liability, the "Convention on Third Party Liability in the Field of Nuclear Energy (Paris Convention)", was concluded in 1960 and officially entered into effect in 1968. The 1986 Chernobyl disaster empirically validated prior theoretical assessments, underscoring the potential for a nuclear incident to inflict damage of extreme magnitude. This incident underscored the inherently transboundary nature of nuclear accidents, affirming that their adverse impacts surpass national demarcations and may proliferate into areas well outside the territorial sovereignty of the State experiencing the accident. There may be damage to individuals, to property and to the environment in several States (Carlton et al., 2003). Consequently, following the inception of the Paris Convention, endeavors to reform and enhance the international regime governing liability for nuclear damage compensation have persisted unabated.

1. The emergence and development of the international regime for nuclear damage compensation

1.1. The emergence and development of the Paris Convention

Historically, Europe has been characterized by a landscape dotted with numerous small states, the compact geographical configuration of European nations has heightened apprehensions regarding the potential for cross-border nuclear damage in the era of nuclear energy's peaceful utilization. In response, the Nuclear Energy Agency of the Organization for European Economic Co-operation drafted the Convention on Third Party Liability in the Field of Nuclear Energy (Paris Convention), the world's first international treaty addressing nuclear damage liability (NEA, 2022a). This convention came into effect in 1968 and established the foundation for international nuclear damage compensation.

The Paris Convention established fundamental principles, such as the sole liability principle and the strict liability principle of the operator that remain operative to this day. Acknowledging the potential inadequacy of its compensation limits to fully address nuclear damages, the OECD Nuclear Energy Agency (NEA) revised the convention, culminating in the formulation of the "Brussels Supplementary Convention" in 1964. This supplementary convention established a three-tier compensation mechanism involving national and international public funds (Carlton et al., 2003). Consequently, the "Brussels Supplementary Convention" has established a solid financial linkage among the contracting states, fostering close ties between them (NEA, 2022b). The "Brussels Supplementary Convention" consists of 25 articles and officially came into effect on 4 December 1974. According to its Article 19, a prerequisite for joining this Convention is to be a member state of the "Paris

Convention". Consequently, the "Brussels Supplementary Convention" grants member states of the "Paris Convention" the option to join, allowing them to voluntarily decide whether to become part of the Brussels Supplementary framework. Together, these treaties constitute the "Paris Convention" system.

As of December 2022, a total of sixteen countries have ratified their membership in the "Paris Convention" system (NEA, 2022c), of which thirteen have also ratified the "Brussels Supplementary Convention" (NEA, 2024d). The member states of the "Paris Convention" system are all members of the OECD, predominantly from Western Europe, thereby giving the "Paris Convention" system a pronounced regional characteristic.

1.2. Formation and evolution of the Vienna Convention System

In 1953, US President Dwight D. Eisenhower's "Atoms for Peace" speech at the UN General Assembly led to the founding of the International Atomic Energy Agency (IAEA) in 1956 (Atoms for Peace Speech, 1953). Aiming to establish a broader and more encompassing international legal framework for nuclear damage liability, the newly established International Atomic Energy Agency (IAEA) promulgated the "Vienna Convention on Civil Liability for Nuclear Damage" (Vienna Convention) in May 1963. This convention officially took effect in November 1977 and consists of twenty-nine articles.

The Vienna Convention precisely defines "nuclear damage" and "nuclear incident", establishes statutes of limitations for nuclear damage claims, outlines financial security obligations for operators, and enforces the principle of single court jurisdiction. In September 1997, to enhance the 1963 Vienna Convention, the "1997 Vienna Convention on Civil Liability for Nuclear Damage" was adopted, commonly referred to as the "1997 Vienna Convention" (Vienna Convention on Civil Liability for Nuclear Damage, 1997). Comprising twenty-four articles, it officially came into effect in October 2003. Building upon the 1963 Vienna Convention, the 1997 Vienna Convention extended its applicability, refined the concept of nuclear damage, reduced exemptions for nuclear facility operators, increased compensation limits, and extended the statute of limitations for damage claims.

As of December 2022, the 1963 Vienna Convention had forty-two signatory states (IAEA, 2022b), while the 1997 Vienna Convention had fifteen member states (IAEA, 2020b)

1.3. Convergence and development of the two major convention systems

1.3.1. Joint Protocol Relating to the application of the Vienna Convention and the Paris Convention

While the "Vienna Convention System" and the "Paris Convention System" are similar in legislative intent, legal principles, and specific article contents, these two major systems did not initially interact with each other and were applicable only within their respective contracting states. The 1986 Chernobyl nuclear disaster made countries in the world realize the importance of expanding the scope of international nuclear damage compensation mechanisms (NEA, 1992b). Thus, to expand the applicability of the Paris Convention System and Vienna Convention System, and link

them together, a conference was jointly held in September 1988 by the IAEA and OECD Nuclear Energy Agency regarding the relationship between the two conventions. The outcome was the formulation and adoption of the "Joint Protocol Relating to the Application of the Vienna Convention and Paris Convention", abbreviated as the "Joint Protocol". The Joint Protocol, comprising eleven articles, officially came into effect on 27 April 1992. It does not prescribe substantive provisions but delineates the mechanisms through which contracting states may implement one of the two convention systems following an incident. As a bridge effectively connecting the Paris Convention and Vienna Convention systems (NEA, 2022a), the Joint Protocol is open only to all contracting states within the two convention systems. With Morocco's ratification in August 2022, thirty-three countries have now ratified the Joint Protocol (IAEA, 2022a).

