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Maritime Nuclear Regulation by International Organizations and in State Practice: A Comparative Survey and Proposals for Korea

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1. INTRODUCTION

Floating nuclear power plants (FNPPs) and nuclear-powered merchant vessels are attracting renewed attention in response to growing concerns over decarbonization and energy security. In its 2024 advisory opinion, the International Tribunal for the Law of the Sea concluded that anthropogenic greenhouse gas emissions constitute pollution of the marine environment within the meaning of the United Nations Convention on the Law of the Sea (UNCLOS) [1][2]. Several maritime nuclear projects have since progressed beyond the conceptual stage. Russia's 70 MWe Akademik Lomonosov has been in commercial operation since May 2020 [3][4]; advanced reactor technologies are being evaluated for merchant-ship propulsion [5]; and, in June 2026, the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Coast Guard (USCG) concluded a memorandum of understanding (MOU) concerning civilian maritime nuclear projects [6]. In Korea, the American Bureau of Shipping (ABS) issued approvals in principle for a 15,000 twenty-foot equivalent unit (TEU) containership powered by a molten-salt reactor in February 2025 [7] and for a floating small modular reactor (SMR) power module in June 2025 [8]. In addition, an application for standard design approval of the 170 MWe innovative SMR (i-SMR) was submitted to the Nuclear Safety and Security Commission in February 2026 [9]. These approvals, however, are preliminary classification assessments at the conceptual design stage and do not constitute nuclear regulatory approval.

Despite increasing industrial and research activity, the applicable regulatory framework remains fragmented across UNCLOS, International Maritime Organization (IMO) and International Atomic Energy Agency (IAEA) instruments, and national legal systems. Although the need for international coordination has long been recognized [10]–[14], earlier proposals for dedicated conventions and agreed definitions of the regulated object did not result in an operative framework. Coastal States generally sought stronger notification, control, and liability arrangements, whereas operating, flag, and cargo States resisted measures perceived as restricting navigation or expanding liability [10][13]. The institutional landscape is now beginning to change. The Convention on Supplementary Compensation for Nuclear Damage (CSC) entered into force in 2015, and the United Kingdom became its twelfth Contracting Party on 1 January 2026 [15]. The IMO initiated the revision of the 1981 Code of Safety for Nuclear Merchant Ships in 2025, with technical work commencing in January 2026 [16][17], and the IAEA launched its ATLAS initiative (Atomic Technologies Licensed for Applications at Sea) in Washington, D.C., in August 2026 [18]. Against this background, this paper surveys the applicable international framework and selected national practices, identifies the principal unresolved issues, and proposes corresponding measures for Korea. The analysis relies primarily on treaty texts and official institutional instruments and expressly distinguishes settled rules from questions that remain legally or institutionally unresolved.

2. SURVEY OF THE CURRENT FRAMEWORK

2.1. International Legal and Institutional Regimes

Maritime nuclear activities are subject to overlapping regimes that address different aspects of the same activity; the resulting overlaps and gaps are therefore structural (**Table I**). UNCLOS Article 23 requires nuclear-powered ships and ships carrying nuclear substances to carry prescribed documents and observe internationally established precautions during innocent passage, but does not expressly authorize denial of passage that is otherwise innocent. Articles 22 and 25 permit designated sea lanes and temporary suspension of passage, subject to specified conditions. Article 60 applies only where a unit qualifies as an artificial island, installation or structure, and Article 234 only in qualifying ice-covered areas. Articles 198, 199 and 206 may apply where pollution damage requires notification and contingency cooperation or planned activities may cause substantial pollution [2]. Article 194 imposes due diligence proportionate to risk. The Tribunal characterized this standard as stringent for greenhouse-gas pollution but did not address radiological risks [1].

IMO regulation follows two tracks. Packaged irradiated nuclear fuel, plutonium and high-level radioactive waste are governed by the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on board Ships (INF Code), adopted in 1999 and mandatory through Chapter VII of the International Convention for the Safety of Life at Sea (SOLAS) since 2001 [19]. Nuclear propulsion is governed by SOLAS Chapter VIII and the 1981 Code, which reflect the reactor and ship-

design assumptions of their time [20][21]. A goal-based, technology-neutral revision is under way, with adoption targeted for 2030 [16][17]. Non-self-propelled floating power units are outside the agreed output [16], and a separate output proposed at MSC 111 was not agreed [22].

