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International Nuclear Liability Regimes and their Prospective Implementation in Uzbekistan's Legal System

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Abstract

This article examines how international nuclear civil liability regimes can be effectively implemented in Uzbekistan's legal system as the country moves towards commercial nuclear power. It first maps the fragmented treaty architecture built around the Paris–Brussels and Vienna/CSC regimes and distils their core principles of strict and exclusive operator liability, mandatory financial security and concentrated jurisdiction. Using doctrinal and comparative methods, the study benchmarks Uzbekistan's existing atomic energy legislation and planned reforms against the practice of selected Vienna-Convention and newcomer states. The analysis shows that accession to the Vienna Convention marks a turning point, but that detailed domestic legislation on liability limits, insurance schemes and state guarantees remains under development. The article concludes with policy options for designing a coherent, victim-oriented liability framework and outlines implications for regional cooperation and future research.

Keywords: Nuclear Civil Liability, Vienna Convention, Uzbekistan, Energy Transition, Financial Security, Operator Liability, Nuclear Insurance, Transboundary Risk

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I. Introduction

The renewed global interest in nuclear power as a low-carbon base load source of electricity has revived long-standing concerns about how to allocate the risk of catastrophic nuclear accidents across operators, states, and affected communities. Even though major accidents remain rare, events such as Chernobyl and Fukushima have demonstrated that nuclear damage can easily exceed national borders, overwhelm domestic compensation schemes, and generate complex trans boundary claims (Chen & Yap, 2025). Against this backdrop, states have progressively developed a specialized body of rules on civil liability for nuclear damage, distinct from general tort and environmental liability regimes. At the international level, this process has produced two principal treaty "families" the 1960 Paris Convention on Third Party Liability in the Field of Nuclear Energy and the 1963 Vienna Convention on Civil Liability for Nuclear Damage as well as the 1988 Joint Protocol bridging the two systems and the 1997 Convention on Supplementary Compensation for Nuclear Damage (CSC). These instruments, together with subsequent amending protocols and explanatory texts, articulate core principles such as strict and exclusive operator liability, mandatory financial security, limitations in amount and time, and the concentration of jurisdiction in the courts of a single state. Despite this seemingly dense treaty network, the global nuclear liability regime remains geographically fragmented and only partially modernized, with significant regional and substantive gaps in coverage.

Over the past three decades, a substantial body of scholarship has examined the design and performance of international nuclear liability regimes, often in response to high-profile accidents and reform initiatives. The evolution of the Paris and Vienna Conventions, the rationale for strict and channeled liability, the relationship between treaty-based liability and general rules on state responsibility, and the prospects for a more coherent transnational compensation system. Much of this literature is comparative, focusing on the interaction between international instruments and the domestic laws of long-standing nuclear states in Europe, North America and parts of Asia. Recent studies have also highlighted persistent weaknesses in the regime, including low minimum compensation amounts in some instruments, the exclusion of certain categories of environmental damage, and the incomplete adherence of major nuclear states to the most recent conventions. At the same time, research on "newcomer" countries has tended to focus on nuclear safety, security and safeguards, paying comparatively less attention to the detailed design of civil liability and compensation frameworks. As a result, there is still limited doctrinal analysis of how international nuclear liability standards can be effectively transplanted into the legal systems of states that are only now moving from research reactors to large-scale nuclear power projects (Nriezedi-Anejionu, 2024).

Uzbekistan illustrates many of the challenges facing such newcomer states. The country has been a member of the International Atomic Energy Agency (IAEA) since

1994 and operates a research reactor, but it has not yet commissioned a commercial nuclear power plant. In recent years, however, the government has identified nuclear energy as a strategic option for meeting growing electricity demand, diversifying away from natural gas, and achieving climate and energy-security objectives, and has launched projects with the Russian state corporation Rosatom to develop both small modular units and a large-capacity plant. Domestically, a dedicated Law of the Republic of Uzbekistan "On the Use of Atomic Energy for Peaceful Purposes" (No. ZRU-565 of 9 September 2019) now provides a general framework for regulating peaceful nuclear activities and establishes core principles such as the priority of protecting human life and health, environmental protection and the prohibition of nuclear weapons. Licensing rules adopted under this law require operating organizations to demonstrate the availability of financial support for compensation of damage caused by radiation exposure and to substantiate their financial stability throughout the life cycle of a nuclear installation. On the international plane, Uzbekistan has recently acceded to several key nuclear safety and emergency conventions and, crucially for this study, has joined the Vienna Convention on Civil Liability for Nuclear Damage, depositing its instrument of accession on 7 November 2025, with entry into force scheduled for 7 February 2026. Parallel policy documents indicate that, in 2025–2026, the country intends to adopt around twenty-five regulatory acts based on IAEA safety standards and to establish a nuclear liability insurance system.

These developments mean that Uzbekistan is transitioning rapidly from a general atomic energy framework to a more specialized regime in which civil liability for nuclear damage will play a central role. Joining the Vienna Convention entails not only the acceptance of international obligations but also the need to embed its core principles into the national legal order in a manner that is coherent with Uzbekistan's civil-law tradition, existing environmental and disaster-risk legislation, and the structure of its insurance and financial sectors. Key design choices include whether to adopt a stand-alone nuclear liability act or to rely on amendments to general civil and environmental codes, how to structure operator liability and mandatory financial security, and how to address Tran's boundary claims in a region where neighboring states may have different treaty affiliations. For a country that is simultaneously building nuclear infrastructure, strengthening regulatory capacity and aligning with IAEA standards, the sequencing and content of these reforms have significant implications for investor confidence, public trust and regional cooperation. Yet, apart from official policy statements and technical cooperation reports, there is little publicly available analysis in English that systematically evaluates how the emerging Uzbek framework will interact with the international nuclear liability regime.