1.3.2. Convention on supplementary compensation for nuclear damage

Since its inception, the International Atomic Energy Agency (IAEA) has diligently worked toward establishing a comprehensive global nuclear damage compensation liability regime. By creating a unified global system, the IAEA aims to enhance compensation levels, foster regional and global collaboration, and promote the safe and efficient utilization of nuclear energy. As a result, the Convention on Supplementary Compensation for Nuclear Damage (CSC) was introduced by IAEA in September 1997. The 1997 CSC not only connects countries of the Vienna Convention and Paris Convention but also establishes links between contracting and non-contracting states. It stipulates that any country, whose domestic laws align with the liability mechanisms detailed in the annex, can join the convention. Therefore, the CSC is open to nearly all countries and is more compatible and open than any previous related treaties. It heralded a new era for the establishment of international mechanisms for nuclear damage compensation (Mcrae, 1998).

CSC was enacted simultaneously with the 1997 Vienna Convention, marking a significant milestone in the establishment and development of the global nuclear damage compensation liability mechanism. After the 2011 Fukushima nuclear accident in Japan, the IAEA urged member states to work towards a global nuclear liability mechanism to alleviate concerns of countries potentially affected by nuclear accidents (Chen and Zhao, 2018). In April 2015, with Japan's ratification, the CSC officially came into effect, consisting of a main text with twenty-seven articles and its annex.

A key feature of the CSC is its independence and inclusivity. While it is based on the systems of both the Vienna Convention and Paris Convention, it is an independent treaty open to all countries. Both signatory countries of the Paris Convention and Vienna Convention are eligible to join the CSC. Additionally, non-signatory nations may accede to the CSC if their domestic laws align with the principles and spirit outlined in the CSC's annexes and if they are also parties to the Convention on Nuclear Safety. Furthermore, the CSC was designed to be compatible with both the Paris Convention and Vienna Convention, so signatories don't have to modify previously acceded conventions but only need to amend their domestic laws to comply with the annex's requirements. Moreover, via the CSC's reserve clause, even if a country's domestic laws don't entirely align with the convention, it can still accede and become

a contracting state. Thus, compared to the two previous convention systems, the CSC is more conducive to the development and perfection of a global nuclear damage compensation liability mechanism. After the Fukushima nuclear accident, Japan formally acceded to the CSC in 2015. As of now, eleven countries have officially become contracting states, including Romania, Morocco, Argentina, the United States, United Arab Emirates, Japan, Montenegro, India, Ghana, Canada, and Benin (IAEA, 2020a).

1.4. Other treaties on nuclear damage compensation

In addition to the conventions previously discussed, there exist the "1962 Convention on the Liability of Operators of Nuclear Ships", which remains pending entry into force, and the "1971 Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material". The latter convention was ratified and came into force in 1975, further extending the legal framework governing nuclear liability to include specific aspects of maritime nuclear transport.

1.5. Practice of the international civil liability regime for nuclear damage

The international legal framework for nuclear damage liability treaties has not seen direct practical application. During the Three Mile Island incident, the United States was not a party to any international nuclear liability conventions. Similarly, at the time of the Chernobyl disaster, the Soviet Union was not a signatory to any nuclear damage treaties. However, following the Chernobyl incident, there was significant development in European nuclear liability treaties. Additionally, post-Soviet Russia joined the Vienna Convention in 2005.

During the Fukushima nuclear accident, Japan did not operate under any international nuclear liability treaties for compensation. Nonetheless, Japan applied the principles of nuclear damage treaties in its compensation practices. Notably, unlike the international nuclear liability treaties, Japan adopted an unlimited liability approach. This led to protracted compensation processes and delayed the recovery of the nuclear industry, highlighting the efficiency and superiority of the principles enshrined in the treaties compared to Japanese practice. Furthermore, Japan's accession to the CSC in 2015, four years after the Fukushima incident, reflects its recognition of these principles.

Therefore, although international nuclear damage liability treaties have not been directly tested in practice, their principles have been continually applied and developed over the years.

2. Important legal principles established by the International Convention on liability for Nuclear Damage

Principle refers to the fundamental rules or standards on which speech or actions are based. Principles carry a depth and weight that rules do not (Li, 2006). The legal principles of nuclear damage compensation liability refer to the principles that are clearly stipulated or embodied in the nuclear damage compensation liability system, have universal guiding significance in the field of nuclear damage compensation, reflect the basic characteristics of the nuclear damage compensation system, and form

the basis of the nuclear damage compensation regime (Cai, 2020). Although the subsequent principles were not established by the international liability conventions for nuclear damage, the conventions' primary objective and benefit rest in elucidating and promoting universal endorsement of these principles among a broadening array of nations, regardless of their involvement in the development of nuclear power industries.

2.1. Sole liability principle

In cases of accidents due to defects in services, materials, or equipment, the injured party typically has the right to sue involved parties or manufacturers. However, the "Sole Liability Principle", also known as the "Concentrated Liability Principle", focuses responsibility on one entity, sparing others from direct liability to the victim (IAEA International Law Series No. 3, 2017).

The Solo Liability Principle guarantees victims may seek compensation from entities possessing superior financial capabilities, thereby fostering risk prevention and attributing exclusive responsibility for all nuclear damage compensation to the nuclear facility operators. Such operators, being duly licensed, possess the requisite expertise to effectively manage risks, avert incidents, and alleviate adverse outcomes. Imposing liability on operators serves as a significant incentive for investment in nuclear safety measures. Implementing the principle of exclusive liability can effectively address the issue of identifying the liable party for victims, concentrating the compensation responsibility on those with greater financial capability to ensure victims receive adequate compensation. Additionally, this approach encourages the entity bearing concentrated responsibility to more prudently manage risks and centralizes insurance liability, relieving entities not responsible from the economic burden of purchasing relevant insurance. It also facilitates regulatory oversight and management by government agencies (Yoshikawa, 2014).