The IAEA Regulations for the Safe Transport of Radioactive Material (SSR-6) apply to all transport modes [23] and are given effect at sea by the mandatory International Maritime Dangerous Goods (IMDG) Code, whose current radioactive-material provisions follow the 2018 edition [24]. No dedicated IAEA Safety Requirement or Safety Guide, however, addresses reactors operating at sea across their maritime life cycle. The Agency has published studies on FNPPs and transportable reactors since 1997 [25]–[27], while broader assessments, including Safety Reports Series No. 123 (SRS-123), examine the applicability of existing standards to advanced reactors generally [28]. These efforts have produced technical studies rather than binding requirements. The Convention on Nuclear Safety is limited to land-based civil plants [29].

Two additional regimes apply to the life cycle. The London Convention and 1996 Protocol regulate dumping and deliberate disposal at sea of wastes, vessels and structures, but neither establishes a comprehensive decommissioning regime for maritime nuclear facilities [30][31]. The Paris, Vienna and CSC regimes channel civil liability to installation operators and exclude a reactor equipping a means of sea or air transport as a source of power [32]–[34]. This exclusion does not apply uniformly to every floating or transportable reactor. The IAEA International Expert Group on Nuclear Liability (INLEX) considers that a transportable plant fixed in position and generating electricity externally may qualify as a nuclear installation; coverage during carriage depends on fuelling and deployment arrangements [35]. The clearest treaty gap therefore concerns reactors forming part of nuclear-powered ships, for which the 1962 Brussels Convention never entered into force [10][36]. The 1971 Convention relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material (NUCLEAR 1971) creates no compensation regime, but exonerates maritime actors where liability is imposed on an installation operator; it does not cover damage from a shipboard propulsion reactor [37]. Separate conventions govern emergency notification and assistance but not maritime command and port-State interfaces [38][39].

Table I. Regimes of the International Organizations and their Limits for Maritime Nuclear Use

Regime	Instruments	Coverage and principal limitation
UNCLOS	Arts. 22, 23, 25, 60, 194, 198-206, 234, 236 [2]	Jurisdiction, passage and environmental duties; no cross-instrument definition of "ship"; no express nuclear-specific power to deny
		otherwise innocent passage
IMO	International Maritime Dangerous Goods (IMDG) Code [24]; INF Code [19]; SOLAS ch. VIII [20]; 1981 Code [21]	Mature for packaged cargo; propulsion code based on 1981 assumptions; revision targeted for 2030; non-self-propelled units not placed on the agenda [22]
IAEA	SSR-6 [23]; TECDOC-940 [25]; NG-T-3.5 [26]; SRS-123 [28]	Comprehensive transport requirements; technical studies, but no Safety Requirement or Guide dedicated to a plant at sea
Nuclear safety	Convention on Nuclear Safety [29]	Limited to land-based civil nuclear power plants
Dumping	London Convention [30]; 1996 Protocol [31]	Different controls on dumping and disposal at sea; no comprehensive life-cycle decommissioning regime
Civil liability	Paris [32], Vienna [33], CSC [34]; 1962 Brussels [36]; NUCLEAR 1971 [37]	Shipboard power reactors are excluded, but a plant fixed in position may qualify as an installation [35]; 1962 Convention not in force
Emergency	Early Notification [38]; Assistance [39]	Notification and assistance duties apply; maritime command and port-State interfaces are not addressed

2.2. National Practice in Selected States

Ten States were surveyed against five criteria (Table II): reactor-licensing authority, maritime construction and navigation rules, nuclear-maritime coordination, participation in liability conventions, and the status of maritime nuclear activities, drawing on national legislation, NEA country profiles [40] and IAEA liability factsheets [41]. No omnibus statute or one-stop procedure was identified in publicly accessible primary materials as of 31 July 2026, although unpublished arrangements or naval rules may exist. Several States nevertheless regulate substantial portions of the life cycle. Canada requires a licence to construct, operate, decommission or abandon a nuclear-powered vehicle [42]. Norway licenses visits by nuclear-powered naval vessels under its 1972 Act [43][44]; extension to commercial vessels requires separate analysis. Argentina regulates radioactive-material transport by water [45],

and the United Kingdom imposes detailed requirements on commercial nuclear ships, including approval, safety assessment, port entry and decommissioning [46]. No single pathway linking all authorizations was identified (Table II).