Against this background, the central problem addressed in this article is how Uzbekistan can implement its forthcoming obligations under the Vienna Convention in a way that ensures effective, predictable and equitable compensation for nuclear damage, while remaining consistent with its broader legal system and policy priorities.

The existing literature offers valuable comparative insights into the strengths and weaknesses of the Paris, Vienna and CSC regimes and into the experience of established nuclear states, but provides limited guidance tailored to the circumstances of a Central Asian civil-law country at an early stage of nuclear power development. At the national level, current legal acts including the 2019 Atomic Energy Law and subordinate licensing regulations contain important elements relevant to liability and financial security, yet they do not amount to a fully-fledged nuclear liability and compensation system aligned with the Vienna Convention's modernized standards. There is thus a clear research gap concerning how international nuclear liability norms can be operationalized in Uzbekistan, taking into account institutional capacities, insurance market depth and regional cross-border risk. Building on doctrinal, comparative and policy-oriented analysis, this article aims to fill that gap by articulating a set of concrete options for designing a nuclear civil liability regime that is both internationally compatible and domestically workable. More specifically, the study seeks to (1) map the core features of the principal international nuclear liability instruments and distil the principles most relevant for newcomer states; (2) benchmark Uzbekistan's current and planned legal framework against those principles; (3) identify legal and institutional gaps that could undermine effective victim compensation or compliance with international commitments; and (4) propose a set of legislative and regulatory measures that could guide the prospective implementation of the Vienna Convention in Uzbekistan's legal system.

In line with these objectives, the article is guided by the following overarching research question: *How can Uzbekistan design and implement a civil nuclear liability regime that faithfully reflects the requirements and underlying principles of the Vienna Convention while remaining compatible with its domestic legal order and institutional realities?* To operationalize this enquiry, the analysis addresses three subsidiary questions: first, what lessons for Uzbekistan can be drawn from the structure and practice of the main international nuclear liability regimes and selected national implementations; second, to what extent do existing Uzbek laws, regulations and policy documents already embody the key elements of these regimes; and third, which legislative, institutional and financial reforms are necessary to close remaining gaps and to ensure effective access to compensation in the event of a nuclear accident. By answering these questions, the study seeks to contribute to three distinct but related debates in the literature on international nuclear law, energy transition and comparative liability regimes. At a theoretical level, it adds a newcomer-state perspective to discussions on the future of the global nuclear liability regime and on the interaction between treaty-based compensation schemes and general principles of state responsibility and transboundary harm. At a policy level, it provides timely input for Uzbek lawmakers and regulators who are currently engaged in building a nuclear legal and regulatory infrastructure in close cooperation with the IAEA and other partners. Finally, at a practical level, it is intended to support the development of clear, credible and victim-oriented rules that can enhance public confidence in nuclear

projects, facilitate cross-border cooperation and ensure that, should an accident occur, affected individuals and communities in Uzbekistan and beyond have access to prompt and adequate compensation.

II. Methods

This study adopts a qualitative, doctrinal and comparative research design tailored to the field of international nuclear law and energy policy. The core of the research consists in a systematic analysis of primary legal sources, including international treaties, protocols, explanatory reports and selected national legislation, which are interpreted using established methods of legal reasoning. In parallel, the study undertakes a structured review of secondary scholarly literature, policy papers and technical reports in order to situate the legal analysis within broader debates on nuclear liability and energy transition. The research design is explicitly non-experimental and does not involve human subjects, surveys or experimental interventions, which would be ill-suited to the normative questions at issue. Instead, it focuses on the reconstruction, comparison and critical evaluation of legal norms and institutional arrangements governing civil liability for nuclear damage. Particular attention is paid to the interaction between international nuclear liability instruments and the domestic legal order of Uzbekistan as a newcomer nuclear state. The overall design thus combines doctrinal legal analysis, comparative case studies and policy-oriented evaluation in a single integrated framework.

The “sample” for this study is defined as a corpus of legal and policy documents that are directly relevant to the design and implementation of nuclear civil liability regimes in Uzbekistan. At the international level, the corpus includes the Vienna Convention on Civil Liability for Nuclear Damage and its amending instruments, the Paris Convention and related protocols, the Joint Protocol, the Convention on Supplementary Compensation for Nuclear Damage and selected IAEA instruments and guidance documents that influence the interpretation and implementation of these treaties. At the national level, the study analyses the Law of the Republic of Uzbekistan on the Use of Atomic Energy for Peaceful Purposes, associated implementing regulations, and relevant provisions of the Civil Code, environmental legislation and disaster-risk management norms. In order to generate comparative insights, the corpus further encompasses nuclear liability statutes and implementing rules from a small number of reference jurisdictions that combine participation in one or more nuclear liability conventions with experience in operating nuclear power plants. These reference jurisdictions are selected purposively, on the basis of their legal tradition (civil-law systems comparable to Uzbekistan), their treaty affiliations and their stage of nuclear power development. Policy strategies, governmental concepts and IAEA technical cooperation documents relating to Uzbekistan’s nuclear program are also included, as they clarify the country’s planned approach to liability and insurance arrangements. All documents are collected from official treaty databases, governmental portals, recognized international organizations and reputable

academic or professional publishers to ensure authenticity and reliability.

Data collection proceeds through a structured document-gathering process, which begins with the identification of relevant international instruments and then moves to national and comparative materials. Official treaty texts and national legislation are retrieved from authoritative online repositories, supplemented where necessary by printed compilations and official gazettes. Scholarly articles, books and policy reports are identified through keyword searches in legal and multidisciplinary databases, as well as through citation tracking from key works in the field. For each document in the corpus, bibliographic details, legal status, date of adoption and entry into force, and any subsequent amendments are recorded in a reference management system. The documents are then organized into thematic folders corresponding to core aspects of nuclear liability regimes, such as scope of application, liable person, heads of damage, financial security, jurisdiction and time limits. This organization facilitates both within-instrument analysis and cross-instrument comparison. Where necessary, unofficial English translations of national legislation are cross-checked against the original language versions to minimize interpretative errors.