Regarding this, as early as the 1960 Paris Convention Article 3, it was explicitly stipulated that the operator of a nuclear installation is responsible for nuclear damage. The 1963 Vienna Convention Article 2 reaffirmed this basic principle, stating that "the operator of a nuclear facility shall be liable for nuclear damage". The 1997 CSC also outlined in Annex Article 3 "Operator's Liability" that the operator of the nuclear facility causing the nuclear accident is responsible for the resulting nuclear damage.

Liability for nuclear damage during transportation is directly borne by the operator of the nuclear installation in case of any incident while the materials are in transit. The IAEA has summarized the basic approach to handling such liability for nuclear damage during transportation in clear and straightforward language: for nuclear damage involving the transportation of nuclear materials, the responsibility falls either on the operator of the nuclear installation from where the nuclear material originated or on the operator at the destination of the nuclear material. In other words, either the sender or the recipient is responsible. Therefore, the sender and recipient should agree via a written contract on the stage of transportation at which the liability is transferred. In the absence of such a contract, when the recipient accepts the nuclear materials, the liability transfers from the sender to the recipient (Carlton et al., 2003).

2.2. Strict liability principle

Strict liability is a legal principle that holds an entity responsible for damage caused by their actions, regardless of fault or negligence. Unlike fault liability, which considers intent or negligence, strict liability focuses solely on the outcome of the action. It ensures swift compensation for victims without the need to prove fault, especially in inherently dangerous activities.

The concept of strict liability emerged during the Industrial Revolution due to complex production processes and increased industrial accidents. It was developed to ensure swift compensation for victims without the need to prove fault or negligence, especially for inherently dangerous activities. Today, strict liability applies to activities like nuclear facility operation and nuclear material transportation, as these involve inherent risks requiring special safety measures. Nuclear facilities are recognized as inherently hazardous, given their potential for severe damage. The operation of nuclear facilities always entails risks; design and manufacturing defects, construction and installation errors, operational and maintenance negligence, as well as equipment malfunctions, can all lead to incidents of nuclear damage (Jiang, 2015). Therefore, the operational activities of nuclear facilities and the transportation of nuclear materials are recognized as inherently high-risk activities. This recognition is based on the "inherent high danger" associated with nuclear installations and their utilization, as well as the significance of the damages that can result from such activities (Lin, 2000). Therefore, adopting the principle of strict liability as the basis for attributing responsibility for nuclear damage compensation is a consensus among national legislations and international conventions on nuclear liability (Liu, 2020).

In the context of nuclear damage compensation, strict liability dictates that the operator of a nuclear facility must bear compensation liability, regardless of fault. This principle eliminates disputes over responsibility, facilitating prompt compensation for victims, which is crucial due to the large compensation amounts, wide geographic impact, and complex harm mechanisms associated with nuclear damage. The operator's liability is considered absolute under these conventions and national legislation on nuclear liability, ensuring victims' interests are protected and compensation is delivered promptly.

2.3. Limited liability principle and financial guarantee

The essence of nuclear damage liability legislation is to enhance the protection of victims' interests and to mitigate the adverse effects on their benefits following a nuclear incident or accident. This legal framework is designed to guarantee that victims receive timely and comprehensive compensation, allowing them to rehabilitate their lives and return to their pre-incident conditions as swiftly as possible. Concurrently, the legislation aims to prevent the stagnation, collapse, or potential bankruptcy of the civilian nuclear industry triggered by nuclear accidents and the ensuing compensation claims.

This dual objective underscores the critical balance the legislation seeks to maintain: on one hand, it prioritizes victim compensation and recovery, ensuring they are made whole to the greatest extent possible; on the other hand, it safeguards the viability and sustainability of the nuclear industry (Cai, 2020). By instituting

mechanisms such as the limited liability principle, financial guarantees in advance, and a tiered compensation framework, the legislation facilitates a responsive and responsible approach to nuclear incidents.

These provisions not only foster a resilient nuclear energy sector capable of contributing to national energy needs but also instill public confidence in nuclear safety and compensation protocols. Thus, the nuclear damage liability legislation plays a pivotal role in the sustainable development of nuclear energy, balancing economic, environmental, and social considerations in the aftermath of nuclear incidents.

2.4. State supplementary compensation principle

The role played by the State in the field of nuclear damage compensation is characterized by its auxiliary, supplementary, and fundamental nature (Vanda, 2011). If the pre-financial guarantees provided by the nuclear operator are insufficient to cover the required nuclear damage compensation, and the amount exceeds the operator's capacity to pay, the State should timely supplement the compensation with fiscal funds to compensate the victims and cover the loss. This supplement, which the operator cannot pay but is required to, embodies the Principle of State Supplementary Compensation within the nuclear damage liability system. The Principle of State Supplementary compensation, also known as the State Intervention Principle, entails the State's participation in nuclear damage compensation efforts and assumes the responsibility for paying compensation that the accident-involved nuclear facility operator is unable to afford (Cai, 2020). State Supplementary Compensation can effectively alleviate the immense pressure on nuclear facility operators to continue their engagement in the nuclear energy sector. The prioritization of victim protection stipulated by the nuclear damage compensation system actually facilitates legislators in considering the interests and achieving a balance among participants (the Operators, the State) within civil legislation (Chen, 1995).