Deployment maturity also varies. Russia is the only State operating a commercial FNPP [3][11]. Public reporting in 2023 indicated that China's proposed ACP100S deployment in the South China Sea had been suspended, although this does not establish that design work ceased [47]. Norway remains at concept stage and Canada at pre-licensing stage. Russia applies maritime and nuclear law cumulatively to the Akademik Lomonosov: Federal Law No. 170-FZ treats floating facilities containing nuclear installations as facilities using atomic energy [48], while the IAEA Power Reactor Information System lists its two units as operational power reactors [4]. This does not itself show legal indeterminacy, but illustrates that status and regulatory responsibility may vary by function and life-cycle stage.

Table II. Ten States against the Five Survey Criteria

State	Reactor-licensing authority	Maritime construction and navigation rules	Nuclear-maritime coordination	Liability conventions	Status of maritime nuclear activities
Russia	State safety regulatory authority; floating facilities with reactors are nuclear facilities under 170-FZ [48]	Register of Shipping rules required by the nuclear statute [48]	Nuclear and maritime law apply cumulatively [48]	Vienna	Akademik Lomonosov in commercial operation since 2020 [4]
China	Nuclear Safety Law: licensing by the State nuclear safety regulator [49]	Separate maritime legislation [50]	Not identified for reactors	None	ACPR50S, ACP100S; ACP100S deployment reportedly suspended in 2023 [47]
Norway	1972 Act; s. 17 permits special rules for ship reactors [43]; none identified	Not identified	Licensed naval-vessel visits only [44]	Paris	Concept development
Canada	Canadian Nuclear Safety Commission (CNSC) licence for nuclear-powered vehicles (Nuclear Safety and Control Act (NSCA), s. 26) [42]	Not identified	CNSC-Transport Canada arrangements [42]	CSC (2017)	Research and pre-licensing
United States	NRC under the Atomic Energy Act; Title 10 of the Code of Federal Regulations (10 CFR) Parts 50, 52 or 53 [51][52]; Part 71 covers transport packaging only [53]	U.S. Coast Guard [6]	NRC-USCG MOU, June 2026 [6]	CSC (2015)	NRC licensing review for FNPPs and propulsion [54]
France	Nuclear statute; no ship-reactor provision identified [40]	Maritime administration approves reactor installation (Division 221) [55]	No single pathway identified	Paris	No FNPP; reprocessing and transport
United Kingdom	Secretary of State approval of reactor installation and safety assessment [46]	Merchant Shipping (Nuclear Ships) Regulations 2022: approval, safety assessment, port entry, decommissioning [46]	Allocation between maritime and nuclear regulators by life-cycle phase [56]	Paris; CSC (2026) [15]	No FNPP; transport fleet
Japan	Nuclear regulator [40]	Ship Safety Act (MLIT, Japan Coast Guard) [40]	Separate authorities; no single pathway identified	CSC (2015)	No FNPP; mixed-oxide (MOX) fuel imports; Mutsu precedent
Argentina	Nuclear Regulatory Authority (ARN) under Ley 24.804 [45]	ARN: safety norms for waterborne transport of radioactive material [45]	Not identified	Vienna; CSC [41]	Land-based SMR; no maritime project
Korea	Nuclear Safety Act; no dedicated ship-reactor category [57]	Ship Safety Act; Nuclear Ship Standards [58]	Nuclear Safety and Security Commission (NSSC)-Ministry of Oceans and Fisheries (MOF) link only for port entry of foreign	None of the three	ABS approvals in principle [7][8]; i-SMR design approval sought [9]

State	Reactor-licensing authority	Maritime construction and navigation rules	Nuclear-maritime coordination	Liability conventions	Status of maritime nuclear activities
			nuclear ships; no standing mechanism [57]		

Not identified: not found in the publicly accessible primary materials reviewed as of 31 July 2026.

3. REGULATORY GAPS, LIMITATIONS, AND CONTESTED ISSUES

The survey indicates that radioactive-material transport by sea is governed by a well-established framework applied with relative consistency. By contrast, four issues remain unresolved for maritime nuclear facilities: legal classification, the technical adequacy of the nuclear-ship safety framework, liability for reactors used as shipboard power sources, and coastal-State jurisdiction.

3.1. A Comparatively Mature Framework

Packaged radioactive material is governed by a mature, multilayered framework. SSR-6 establishes requirements for all transport modes [23]; the mandatory IMDG Code implements them at sea [24], and the INF Code adds ship-specific requirements; both apply through SOLAS Chapter VII without separate accession [19][24]. UNCLOS Article 23 further imposes documentation and precautionary duties during innocent passage [2]. No major structural gap was identified within the scope of this survey.