The primary analytical technique employed is doctrinal legal analysis, which involves close reading, interpretation and systematic reconstruction of the rules governing civil liability for nuclear damage. Provisions of international instruments and national legislation are interpreted in light of their text, context, object and purpose, and, where relevant, the general principles of treaty interpretation. The analysis focuses on identifying the core principles embodied in the international nuclear liability regime, such as strict and exclusive operator liability, limitations in amount and time, compulsory financial security and the concentration of jurisdiction. These principles are then used as benchmarks against which to assess the existing and prospective legal framework of Uzbekistan. Comparative analysis is carried out by juxtaposing the solutions adopted in the reference jurisdictions with those contemplated or already in place in Uzbekistan, highlighting both convergences and divergences. Particular attention is paid to institutional design questions, including the allocation of regulatory responsibilities, the role of insurers and guarantee funds, and the mechanisms for handling transboundary claims. Throughout, the analytical framework remains sensitive to the broader policy objectives of energy security, decarbonization and public protection that inform nuclear liability choices.

To give greater concreteness to the comparative analysis, the study incorporates a set of qualitative case studies of selected national nuclear liability regimes. Each case study examines how a particular jurisdiction has implemented its international obligations, structured operator liability and financial security, and addressed issues such as environmental damage, latent harm and transboundary claims. These case studies are not designed to be statistically representative; rather, they serve as illustrative examples that can inform Uzbekistan’s own choices. Within each case, legal provisions are read together with explanatory materials, regulatory guidance and,

where available, relevant court decisions or administrative practice. In addition, the study uses simple descriptive quantitative techniques to organize certain aspects of the collected data, such as compiling tables of liability limits, insurance requirements and participation in international instruments across the reference jurisdictions. These tables are used to identify basic numerical ranges and patterns but do not involve inferential statistics or hypothesis testing. The use of such limited quantitative summaries is intended to complement, rather than replace, the predominantly qualitative legal analysis.

Because the research is based entirely on publicly available legal and policy documents and does not involve human participants, confidential data or interventions, it does not require formal approval from a research ethics committee. Nevertheless, the study adheres to general ethical principles applicable to legal scholarship, including accurate citation of sources, avoidance of plagiarism and transparent acknowledgement of limitations. Internal validity is promoted by triangulating information from multiple authoritative sources, especially where unofficial translations or secondary commentaries are used. External validity is necessarily limited, as the findings are tailored specifically to Uzbekistan's legal system and to the selected group of reference jurisdictions. The purposive sampling of jurisdictions means that the conclusions cannot be generalized to all nuclear or newcomer states, although they may offer useful insights for countries with similar characteristics. A further limitation is that the analysis depends on the availability and accessibility of up-to-date legal texts and policy documents, which may evolve as Uzbekistan's nuclear program and international commitments develop.

III. Results

The analysis of treaty participation confirms that the global nuclear liability regime remains structurally fragmented, notwithstanding decades of codification efforts under the auspices of the IAEA and the OECD Nuclear Energy Agency. The Paris Convention, adopted in 1960 for mainly Western European states, and the Vienna Convention, adopted in 1963 with a global vocation, continue to operate as parallel systems, supplemented but not fully unified by the 1988 Joint Protocol and the Convention on Supplementary Compensation for Nuclear Damage. Many long-standing nuclear states participate in one "family" but not the other, and several major nuclear countries are not yet party to any of the core conventions, relying instead on national law alone. Against this background, the work of the International Expert Group on Nuclear Liability (INLEX) has sought to clarify the interaction among the instruments and promote more coherent adherence, but the empirical picture still reveals uneven coverage and varying levels of modernization. Recent analytical reports emphasize that the existence of three partially overlapping regimes Paris/Brussels, Vienna/Joint Protocol and CSC has produced a complex mosaic rather than a seamless global network, particularly in relation to transport and cross-border damage. As a result, the territorial reach of uniform rules on jurisdiction, heads of

damage and minimum liability amounts still depends heavily on the pattern of ratifications in a given region (McIntosh, 2022).

Within this landscape, Central Asia historically stood out as a "blank space" with no operating power reactors and no participation in the international nuclear civil liability conventions. This situation has begun to change as Uzbekistan has moved from a research-reactor profile to concrete plans for both small modular reactors and a large-capacity nuclear power plant, based on agreements with Rosatom and reflected in national energy strategies. A key empirical finding of this study is that, by adopting the Law No. LRU-1086 of 26 September 2025 "On the Accession of the Republic of Uzbekistan to the Vienna Convention on Civil Liability for Nuclear Damage (Vienna, 21 May 1963)" and subsequently depositing its instrument of accession with the IAEA on 7 November 2025, Uzbekistan has repositioned itself from an "unaligned" state to an emerging Vienna-Convention country. According to the IAEA's legal database, the Convention will enter into force for Uzbekistan on 7 February 2026, making it the first Central Asian state formally integrated into the treaty-based nuclear liability regime. Media and governmental reports consistently underline that accession is expected to ensure access to internationally recognized compensation mechanisms for citizens in the event of a nuclear accident and to require the establishment of minimum financial security for operators.

The doctrinal reconstruction of the Paris and Vienna Conventions, together with subsequent explanatory texts and NEA analyses, confirms that a relatively stable set of core principles underpins the treaty-based nuclear liability regime. First, liability is "strict" in the sense that the operator of a nuclear installation is liable for nuclear damage irrespective of fault, thereby relieving victims of the burden of proving negligence and aligning risk allocation with the operator's control of the hazardous activity. Second, liability is "channeled" exclusively to the operator, meaning that claims must be brought against a single entity rather than a diffuse group of suppliers and contractors, which simplifies litigation and facilitates insurance arrangements. Third, the conventions require the operator to maintain financial security typically insurance or other financial guarantees up to at least a prescribed minimum amount, while the state assumes a residual responsibility to ensure compensation where this security proves insufficient or unavailable. Finally, jurisdiction over claims is concentrated in the courts of a single state, usually where the nuclear incident occurred, and limitation periods are established, with longer periods for personal injury and shorter ones for property damage.