There are three reasons for incorporating the Principle of State Supplementary Compensation into international treaties on nuclear damage liability. First, the nuclear industry is subject to stringent government regulation. The occurrence of nuclear accidents causing damage, even if entirely due to force majeure or accidental events, is to some extent causally linked to inadequate government oversight. Therefore, it is reasonable for the state to fulfill supplementary compensation obligations to victims of nuclear accidents. Additionally, requiring the government to assume supplementary compensation responsibilities encourages the government to enhance its regulatory oversight of the nuclear industry, ensuring nuclear safety (Wang and Hu, 2021). Second, the immense risk posed by nuclear accidents severely threatens the safety and stability of the entire society. Therefore, state intervention, adjustment, and relief are necessary. The state has an obligation to provide economic relief to victims suffering hardships due to nuclear damage, ensuring the restoration of their interests and livelihoods. Third, the relief for "mass victimization" caused by nuclear accidents is considered one of the challenges of modern civil law (Liang, 1997). Traditional tort law is based on the binary structure of perpetrator and victim, inherently constituting a "mechanism that pursues individual responsibility" (Wang, 1999), It has failed to offer effective solutions. Adopting the Principle of State Supplementary compensation

and introducing public authority breaks the traditional pattern of internal loss compensation among private subjects in the tort domain, meeting the practical needs of accident management.

Therefore, Article 7 of the 1997 Vienna Convention stipulates that losses from a nuclear accident should first be compensated by insurance or other financial guarantees. When insurance or other financial guarantees are insufficient to fully meet the claims, the country hosting the nuclear facility should provide the necessary funds to ensure the payment of claims by operators for established nuclear damage. Simultaneously, Article 5 of the Annex to the 1997 CSC also requires that the country hosting the nuclear facility be listed as a supplementary compensator, covering victims' losses that cannot be compensated by operators and other responsible parties within specified limits.

Under this principle, the state not only plays a role in guiding the peaceful use of nuclear energy but also safeguards nuclear damage compensation in the event of a nuclear accident. When operators are unable to fulfill compensation obligations, the state must promptly supplement with fiscal funds to protect the rights and interests of the victims, ensuring they receive timely and fair compensation. This alleviates the significant financial pressure on the operators of the accident-impacted nuclear facilities, thereby stabilizing the continuous development of the civilian nuclear industry.

2.5. Exclusive jurisdiction principle

Whether it is the 1960 Paris Convention, the 1997 Vienna Convention, or the 1997 CSC for legal disputes arising from nuclear damage caused by nuclear accidents, only the remedy of "litigation" is specified. Moreover, it is stipulated that only the courts of the contracting state where the nuclear accident occurred have jurisdiction. Different from the jurisdictional approach for ordinary tort damages, disputes over nuclear damage compensation typically adhere to the "Exclusive Jurisdiction Principle". This principle means that within a country, a single competent court is designated to handle all lawsuits related to the same nuclear damage incident against the nuclear facility operator, including direct lawsuits against insurance companies or other financial guarantors and lawsuits to determine claims (International Expert Group on Nuclear Liability, 2004).

This principle of exclusive jurisdiction by a single court grants exclusive jurisdiction to a specific court in the country where the accident occurred, excluding the jurisdiction of any other courts. This principle is an extension of the limited liability principle, ensuring that the limited compensation funds are distributed fairly and reasonably (Guo, 2007). Such centralized jurisdiction not only ensures the reliability of the law but also eliminates the possibility of nuclear damage victims choosing courts to submit claims for higher compensation. This practice of forum shopping could lead to significant losses for operators, potentially resulting in the rapid depletion of funds available for compensation, thereby leaving other victims uncompensated (Carlton et al., 2003). This principle, which specifies the court with jurisdiction over nuclear damage compensation disputes, ensures the uniformity of judicial authority and the fairness of justice. It prevents victims from receiving

inconsistent compensation due to varying adjudication standards across different courts. Additionally, it spares victims the burden of litigating in multiple courts across different countries, thus saving them litigation costs and time (Liu, 2020).

3. The development of the international legal regime on nuclear damage liability

The Paris Convention on Third Party Liability in the Field of Nuclear Energy, the world's inaugural international treaty addressing nuclear damage compensation, has been in effect for over six decades. Throughout its history, the international framework for nuclear damage compensation has undergone significant evolution, both in its scope and substance. The aftermath of the Fukushima nuclear disaster in March 2011 catalyzed an increase in the number of countries ratifying international treaties related to nuclear damage compensation. This, in turn, has amplified the treaties' influence on both member and non-member states alike. Consequently, more nations are creating, enhancing, and refining their domestic legal frameworks for nuclear damage compensation, drawing upon these international agreements. Therefore, analyzing the developmental trends and key elements of these international treaties is crucial for a comprehensive understanding and study of the nuclear damage compensation legal framework.

3.1. Expanding compensation scope for nuclear damage

The definition of compensable nuclear damage has progressively broadened over time. Initially, the 1960 Paris Convention confined compensation to personal injuries, fatalities, and property damage. The scope was widened by the 1963 Vienna Convention to potentially include additional types of damage, contingent upon the approval of the law governing the competent court. The 1997 Vienna Convention further extended this scope to cover a variety of economic losses, environmental damages, and costs associated with preventive measures, all subject to the adjudication of the competent court.