3.2. Uncertain Legal Classification of Maritime Nuclear Facilities

Neither UNCLOS nor SOLAS provides a common, cross-instrument definition of "ship" or "vessel" that determines the status of every configuration and operational phase of a floating nuclear facility [2]; the International Law Commission (ILC)'s 1956 draft articles likewise contained none [59]. An FNPP may therefore be characterized as a vessel, a nuclear installation or a hybrid object, depending on its design, location, function and operational stage [11][12]. Classification is instrument-specific: the same unit may be a ship for navigation, a nuclear facility under domestic law, and either within or outside a liability convention's definition of nuclear installation. Because the applicable instruments change with the life-cycle phase [60], a functional, life-cycle approach that fixes status, jurisdiction and responsibility in advance is preferable, as classification affects safety jurisdiction, navigation, safety zones, maritime rules and liability coverage.

3.3. Obsolescence of the Safety Framework and the Liability Gap

The 1981 Code presents an effectiveness gap rather than a normative vacuum. SOLAS Chapter VIII and the Code establish a framework for nuclear-powered merchant ships but reflect the technologies and design assumptions of their adoption and do not readily accommodate advanced reactors [20][21]. The IMO therefore began a goal-based, technology-neutral revision in 2025, leaving non-self-propelled floating power units outside its scope [16]. In May 2026, the Maritime Safety Committee (MSC) at its 111th session (MSC 111) declined to add guidance for such units to the post-biennial agenda and requested further IAEA coordination [22].

The liability gap is more fundamental. The 1962 Brussels Convention never entered into force, while the Paris, Vienna and CSC regimes exclude reactors equipping a means of transport as a source of power. No generally applicable treaty therefore governs compensation for damage from a civil nuclear-powered ship [10][32]–[34][36]. A floating plant fixed in position and supplying external electricity may, by contrast, fall within those conventions [35]. The 1962 Convention used principles familiar to land-based nuclear liability law, and its failure suggests that any future regime must address warships and State-operated vessels and establish insurable or State-backed financial security [10]. In May 2026, MSC 111 invited the IMO Legal and Facilitation Committees to consider civil liability [22]; no dedicated work output had been identified by 31 July 2026.

3.4. Unsettled Scope of Coastal-State Jurisdiction

UNCLOS Article 23 requires nuclear-powered ships and ships carrying nuclear substances to carry prescribed documents and observe internationally established precautions during innocent passage, but does not expressly authorize denial of otherwise innocent passage; Article 22(2) permits designated sea lanes [2]. Some coastal States nevertheless require prior notification or authorization, while flag and shipping States regard such measures as inconsistent with innocent passage. Because these disputes have generally been managed through protest, negotiation and route adjustment rather than adjudication, the permissible extent of coastal-State control remains unsettled [13]. A related but distinct issue arises along the Northern Sea Route, where Russia’s navigation rules seek to ensure navigational safety and to prevent, reduce and control marine pollution from ships [61]. The Arctic Sunrise tribunal did not assess this regime as a whole; it held only that the measures at issue were not lawful exercises of authority under Articles 220 or 234 [62]. Article 234 applies only where its geographical and climatic conditions are satisfied and requires non-discrimination and due regard for navigation [2], which limits the authority Russia can claim under it.

4. INTERNATIONAL RESPONSES AND IMPLICATIONS FOR KOREA

4.1. Ongoing International Responses

Three parallel international tracks are under way, although none has produced a binding instrument. The IMO process is the most advanced. MSC 110 tasked the Sub-Committee on Ship Design and Construction (SDC) in June 2025 with revising the 1981 Code and SOLAS Chapter VIII on a goal-based, technology-neutral basis [16]. SDC 12 finalized a work plan in January 2026 targeting adoption in 2030 [17], and MSC 111 endorsed it in May. MSC 111 also invited the Legal and Facilitation Committees to consider civil liability, left security open for further submissions, and declined a separate output for non-self-propelled floating power units [22]. As a co-sponsor, Korea can participate directly in developing the framework [63].

The IAEA launched ATLAS at a high-level forum in Washington, D.C., on 26-27 August 2026 [18]. The ministerial joint statement supports international cooperation on the safety, security and peaceful use of maritime nuclear applications and the formation of a steering committee and project groups; it describes ATLAS as technology-neutral and states that designs, business models and operational concepts remain largely at an early stage [64]. Six project groups were proposed, covering international safety standards, legal and regulatory frameworks, maritime classification, safeguards, nuclear security, and a deployment roadmap including infrastructure and the fuel cycle, with 24 proposed deliverables. The legal group is to identify licensing responsibilities by deployment model and life-cycle phase, map existing legal frameworks, and assess liability and insurance [65]. A first steering committee meeting is planned for 1 December 2026 and in-person project group meetings from spring 2027 [65]. ATLAS outputs may inform the IMO revision but are not binding and do not replace IMO adoption procedures. Classification societies form a third track by issuing rules, guidance and approvals in principle [7][8][66]. These approvals support design development but are neither construction authorization nor regulatory licensing. Technical assessment is thus advancing faster than the public-law framework, while the underlying classification issue remains unresolved.