From the perspective of Uzbekistan, an important empirical observation is that the Vienna Convention, as amended, codifies these principles in a form that is both more globally representative and more clearly aligned with post-Chernobyl understandings of nuclear risk than the original 1963 text alone. The explanatory materials prepared by INLEX and the IAEA emphasize, for example, the broadened definition of "nuclear damage," the inclusion of certain environmental and economic

losses, and the encouragement to set higher liability amounts than the minimum floor; these elements are particularly relevant for a seismically active, landlocked state whose nuclear installations may affect transboundary water and agricultural resources. At the same time, the conventions leave considerable discretion to contracting states regarding the exact level of operator liability, the form and providers of financial security, and the mechanisms for state supplementation, which means that the practical effectiveness of the regime depends heavily on national implementation choices. This discretionary space is a critical parameter for Uzbekistan, as it will have to calibrate liability limits and insurance structures to domestic market depth and fiscal capacity without undermining victim protection or investor confidence.

The comparative case studies reveal that existing Vienna-Convention states with a civil-law tradition have generally opted for dedicated legislation on nuclear civil liability, even where a broader atomic energy act exists. In Hungary, for instance, Act CXVI of 1996 on Atomic Energy expresses the national policy on the use of atomic energy and mandates, inter alia, the registration and inspection of insurance or other financial instruments related to liability for nuclear damage, while separate regulations and funds address decommissioning and long-term financial responsibilities. The Hungarian framework thus combines general atomic-energy principles with specific institutional mechanisms, such as the Central Nuclear Financial Fund, which provide a predictable source of financing for certain categories of nuclear-related costs. Although Hungary is primarily associated with the Paris/Brussels regime, its legislative practice illustrates how detailed financial security provisions and state-backed funds can operationalize the abstract principles set out in international instruments (VARI & FERENCZ, 2007).

In the Czech Republic, the Atomic Act No. 263/2016 Coll. addresses the peaceful use of nuclear energy and ionizing radiation and explicitly links licensing to proof of nuclear damage liability insurance or other financial collateral arrangements. Licensing applicants must provide evidence of such insurance as part of the permit application, and separate legislation continues to govern nuclear third-party liability until new rules are adopted, demonstrating a phased approach to modernizing the liability framework. Ukraine, by contrast, has adopted a stand-alone Law “On Civil Liability for Nuclear Damage and its Financial Provision,” which regulates relations concerning civil liability for nuclear damage, sets out procedures for compensation and specifies the mechanisms and limits for financial security. Under this law, liability is capped by reference to multiples of a statutory tax-free minimum income and may be backed by mandatory insurance and state guarantees, while more recent regulations establish a nuclear insurance pool and clarify the licensing requirements for insurers. These examples show that Vienna-Convention states have used different legislative techniques, but converge on the need for clear statutory bases for liability amounts and financial security obligations.

The United Arab Emirates offers a particularly relevant precedent for a

newcomer state that has implemented the Vienna Convention through modern legislation designed from the outset for a large nuclear power project. Federal Law by Decree No. 4 of 2012 concerning Civil Liability for Nuclear Damage was drafted in line with international standards and channels civil liability exclusively to the licensed operator, in harmony with the Vienna principles. Under the UAE regime, the operator's liability is backed by mandatory financial security, and OECD-NEA data indicate that the applicable amount has been set at 450 million Special Drawing Rights for nuclear transport associated with facilities in the country. Scholarly analysis of this framework emphasizes that it represents a significant evolution in domestic tort law, aligning national practice with Vienna-style strict and exclusive operator liability, while preserving scope for state involvement in residual risk coverage. For Uzbekistan, the UAE example is instructive because it shows how a newcomer jurisdiction with limited prior nuclear experience can use a comprehensive nuclear liability statute to integrate international norms, provide clarity to investors and reassure the public.

Across these reference jurisdictions, several cross-cutting patterns emerge that are directly relevant for Uzbekistan's forthcoming implementation choices. First, all jurisdictions examined locate the core of nuclear civil liability in a high-ranking legislative act either an atomic energy law with detailed liability chapters or a separate liability statute rather than dispersing it across secondary regulations. Second, licensing for nuclear installations or major radiation sources is systematically tied to evidence of nuclear liability insurance or equivalent financial collateral, ensuring that the operator's ability to pay is verified ex ante rather than only after an incident. Third, national systems tend to combine private-sector insurance with state-supported funds or guarantees, reflecting the reality that very high or catastrophic damages may exceed commercial market capacity. Finally, these jurisdictions have begun to grapple with emerging issues such as coverage of environmental damage, long-term waste repositories and war-related incidents, demonstrating that even mature regimes must evolve to address new risk profiles.

The analysis of Uzbekistan's existing legislation indicates that the Law "On the Use of Atomic Energy for Peaceful Purposes" (No. ZRU-565 of 9 September 2019) provides a general framework for nuclear and radiation safety, allocation of institutional responsibilities and development of human resources, but does not, in its current form, constitute a comprehensive nuclear civil liability statute. International reports describe this law as regulating relations in the peaceful use of atomic energy, setting out principles such as priority of safety and protection of public health, and establishing a regulatory authority under the Cabinet of Ministers. However, available summaries do not indicate the existence of detailed provisions on strict and exclusive operator liability, specific monetary limits, or a clear scheme of compulsory financial security equivalent to those found in dedicated nuclear liability laws of Vienna-Convention states. As a result, one of the key empirical findings is that, prior to accession to the Vienna Convention, Uzbekistan's domestic framework addressed

nuclear-related risk primarily through general safety regulation and broad compensation references, rather than through a specialized civil liability and insurance regime.