Figure 1 delineates the gradual enlargement of the scope of damages eligible for compensation in the wake of a nuclear incident. This spectrum now embraces personal injuries or death, property damages, economic losses, costs for environmental rehabilitation, income losses attributable to environmental degradation, expenses for preventive actions, and other related economic losses. These latter categories (3 to 7) are recognized provided they conform to the legislation interpreted by the competent court. The term "reinstatement measures" denotes initiatives sanctioned by the relevant national authority to repair environmental damage, whereas "preventive measures" involve prudent steps taken after a nuclear incident aimed at averting or mitigating further damage, as judged by the competent court in light of specific circumstances.

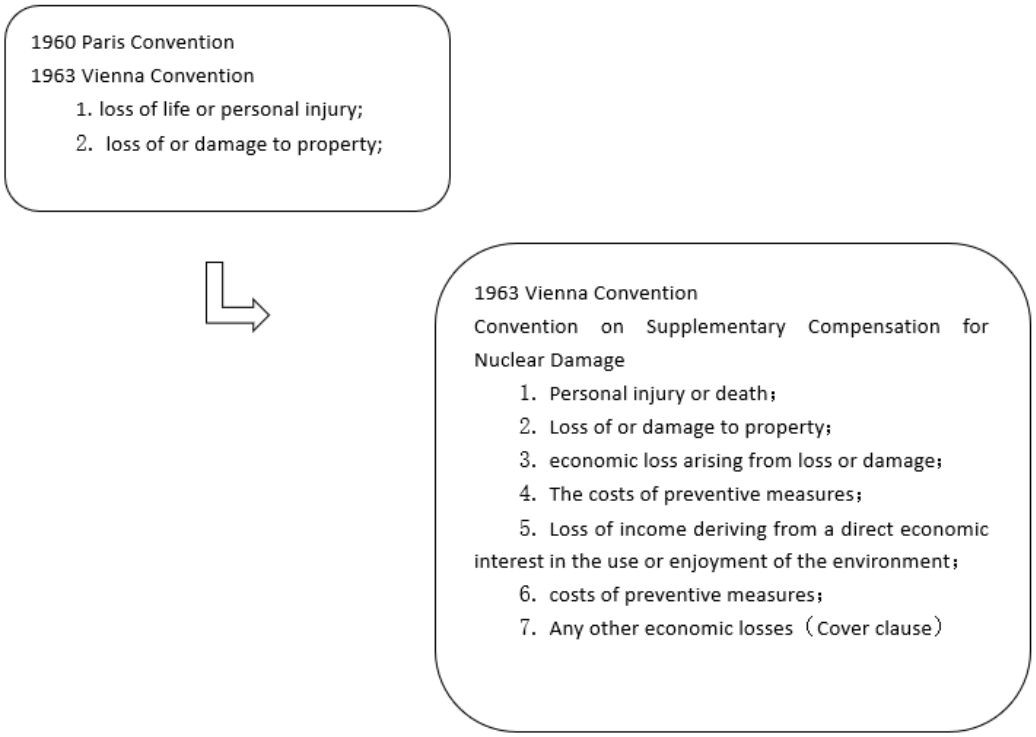

Figure 1. The scope of compensation for nuclear damage is increasingly broad.

3.2. Fewer exemptions for nuclear facility operators

International conventions on nuclear damage compensation impose strict liability on operators of nuclear facilities, yet these obligations are not absolute. Specific statutory conditions allow for operators to be exempted from liability for nuclear damage, even in cases where their actions would normally incur such liability. The foundational texts in this domain, the Paris Convention and the 1963 Vienna Convention, clearly delineate the circumstances under which nuclear facility operators may be exempted from compensating for nuclear damage.

The "Paris Convention" Article 9 states that:

The operator shall not be liable for nuclear damage caused by a nuclear incident directly due to an act of armed conflict, hostilities, civil war, or insurrection.

The Paris Convention, in Article 9, specifies that operators are not liable for nuclear damage caused directly by nuclear incidents if those incidents result from acts of armed conflict, hostilities, civil war, or insurrection. Similarly, Article VI of the 1963 Vienna Convention states that operators can be wholly or partially relieved from their compensation obligations if the nuclear damage was caused, in whole or in part, by the gross negligence or intentional misconduct of the damaged party. This article further exempts operators from liability for nuclear damage directly resulting from acts of armed conflict, hostilities, civil war, insurrection, or, unless otherwise specified by the Installation State's law, grave natural disasters of an exceptional character.

To summarize, the earliest international treaties on nuclear damage compensation provide liability exemptions for operators under three conditions:

1) Nuclear incidents arising from armed conflict, hostility, civil war, or insurrection;
2) Incidents directly caused by severe natural disasters;
3) Incidents where the victim's negligence or intentional acts contribute to the

damage, potentially absolving the operator from compensatory obligations, either partially or fully.

The 1997 Convention on Supplementary Compensation for Nuclear Damage reaffirms these exemptions in Article 3, with conditions similar to those in the Paris and Vienna Conventions. However, the 1997 Vienna Convention, and the revised Paris Convention, which was amended in 2004 and came into effect in 2022, reflect a shift. As **Figure 2** delineated, the revised Paris Convention removes the exemption for nuclear damage caused by severe natural disasters, signaling a move towards fewer exemptions for nuclear facility operators. This change indicates a gradual tightening of the conditions under which operators can claim exemption from liability, effectively reinforcing the principle of strict and exclusive liability for nuclear facility operators in the face of nuclear incidents.