4.2. Status in Korea

Korea has several relevant statutory provisions. The Nuclear Safety Act regulates the entry and departure of foreign nuclear-powered ships [57], and the Nuclear Ship Standards under the Ship Safety Act prescribe requirements for nuclear-ship structure and equipment [58]. The Special Act on the Promotion and Support of Small Modular Reactor Development, enacted on 10 March 2026 and in force since 11 September 2026, provides a legal basis for SMR research, development and demonstration [67].

These provisions, however, do not establish an integrated licensing framework for maritime reactors. The Special Act is primarily promotional: it creates no marine-reactor licensing category and does not define the interface between the Nuclear Safety and Security Commission and the Ministry of Oceans and Fisheries. Existing provisions likewise do not link reactor authorization under the Nuclear Safety Act with vessel certification under the Ship Safety Act across design, construction, operation and decommissioning [67][68]. The i-SMR is an integrated pressurized water reactor [9], whereas several maritime concepts use molten-salt or other advanced technologies [5][7]. Maritime deployment also introduces towing and marine external hazards [11][12] and ship-specific accident conditions such as flooding, sinking and capsizing [68]. Korea remains outside the Paris, Vienna and CSC regimes [69]. Korean law allocates these matters across separate statutes without a dedicated framework [14][68], and no permanent statutory mechanism integrating the relevant nuclear, maritime, emergency-response and security authorities was publicly identified as of 31 July 2026.

5. CONCLUSIONS

This paper examined maritime nuclear regulation at the international, national and Korean levels. It found that radioactive-material carriage is governed by a comparatively coherent framework, whereas the classification of floating nuclear facilities, the technical adequacy of the nuclear-ship safety regime, liability for shipboard power reactors and coastal-State jurisdiction remain unresolved. These issues are interconnected because classification affects safety jurisdiction, navigational rights and liability. The IMO revision and the IAEA's ATLAS initiative are the most significant modernization efforts in decades. The IMO revision remains technical, with civil liability referred to other committees [22], and the ATLAS legal group’s deliverables, including liability and insurance, were still at the proposal stage in August 2026 [65]. The IMO work plan targets adoption of a revised Nuclear Code and SOLAS Chapter VIII amendments in 2030; adoption is distinct from entry into force. Earlier initiatives were impeded by political, sovereignty, scope, liability and insurability concerns amid limited commercial deployment. Participation in current rule-making is therefore substantive rather than procedural.

Three measures should be prioritized. First, Korea should establish a permanent interagency coordination mechanism jointly led by the Nuclear Safety and Security Commission and the Ministry of Oceans and Fisheries, drawing on the allocation of responsibilities and coordination arrangements reflected in the 2026 NRC–USCG framework [6]. Such a mechanism should integrate nuclear safety, vessel certification, port regulation, emergency preparedness, security, safeguards, and decommissioning across the full life cycle of maritime nuclear facilities. Second, Korea should develop a technology-neutral, life-cycle licensing

framework applicable to both nuclear-powered vessels and floating nuclear power plants and periodically assess its consistency with evolving IMO and IAEA standards [17][18]. This domestic framework should be developed in parallel with Korea's active participation in the revision of the Nuclear Code and in the ATLAS initiative, whose joint statement lists Korea among the participating States [64], making use of its status as a co-sponsor of the IMO revision proposal [63]. Third, Korea should examine accession to the CSC as part of a broader strategy for managing transboundary nuclear liability. CSC accession alone would not resolve the liability gap for nuclear-powered ships because the Convention excludes a reactor installed in a means of sea transport for use as a source of power. It may, however, apply to a floating nuclear power plant that is fixed at a designated site and supplies electricity externally, depending on its configuration and legal characterization [34][35]. Korea should therefore supplement any decision on CSC accession with domestic legislation addressing strict liability, the channelling of liability to the responsible operator, jurisdiction, liability limits, compulsory financial security, and, where necessary, State guarantees, while supporting the development of a dedicated international liability regime for civil nuclear-powered ships through the IMO Legal Committee.

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