Governmental and media sources from 2025 show that accession to the Vienna Convention has been explicitly framed by Uzbek authorities as a catalyst for filling this gap and for developing a modern nuclear liability and compensation system. Statements by the Senate and government emphasize that the law on accession aims to establish operator liability, define procedures and timeframes for compensation, and strengthen public trust in nuclear safety. Reports further indicate that Uzbekistan plans to adopt at least twenty-five regulatory documents based on IAEA safety standards in 2025–2026, including the creation of a nuclear liability insurance system and specific rules on compensation standards for nuclear damage. According to public information, these reforms will be implemented under the supervision of the Committee for Industrial, Radiation and Nuclear Safety and in close cooperation with the IAEA, as part of broader efforts to license and assess the planned nuclear power plants. Yet, as of November 2025, detailed implementing regulations on operator liability limits, the structure of insurance pools and the role of the state in residual compensation have not been publicly available in the same depth as in more mature regimes, meaning that the practical contours of Uzbekistan's nuclear liability system are still being shaped.

A further empirical finding relates to the role of general civil, environmental and disaster-management legislation in addressing nuclear damage prior to the entry into force of Vienna-based rules. Energy and environmental policy reviews note that Uzbekistan has been strengthening its framework for industrial safety, emergency response and environmental protection, including in relation to hazardous facilities and earthquakes, but these instruments are not tailored to the specific allocation of liability for nuclear damage as defined in the international conventions. In the absence of a dedicated nuclear liability act, nuclear-related damages would likely have been addressed through general tort rules and sectorial safety norms, which may not provide the same clarity on strict liability, channeling and jurisdiction as Vienna-style regimes. The adoption of the accession law therefore marks a qualitative shift, signaling the intention to move from reliance on broadly framed civil-law concepts towards a specialized, treaty-aligned liability structure.

When the findings on Uzbekistan's current framework are juxtaposed with the comparative case studies, several concrete implications for the country's implementation trajectory become apparent. First, like Ukraine and the UAE at earlier stages, Uzbekistan will have to decide whether to enshrine nuclear civil liability in a dedicated law or to embed it as a distinct chapter within its existing atomic energy act, supplemented by secondary regulations. The reference jurisdictions suggest that dedicated legislation offers greater visibility and coherence, particularly for complex issues such as the scope of compensable environmental damage, the interaction with state responsibility and the treatment of transboundary claims. Second, the experience

of Hungary, the Czech Republic, Ukraine and the UAE indicates that linking licensing decisions to proof of nuclear liability insurance is a critical operational step, which ensures that theoretical liability obligations are backed by concrete financial capacity. Uzbek policy announcements about establishing a nuclear insurance system and adopting compensation standards suggest that similar mechanisms are envisaged, but the precise role of domestic insurers, possible international pools and the state as guarantor remain to be defined.

Third, the data show that reference jurisdictions have adopted a range of quantitative approaches to setting operator liability limits, from fixed amounts stated in domestic currency or SDRs to formulas tied to economic indicators, and from relatively modest caps to very high or unlimited liability combined with state supplementation. For example, the Paris regime currently requires a minimum operator liability amount of EUR 700 million for standard installations, while UAE law sets a limit of SDR 450 million for certain forms of nuclear transport, and Ukrainian law uses a multiple of a defined tax-free minimum income to determine liability caps. Uzbekistan will need to situate itself within this spectrum by choosing liability amounts that are credible in light of potential damage scenarios and regional practice, yet sustainable for operators and the insurance market. The Tashkent-based reporting on accession already highlights that the Convention sets a minimum limit and that national legislation must establish concrete amounts and enforcement procedures, indicating that this calibration is recognized as a core task for upcoming reforms. These choices will, in turn, influence the design of any state-backed guarantee mechanisms and emergency budgetary arrangements. To synthesize these comparative and national observations, Table 1 below summarizes key features of the international affiliation and domestic implementation models in the reference jurisdictions studied, alongside Uzbekistan's current position and announced intentions.

Table 1. International affiliation and domestic nuclear liability implementation models

Jurisdiction	Convention affiliation*	Core domestic instrument(s) on nuclear civil liability	Main features of operator liability and financial security (summary)

Jurisdiction	Convention affiliation*	Core domestic instrument(s) on nuclear civil liability	Main features of operator liability and financial security (summary)
Hungary	Primarily Paris/Brussels regime	Act CXVI of 1996 on Atomic Energy, plus related decrees and financial-fund legislation	Strict operator liability, mandatory insurance monitored by regulator, state-managed decommissioning and financial fund for long-term costs.
Czech Republic	Vienna/Joint Protocol, with evolving national framework	Atomic Act No. 263/2016 Coll. and earlier third-party liability provisions	Licensing conditional on nuclear damage liability insurance or other collateral; separate liability rules remain in force pending new legislation.
Ukraine	Vienna/Joint Protocol, extensive national nuclear legislation	Law “On Civil Liability for Nuclear Damage and its Financial Provision”, plus nuclear energy and insurance regulations	Specific statute governing civil liability and financial security; liability caps tied to multiples of tax-free minimum income; mandatory insurance and possible state guarantees.

Jurisdiction	Convention affiliation*	Core domestic instrument(s) on nuclear civil liability	Main features of operator liability and financial security (summary)
United Arab Emirates	Vienna Convention (and CSC participation), newcomer nuclear state	Federal Law by Decree No. 4 of 2012 concerning Civil Liability for Nuclear Damage, in conjunction with 2009 nuclear energy law	Strict and exclusive operator liability; mandatory financial security set at SDR 450 million for specified cases; alignment with Vienna principles and strong regulatory oversight.
Uzbekistan	Vienna Convention, accession in 2025 with entry into force in 2026	Law No. ZRU-565 "On the Use of Atomic Energy for Peaceful Purposes"; Law No. LRU-1086 on accession to the Vienna Convention; planned secondary regulations on liability insurance and compensation standards	General atomic energy framework; accession law commits to Vienna principles; detailed rules on operator liability amounts, nuclear insurance and state supplementation under preparation for 2025–2026.