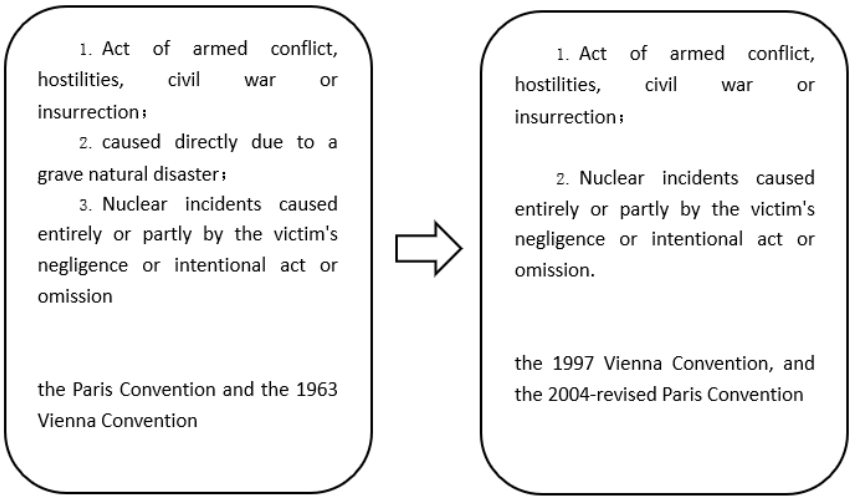

Figure 2. Narrowing exemptions for nuclear facility operators.

3.3. Significant increase in the compensation limits for nuclear damage

International nuclear damage compensation frameworks set forth in treaties delineate maximum liability limits for nuclear facility operators. These caps aim to protect victims' rights post-incident while preventing the financial collapse of operators and the broader civil nuclear sector. Further, they motivate operators to adopt stricter safety measures, thus mitigating the risk of nuclear incidents (China Nuclear Insurance Pool Executive Agency, 2019).

It has become a consensus within the industry that the operation of nuclear facilities must ensure the probability of adverse outcomes is significantly lower than that associated with other accepted industrial activities (Mieczysław et al., 2015). Nuclear power plant reactors are well understood in terms of design safety and operational risks. With the relatively steady expansion of the global civil nuclear industry and the improved financial robustness of operators, these compensation limits have been significantly increased.

Specifically, the Paris Convention of 1960, in its article 7, establishes:

Mandatory liability for nuclear damage from a single incident at no less than 700 million euros by each Contracting Party, ensuring victim protection and industry sustainability.

a) Allowance for reduced liability amounts under specified conditions for certain facilities and nuclear substance transportation, with absolute minimums set at 70 million euros and 80 million euros, respectively, to maintain a safety net.
b) Requirement that compensation for nuclear substance transportation incidents does not reduce operator liability below 80 million euros or a specified higher amount, safeguarding transport-related claims.
c) Application of liability amounts and national provisions uniformly to operators, regardless of the incident's location, promoting consistency across jurisdictions.
d) Permission for Contracting Parties to regulate nuclear substance transit, including potential liability increases for foreign operators, capped at domestic maximums, ensuring equitable treatment.
e) Exemption of specific carriage scenarios from paragraph (e) as per Convention stipulations, clarifying the scope of liability in varied transport contexts.
f) Flexibility for Contracting Parties to adjust liability minimums in engagements with non-Contracting States, contingent on reciprocal arrangements, fostering international cooperation.
g) Clarification that interest and court-awarded costs are additional to the liability cap, emphasizing comprehensive victim compensation.
h) Provision for currency conversion of stipulated sums into national currency, accommodating economic diversity among Contracting Parties.
i) Assurance of direct compensation claim rights for affected individuals, streamlining the legal process for victims.

Article 7's original setting at 15 million European Currency Agreement units reflects an adaptable framework, allowing for adjustments based on insurance or financial guarantees. Subsequent amendments in 1964, 1982, and 2004 significantly raised these caps to 150 million SDRs, 1.5 billion SDRs, and 700 million euros, respectively, indicating a trend towards heightened operator accountability.

Conversely, the 1963 Vienna Convention's Article 5 prescribes a minimum operator liability limit for nuclear damage, ensuring a baseline financial protection for victims while accommodating state-specific legal frameworks.

The 1997 Vienna Convention, Article 5, further iterates on compensation limits, offering a nuanced approach to liability caps based on state provisions and the evolving needs of nuclear damage compensation, marking a progressive step towards ensuring adequate victim compensation and operator responsibility in the nuclear energy sector.

3.4. Expansion of the principle of exclusive jurisdiction

In response to the evolving dynamics of maritime law, particularly regarding Exclusive Economic Zones (EEZs), and the concerns of coastal nations over possible nuclear incidents during the maritime transport of nuclear materials, the 1997 Vienna Convention and the 1997 Convention on Supplementary Compensation for Nuclear Damage (CSC) have broadened the principle of exclusive jurisdiction by a single court. This expansion, building on the foundations laid by previous international nuclear damage compensation treaties, extends exclusive jurisdiction to incidents occurring within a contracting state's EEZ, specifically for adjudicating nuclear damage

compensation claims. This adjustment aims to streamline the legal process for such claims, ensuring clarity and consistency without altering existing rights or obligations concerning the transportation of nuclear materials.

Both treaties underscore the paramountcy of exclusive jurisdiction by a designated court in cases of nuclear damage. They delineate that "should a contracting party have declared its EEZ to the depositary prior to a nuclear incident, exclusive jurisdiction for disputes arising from damages in such zones shall reside solely with the courts of that contracting party." To further solidify legal clarity, an additional clause mandates "contracting parties possessing multiple potential jurisdictions to designate a singular court for all legal matters pertaining to any nuclear incident." This measure seeks to avert the complications of disparate judgments, promoting a cohesive approach to compensation fund allocation and distribution.