Drawing these strands together, the results of the study demonstrate that Uzbekistan has already taken the decisive step of integrating itself into the treaty-based international nuclear liability regime, but that the substantive design of its domestic liability and compensation system remains at a formative stage. The accession to the Vienna Convention and the associated political messaging signal a clear commitment to strict operator liability, minimum financial security and internationally compatible procedures for victim compensation. At the same time, the comparative evidence underscores that the effectiveness of this commitment will

depend on the adoption of detailed legislation and regulations that translate Vienna principles into concrete rules on liability limits, insurance arrangements, state guarantees and the handling of transboundary claims. The reference jurisdictions show that newcomer states can successfully implement such regimes through comprehensive nuclear liability statutes, but also illustrate the importance of aligning legal rules with institutional capacities and market conditions (Pelzer, 2012).

For Uzbekistan, a particularly salient finding is that the timing of liability reforms coincides with critical decisions on plant design, site licensing and regulatory strengthening, as documented in IAEA cooperation roadmaps and national energy strategies. This simultaneity creates both risks and opportunities: on the one hand, there is a risk that liability rules may lag behind technical and infrastructural developments; on the other hand, there is an opportunity to embed robust liability and insurance mechanisms in project contracts, financing arrangements and public-communication strategies from the outset. Finally, the results indicate that Uzbekistan's choices will have implications beyond its borders, as its nuclear installations may have transboundary effects and as other Central Asian states contemplate their own nuclear options. In this sense, Uzbekistan's implementation of the Vienna Convention can serve either as a regional model of good practice or as a case study in partial and fragmented transplantation, depending on how the forthcoming legislative and institutional reforms are ultimately crafted.

IV. Discussion

The results of this study confirm that the global nuclear liability regime remains structurally fragmented, even after multiple rounds of treaty-making and soft-law clarification. Scholars have long described the coexistence of the Paris–Brussels and Vienna–Joint Protocol "families," complemented but not fully harmonized by the CSC, as a complex mosaic rather than a single coherent system. Recent work on the revised Paris–Brussels regime demonstrates how that system has evolved into a sophisticated three-tier compensation structure with high minimum amounts and clear channeling and jurisdiction rules, but also underlines that these refinements primarily benefit a geographically limited group of participating states. In parallel, commentary on the Vienna Convention's sixty-year history emphasizes its aspiration to universal applicability and its role as the principal liability regime for many non-European nuclear states, while acknowledging that adherence remains incomplete and that important nuclear countries still rely on national law alone. Against this backdrop, Uzbekistan's decision to accede to the Vienna Convention rather than to seek Paris membership or to remain outside both regimes appears both legally and politically significant. The choice aligns Uzbekistan with the more global treaty family, which is open to all states and has been updated by protocol to reflect post-Chernobyl understandings of nuclear risk and compensation, even if not all states have ratified the revised text. At the same time, the decision implicitly accepts that Uzbekistan will operate within a regime whose effectiveness depends heavily on robust national

implementation and on the responsiveness of domestic institutions to evolving INLEX and OECD–NEA recommendations.

From a doctrinal perspective, the findings show that Uzbekistan's accession positions it within a set of widely recognized "international principles of nuclear liability", which include strict and exclusive operator liability, concentration of jurisdiction and equal treatment of victims. These principles, distilled from both the Paris–Brussels and Vienna-based regimes, have been described in the literature as offering superior protection and greater legal certainty than general tort law for ultra-hazardous activities. The results support this view by demonstrating that the treaty-based principles create a clearer allocation of risk and a more predictable framework for financial security than Uzbekistan's earlier reliance on general civil and environmental law. At the same time, the comparative evidence highlights that these principles are not self-executing and require detailed national legislation on liability amounts, insurance and state supplementation to deliver their promised benefits in practice. This underscores a key interpretive point: for Uzbekistan, accession to the Vienna Convention is better understood as a starting point for building a comprehensive nuclear liability architecture rather than as the culmination of that process.

A central contribution of this study lies in situating Uzbekistan's trajectory alongside that of other newcomer or recently modernized nuclear states, particularly the UAE and Ukraine. The literature on the UAE's Federal Law by Decree No. 4 of 2012 emphasizes that it represents a "quantum leap" in domestic tort law, embedding strict and exclusive operator liability, mandatory financial security and close alignment with the 1997 Vienna Convention in a jurisdiction with no prior nuclear power experience. Commentators note that this law explicitly incorporates the Vienna Convention where domestic provisions are silent, thereby operationalizing the treaty as a default normative framework and ensuring coherence between international obligations and national procedural rules. In Ukraine, by contrast, a stand-alone law on civil liability for nuclear damage and its financial provision sits alongside broader nuclear and insurance legislation, reflecting a transition from Soviet-era rules to a modernized Vienna-based regime in a state with a long operating history. The results show that, despite these differing starting points, both jurisdictions converge on the need for a clearly articulated statute that translates high-level treaty principles into concrete rights, obligations and institutional mechanisms.