Furthermore, these updates extend the singular court's exclusive jurisdiction to encompass not only incidents within a contracting state's territory or territorial waters but also those within its EEZ. However, this extension is explicitly confined to the scope of these Conventions. It emphasizes that such jurisdictional authority is intended solely for the resolution of nuclear damage claims and "does not extend to exercising jurisdiction in ways that conflict with established international maritime law, including the principles set forth in the United Nations Convention on the Law of the Sea."

3.5. Establishment of an international public fund mechanism for compensating nuclear damage

As the scope of nuclear damage compensation and the liability limits for operators of nuclear facilities have expanded, some international treaties on nuclear damage compensation have introduced an international public fund mechanism to supplement and address potential shortfalls in compensation, in accordance with domestic legislation. Based on **Figure 3**, according to the 2004 Amendment Protocol to the Brussels Supplementary Covention, when a nuclear incident occurs necessitating compensation for nuclear damage, the compensation process involves three levels of funding responsibility:

The first level of compensation funds is primarily the responsibility of the operator, with a liability amount set at 700 million euros.

The second level of compensation funds is provided by the state where the nuclear incident occurred, with a liability amount of 500 million euros. It is worth noting that domestic law has the flexibility to specify that this amount be provided by the operator, effectively increasing their maximum liability (e.g., the operator's maximum liability can be set at 700 + 500 = 1.2 billion euros).

The third level of compensation funds is jointly borne by all contracting states based on certain rules. This level has a liability amount of 300 million euros, and the allocation among contracting states is determined based on specific criteria. The primary principle for determining each country's share is their total installed nuclear power capacity. The larger the total installed capacity of nuclear power in a contracting state, the greater its share of the funds to be contributed.

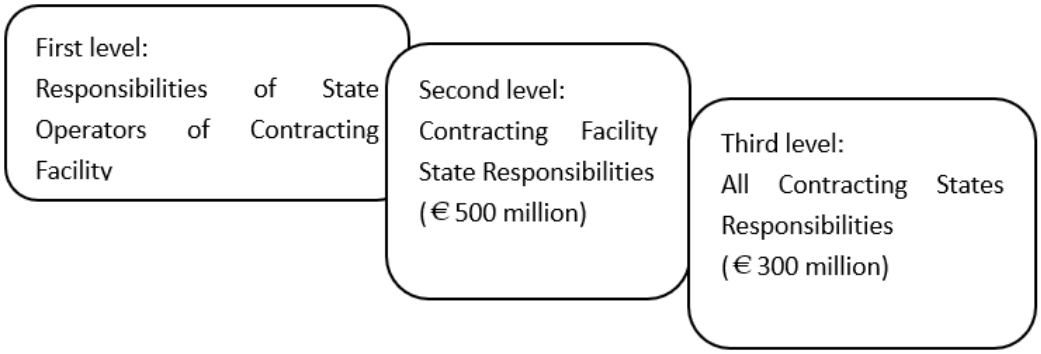

Figure 3. Three-level compensation fund structure stipulated in the 2004 Amendment Protocol to the Brussels Supplementary Convention.

The rules for distributing the public fund among contracting states are as follows:

50% of the fund is allocated based on the ratio of each contracting state's Gross National Product (GNP) to the total GNP of all contracting states, using figures officially published by the Organisation for Economic Co-operation and Development (OECD) from the year preceding the nuclear incident.

The other 50% of the fund is distributed based on the ratio of the thermal power generated by nuclear reactors within each contracting state's territory to the total thermal power generated by all reactors within the territories of the contracting states.

It's important to note that the scope of application of the international public fund mechanism, as stipulated by the 'Brussels Convention,' is limited, primarily involving Western European countries as its member countries.

In summary, the 1997 CSC continues and expands upon the public fund system introduced by the Brussels Convention. It establishes a two-tier international public fund mechanism, ensuring compensation for nuclear damage. Contracting States are required to contribute to these funds, with the second tier of funding shared collectively among them, based on criteria related to nuclear power capacity and economic factors. The CSC aims to address potential shortfalls in compensation for nuclear damage resulting from nuclear incidents.

4. Conclusion and insights from the evolution of the international civil liability regime for nuclear damage

Nuclear energy, crucial for attaining peak carbon and achieving carbon neutrality, represents a significant low-carbon energy source. Despite its benefits, the potential for nuclear incidents exists, posing challenges as the industry progresses. The nuclear damage liability system, which encompasses both pre-incident financial guarantees and post-incident compensation, plays a pivotal role in balancing the legal dynamics between responsible parties and victims. Pioneering organizations such as the International Atomic Energy Agency and the OECD Nuclear Energy Agency have developed foundational treaties—such as the 1960 Paris Convention, the Brussels Supplementary Convention, the 1963 Vienna Convention, the 1997 Vienna Convention, and the Convention on Supplementary Compensation for Nuclear Damage. These treaties articulate core principles of liability: exclusive liability, strict liability, limited liability, advance financial guarantees, and national supplementary

compensation. More than six decades after the inauguration of the first nuclear damage liability treaty, the Paris Convention, the framework has undergone significant evolution. Reflecting on the progression of this system, we observe:

1) The scope of compensation for nuclear damage has been expanding.
2) The number of exemptions available to nuclear facility operators has been decreasing.
3) The limits of nuclear damage liability have significantly increased.
4) The principle of exclusive jurisdiction has been extended.

It is crucial to recognize that the nuclear damage liability regime is one of the fundamental institutions for the steady development of civil nuclear industry.

4.1. The nuclear damage liability regime constitutes a cornerstone in the sustained growth of the civilian nuclear sector

While the primary aim of the nuclear damage compensation regime is to implement preventative measures, the absence of a robust and comprehensive legal framework for nuclear damage compensation undermines the smooth and responsible development of the civilian nuclear industry, environmental protection, and societal stability at large. This challenge stems from the public's inherent apprehension towards nuclear accidents and the subsequent radioactive contamination. Therefore, in the event of a nuclear incident, the ability to promptly and fairly compensate the affected individuals not only serves as a significant measure of the credibility and governance effectiveness of nuclear facility operators but also of the state and government's capacity. A deficient nuclear damage compensation legal framework risks leaving many victims' claims unresolved post-incident, potentially exacerbating public dissatisfaction and posing a threat to social harmony and progress.

4.2. Central pillars: The sole liability and strict liability principles

The nuclear damage liability framework, as enacted by various national laws and the international treaties mentioned, mandates the absolute and strict liability of nuclear facility operators. This approach is universally accepted, as evidenced by the United States adopting the principle of the operator's exclusive liability upon joining the international "Convention on Supplementary Compensation for Nuclear Damage," despite initially advocating for "economic attribution." Under these foundational principles, in the event of a nuclear accident, the nuclear facility operator is unequivocally responsible for all resultant nuclear damage liabilities, absolving other entities or individuals from this burden. Moreover, this liability is imposed regardless of fault.

In practice, the principles of sole and strict liability significantly benefit all parties involved by alleviating the burden of litigating fault and legal responsibility amidst the complexities of nuclear incidents. These principles enhance the efficiency of legal proceedings within courts of exclusive jurisdiction over compensation disputes. They expedite compensation to victims, thereby facilitating the swift resolution of claims by the liable party—the nuclear facility operator—allowing a return to the advancement of the civilian nuclear industry. Consequently, the establishment of these principles by treaty forms the cornerstone of the nuclear damage liability system,

ensuring a balanced, fair, and efficient resolution process for all stakeholders.

4.3. The financial security principle in advance is a prerequisite for nuclear facility operators to be able to assume compensation liability

International nuclear damage liability treaties require nuclear facility operators to provide certain forms of financial guarantees before starting operation to prepare for contingencies (nuclear damage accidents). According to international treaties and national system practices, there are mainly three forms of advance financial guarantee mechanisms for nuclear damage liability: nuclear third-party liability insurance, self-insurance or mutual insurance organizations of nuclear facility operators, and pre-established nuclear damage compensation funds. It is this principle of advance financial guarantee that ensures that nuclear facility operators have strong compensation capabilities when facing nuclear damage compensation.

4.4. National supplementary compensation ensures that victims receive the compensation they deserve and, at the same time, promotes the stable development of the nuclear industry

The concept of national supplementary compensation is integral to the nuclear damage liability framework, developed in tandem to safeguard public interests and ensure the stability of the civilian nuclear industry. This principle acknowledges the unique nature of nuclear liability and the critical importance of protecting both victims and the nuclear sector. The "Price-Anderson Act" in the United States, as an early piece of nuclear damage liability legislation, explicitly acknowledges the state's role in providing additional compensation for nuclear incidents. The Act outlines a three-tiered financial protection system for U.S. nuclear facilities. In the event of a severe accident, should the aggregate coverage of the first two tiers be surpassed, the third tier is enacted, wherein Congress is tasked as the ultimate guarantor to determine the method of compensation.

Similarly, Germany's "Nuclear Energy Act" mandates that if the operator's compensation reserve is inadequate to cover the required compensation, the mechanisms specified beyond Article 33 of the Act come into effect, entrusting the federal and state governments with the responsibility for compensation. These examples illustrate how national supplementary compensation acts as a pivotal mechanism, ensuring that victims receive rightful compensation while concurrently promoting the nuclear industry's sustainable development. By integrating government support into the compensation framework, this principle provides a critical safety net that reinforces the resilience and reliability of the nuclear energy sector (Bar, 2010). The international conventions on nuclear damage also address this issue, as seen in Article 7 of the "1997 Vienna Convention" and Annex V of the "Convention on Supplementary Compensation for Nuclear Damage." These provisions underscore the role of national supplementary compensation in the broader framework of nuclear liability.

In response to the Fukushima nuclear accident in Japan, the Japanese government took significant steps to enhance the effectiveness of state involvement in mitigating nuclear damage. In 2011, Japan enacted the "Act on Compensation for Nuclear

Damage," which specified the mechanisms for the state to promptly and effectively disburse temporary funds to address nuclear damage, thereby addressing the issue of delayed compensation by Tokyo Electric Power Company (TEPCO). Concurrently, Japan established the Nuclear Damage Compensation and Decommissioning Facilitation Corporation through the "Act on Contract for Indemnification of Nuclear Damage Compensation" enabling the government to provide financial support to TEPCO via special government bonds. These actions were pivotal in preventing TEPCO's financial collapse and ensuring the continued sustainable development of Japan's civilian nuclear sector.

This exemplifies how the mechanism of international supplementary compensation, by integrating public authority into the compensation system's framework, serves a dual purpose. It not only addresses the immediate needs for substantial compensation in the aftermath of nuclear incidents, ensuring victims receive prompt and full compensation, but also shields the implicated nuclear facility operators and the national nuclear industry at large from the devastating effects of bankruptcy.

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