Uzbekistan's current framework, as documented in its 2019 Atomic Energy Law and subsequent licensing regulations, does not yet reflect this level of specificity in relation to civil liability and financial security, although it does articulate general safety principles and regulatory competences. Policy documents and parliamentary debates surrounding the 2025 accession law indicate an intention to move towards a more detailed liability regime, including the creation of a nuclear insurance system and the adoption of compensation standards, but the precise legislative technique

remains undecided. The comparative analysis suggests that Uzbekistan could pursue either a Ukrainian-style dedicated liability statute or a UAE-style integrated approach that closely references the Vienna Convention, with both options offering viable pathways to compliance and effectiveness. In this respect, the study complements and extends existing literature on newcomer implementation by demonstrating that there is no single prescribed model, but that all successful models share certain functional features: clear channeling, quantified liability limits, mandatory financial security and explicit state backup mechanisms. The Uzbek case thus reinforces the argument that "form follows function" in nuclear liability design, and that the key normative question is not the exact configuration of legal instruments, but whether they collectively deliver prompt, adequate and non-discriminatory compensation (AllahRakha, 2025).

The findings also invite reflection on how Vienna-style liability principles can be integrated into a civil-law system undergoing broader economic and legal transition. The literature on post-socialist nuclear states has pointed out that the transplantation of Western nuclear liability concepts into civil-law codes requires careful coordination with pre-existing doctrines of state responsibility, enterprise liability and environmental protection. In many such jurisdictions, state ownership or control of nuclear assets historically blurred the distinction between operator liability and sovereign responsibility, raising questions about the practical meaning of "exclusive" operator liability and the role of budgetary guarantees. Uzbekistan, like some Central and Eastern European countries in earlier decades, is in the process of clarifying the division of roles between newly established regulatory bodies, state-owned or state-designated nuclear operators and the Ministry of Energy, as evidenced by recent amendments to its Atomic Energy Law and related institutional reforms. The results indicate that, in this setting, the adoption of Vienna principles offers both an opportunity and a challenge: it can help disentangle regulatory and operational functions and embed objective risk allocation rules, but it also demands that domestic legislation specify how state entities will act when they themselves are the operator or the ultimate guarantor (Raff, 2015).

Another dimension of this integration concerns Uzbekistan's insurance and financial sectors, which must support the requirement of adequate financial security for nuclear operators. INLEX and NEA reports underline that raising liability limits and ensuring sufficient financial security requires not only legislative will but also a realistic assessment of domestic and international insurance capacity, including the potential participation in nuclear insurance pools. In mature nuclear states, experience shows that the combination of private insurance, mutual pools and state-backed funds can deliver large aggregate compensation amounts, but that such arrangements take time to develop and require trust between regulators, operators and insurers. For Uzbekistan, whose insurance market is still consolidating and diversifying, the results suggest that a phased approach to liability limits, accompanied by explicit state guarantees and possibly regional pooling arrangements, may be necessary to reconcile

Vienna obligations with market realities. This insight connects the case study to broader debates in the literature on how energy-transition economies can internalize catastrophic risk without undermining investment incentives or overburdening fiscally constrained states. In that sense, Uzbekistan's experience may provide valuable empirical material for future comparative work on nuclear liability in emerging markets.

The discussion of transboundary effects and regional implications in the results section resonates strongly with recent scholarship on the extraterritorial dimensions of nuclear liability. Authors have emphasized that, while the core conventions concentrate jurisdiction and liability in the state where the incident occurs, the practical distribution of risk is inherently transboundary, particularly in regions with shared river basins, atmospheric circulation patterns and energy interconnections. Post-Fukushima analyses have further highlighted those public perceptions of nuclear projects in neighboring states are heavily influenced by expectations about compensation and cross-border solidarity in the event of a major accident. In Central Asia, where other states may consider nuclear options in the future and where water and energy systems are closely intertwined, Uzbekistan's adoption of a Vienna-based liability regime could serve as a reference point or implicit benchmark for regional practice. This will be particularly salient if Uzbekistan chooses to set liability limits significantly above treaty minima and to provide explicit guarantees of compensation for transboundary damage, in line with INLEX recommendations urging states to exceed minimum amounts and to ensure coverage of latent and long-term injuries.

At the same time, the study's findings underline that accession by a single state does not automatically produce a seamless regional liability network. As the literature on European developments shows, the strongest transnational compensation structures have arisen where multiple neighboring states participate in the same conventions and supplementary funds, thereby aligning jurisdictional rules and pooling financial resources. By contrast, where neighboring countries adhere to different regimes or remain outside the treaty framework, asymmetries in coverage and remedies can persist, complicating both preventive cooperation and ex post claims handling. The Uzbek case therefore suggests a dual policy agenda: domestically, to develop a robust Vienna-compatible liability system; and regionally, to encourage dialogue and possibly coordinated accession among Central Asian neighbors. Such regional engagement would be consistent with broader NEA and IAEA recommendations encouraging states considering long-lived radioactive waste facilities and other nuclear projects to adhere to one of the modernized liability regimes and to enact consistent national legislation. In this way, Uzbekistan's implementation choices may not only shape its own legal landscape but also influence the trajectory of nuclear governance in its wider neighborhood.

Beyond its immediate policy relevance, the study contributes to theoretical debates on how law allocates the risks of ultra-hazardous activities in the context of

the low-carbon energy transition. Classic writings on nuclear liability framed the issue as a special case of strict liability for dangerous activities, justified by the magnitude of potential harm and the difficulty of proving fault, and often contrasted nuclear-specific schemes with general environmental liability and state responsibility for transboundary harm. More recent work, including comparative analyses by INLEX and NEA, has broadened this lens by examining how nuclear liability regimes interact with other ultra-hazardous sectors and with evolving notions of environmental and intergenerational justice. The Uzbek case illustrates how these abstract debates translate into concrete institutional design choices in a state pursuing both decarbonization and economic modernization. By choosing to embed Vienna principles in its legal order, Uzbekistan aligns itself with a model that prioritizes ex ante risk allocation, insurance-based financial security and centralized claims handling over diffuse ex post litigation under general tort law (N. Alhathi et al., 2024).

The findings also suggest that nuclear liability regimes may serve as laboratories for broader approaches to managing systemic risks associated with energy transition technologies. The recommendations emanating from INLEX after Fukushima, including calls for higher liability limits, coverage of latent injuries and the establishment of claims-handling mechanisms, reflect a recognition that catastrophic energy risks require tailored legal responses that go beyond traditional negligence-based frameworks. In this regard, Uzbekistan's prospective implementation of a Vienna-based regime could generate insights into how a transition economy calibrates liability and insurance to balance investor incentives, public acceptance and fiscal prudence. Similar questions are now being asked in relation to carbon capture and storage, hydrogen infrastructure and deep geological repositories for radioactive waste, where emerging NEA analyses emphasize the need for clear definitions of "installation", appropriate liability amounts and careful consideration of long-term stewardship. By highlighting these connections, the study contributes to an emerging strand of literature that views nuclear liability not as an isolated legal niche, but as part of a broader toolkit for governing high-risk technologies in the Anthropogenic.

While the study offers a detailed doctrinal and comparative analysis, several limitations must be acknowledged, both in terms of data availability and the scope of inquiry. First, the assessment of Uzbekistan's domestic framework necessarily relies on currently available legislation, policy statements and international review reports, which may not capture draft regulations or internal governmental deliberations that are still in progress. As Uzbekistan moves from accession to full implementation of the Vienna Convention, new laws and regulations will likely refine liability limits, insurance schemes and claims-handling procedures, potentially altering some of the conclusions drawn here. Second, the comparative sample, while carefully selected to reflect relevant Vienna-Convention and newcomer experiences, is not exhaustive and does not include important Paris-regime states or non-party nuclear countries such as Japan or the Russian Federation, whose practices could provide additional insights

into alternative liability configurations. Future research could broaden the sample and employ mixed-methods approaches, including interviews with regulators, insurers and policymakers, to capture the practical dynamics of implementation that cannot be gleaned from legal texts alone(AllahRakha, 2024).

Third, the study focuses primarily on the design of civil liability and compensation mechanisms and does not examine in depth their interaction with other areas of law, such as administrative enforcement, criminal liability or human rights protections. As recent scholarship on nuclear disasters has shown, victims' experiences and perceptions of justice are shaped not only by the availability of compensation, but also by the transparency of decision-making, the accessibility of legal remedies and the responsiveness of administrative and judicial institutions. In Uzbekistan, where broader reforms of the judiciary, public administration and environmental governance are underway, future work could explore how nuclear liability rules interact with these systemic changes and whether they catalyze or impede improvements in legal accountability. Finally, the study has treated Uzbekistan as a single case, yet the regional implications of its choices suggest that a comparative Central Asian perspective would be valuable, particularly if neighboring states proceed with their own nuclear plans. Longitudinal research tracking how Uzbekistan's regime performs over time, including in response to near-miss events, minor incidents or cross-border drills, would also enrich the empirical basis for theoretical and policy debates. In sum, despite these limitations, the analysis provides a robust foundation for understanding the stakes and options involved in implementing international nuclear liability regimes in newcomer states, and it invites further empirical and interdisciplinary work as Uzbekistan's legal and institutional reforms unfold.

Conclusion

This study has examined how the international nuclear civil liability regime, built around the Vienna and Paris "families" and complemented by the Joint Protocol and the CSC, remains structurally fragmented yet underpinned by a shared set of core principles. It has shown that accession to the Vienna Convention positions Uzbekistan within this normative architecture and commits it to implementing strict and exclusive operator liability, mandatory financial security, concentrated jurisdiction and non-discriminatory victim protection. Against this backdrop, the analysis of comparative practice in jurisdictions such as Hungary, the Czech Republic, Ukraine and the United Arab Emirates demonstrates that effective implementation requires more than formal treaty membership: it depends on detailed domestic legislation that specifies liability limits, insurance obligations, state guarantees and practical claims-handling mechanisms. The examination of Uzbekistan's current framework reveals that the 2019 Atomic Energy Law and associated regulations provide an important regulatory and institutional baseline, but do not yet amount to a comprehensive nuclear civil liability regime aligned with modern Vienna standards. Accession in 2025, accompanied by announced plans to create a nuclear insurance system and to adopt

compensation standards, therefore marks a turning point at which Uzbekistan moves from general safety-oriented regulation towards the construction of a specialized liability and compensation system. Taken together, the findings indicate that Uzbekistan is at a formative stage where the choices it makes in the next few years will determine whether the Vienna Convention functions as a living risk-allocation mechanism or as a largely symbolic reference point.

The analysis suggests several implications for future policy design in Uzbekistan and for comparative research on nuclear liability in newcomer states. From a policy perspective, the most immediate task is to translate Vienna principles into a clear, accessible and internally coherent body of national law, whether through a dedicated civil nuclear liability statute or through an integrated approach that embeds detailed liability and insurance provisions in the existing atomic energy framework. Closely linked to this is the need to calibrate operator liability limits and financial security requirements to realistic damage scenarios and to the depth of domestic and international insurance markets, while ensuring that state-backed guarantees are transparent and fiscally sustainable. In parallel, the development of robust institutional arrangements covering regulatory oversight, licensing conditions, emergency planning and claims administration will be essential if the regime is to deliver prompt and adequate compensation to victims, including in potential transboundary cases. For researchers, Uzbekistan's trajectory offers an opportunity to study, in real time, how a transition economy integrates a specialized international liability regime into a broader agenda of energy diversification, legal reform and regional cooperation, and how public perceptions of nuclear projects are shaped by evolving rules on compensation and redress. Future work could expand the comparative lens to include additional Central Asian and neighboring states, explore the interaction between nuclear liability and other branches of law such as human rights and environmental protection, and investigate how lessons from nuclear liability might inform the governance of other high-risk technologies central to the low-carbon transition. In this way, the Uzbek case can enrich both doctrinal and interdisciplinary debates on how law allocates responsibility for catastrophic risk in an increasingly complex and interconnected energy landscape.

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