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The Future of Nuclear Energy May Be Offshore

Maritime Nuclear Deployment and the Emerging Legal Architecture

by

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I. Introduction

For most of the civilian nuclear era, nuclear energy infrastructure has been overwhelmingly land based. Civilian nuclear reactors have generally been understood as fixed terrestrial facilities, regulated principally through domestic legal systems and situated firmly within the sovereign territory of states. Yet this assumption is beginning to change.

A growing number of technological and commercial developments suggest that an important frontier for civilian nuclear energy deployment may lie offshore. These developments include renewed interest in nuclear-powered commercial shipping, floating nuclear power plants (“FNPPs”), offshore industrial applications powered by advanced reactors, remote maritime installations, Arctic deployment concepts, and potential nuclear-powered seabed infrastructure supporting mining or other industrial activity.



This is a subject I have written about in the past. In a prior [piece in *The National Interest*](#) concerning the regulation of nuclear-powered commercial vessels on the high seas, I argued that the intersection between nuclear technology and maritime governance would likely become increasingly important as advanced reactor technologies matured and maritime decarbonization pressures intensified. Recent developments suggest that this convergence is now accelerating beyond nuclear propulsion alone and into a broader range of offshore nuclear deployment concepts.

In April 2026, for example, the United States Maritime Administration (“MARAD”) [announced an initiative](#) to examine the use of advanced nuclear reactors, including small modular reactors (“SMRs”), for commercial shipping applications. The initiative reflects increasing recognition that maritime nuclear propulsion may offer substantial advantages in an era of shipping decarbonization, strategic competition, and growing global energy demand.

At the same time, companies around the world are exploring floating nuclear power concepts and offshore advanced reactor deployment architectures. Some concepts envision mobile or semi-mobile offshore reactor facilities supplying electricity to coastal grids or industrial facilities. Russia’s Akademik Lomonosov floating nuclear plant, though still relatively unique, has already demonstrated that floating civilian nuclear generation concepts are technologically and operationally feasible. Other concepts contemplate powering offshore infrastructure, seabed industrial activity, remote maritime operations, or energy-intensive coastal industries.

These developments are occurring against the backdrop of another important trend: the increasing strategic importance of maritime space itself. Offshore energy production, seabed mining, subsea infrastructure, Arctic shipping, and remote maritime industrial activity are all becoming increasingly important components of the global economy and of strategic competition among states.

As these trends converge, an important reality is becoming apparent. The future deployment of at least some civilian nuclear technologies may depend not only on nuclear engineering or economics, but also on the complex legal architecture governing maritime space. This reality presents significant regulatory and strategic challenges. Maritime space is not governed by a single unified legal regime. Rather, it is governed through a layered and highly differentiated legal architecture consisting of overlapping jurisdictional zones, distinct allocations of sovereign authority, and multiple interacting international and domestic legal systems. Depending upon where a nuclear installation is located, very different legal rules may apply.

Although my principal professional focus has long been nuclear energy law and policy, for more than two decades I have also taught public international law, including the international law of the sea. Increasingly, it has become apparent that these fields are beginning to converge in important ways. As advanced nuclear technologies move offshore, through nuclear-powered commercial vessels, floating nuclear power plants, and other marine installations, the legal



architecture governing maritime spaces is becoming directly relevant to the future deployment of nuclear energy systems.

A nuclear-powered commercial vessel transiting the high seas, for example, implicates a very different set of legal authorities than does a floating nuclear power plant anchored in a state's Exclusive Economic Zone ("EEZ"). A seabed installation located on a continental shelf raises different jurisdictional issues than does an offshore reactor located within territorial waters. In each case, the interaction between maritime law, environmental law, nuclear regulation and domestic licensing regimes, security regulation, and domestic sovereign authority may differ significantly.

These distinctions are not merely academic. They may profoundly affect project feasibility, licensing pathways, insurance and liability arrangements, export controls, operational flexibility, security obligations, and investor risk assessments.

This Prometheus Occasional Paper provides a conceptual overview of that emerging legal architecture. It begins by examining the basic jurisdictional geography of maritime space under international law. It then considers how those legal frameworks may apply to several categories of offshore nuclear deployment concepts, including nuclear-powered commercial shipping, floating nuclear power plants, and offshore or seabed nuclear installations. Finally, it considers the broader governance and regulatory fragmentation challenges likely to accompany the offshore migration of nuclear energy infrastructure.

II. The Maritime Legal Geography of Nuclear Energy

Any serious discussion of offshore nuclear deployment must begin with a basic understanding of the legal geography of maritime space. The international law of the sea does not treat the oceans as a single undifferentiated domain. Again, maritime space is divided into multiple jurisdictional zones, some of which apply to the water column, the airspace above it, and the seabed below, and some applying to the sea floor and subsoil beneath it. Activity in these zones is governed by distinct yet often overlapping rules, and a complex allocation of authority and rights as between coastal states, flag states, vessels, and the broader international community.

The principal legal framework governing these maritime zones is the 1982 United Nations Convention on the Law of the Sea ("UNCLOS"). Although the United States has not formally ratified UNCLOS, successive U.S. administrations have generally recognized most of its core jurisdictional provisions as reflective of customary international law. For present purposes, the most important point is that maritime legal geography allocates different forms of authority depending on distance from shore, the nature of the activity, and whether the relevant activity occurs in the water column, on the seabed, or through a vessel or installation.

Internal Waters and Territorial Seas

The zone closest to shore consists of a state's internal waters and territorial sea. Internal waters include ports, harbors, bays, and other waters landward of the baseline from which maritime zones are measured. Within internal waters, the coastal state exercises sovereignty, as an extension of its sovereignty over land territory.

Beyond internal waters lies the territorial sea, extending up to twelve nautical miles from the coastal baseline. Within the territorial sea, the coastal state likewise exercises sovereignty, subject to the important qualification that foreign flagged vessels generally retain a right of innocent passage.

For offshore nuclear installations located within internal waters or territorial seas, a coastal state will generally possess extensive regulatory authority. Such facilities would likely be treated in many respects similarly to terrestrial installations, though subject to additional maritime safety, navigation, security, and environmental considerations. Floating nuclear power plants anchored within territorial seas would almost certainly fall primarily within the regulatory authority of the coastal state, as the right of innocent passage would not apply. The same would generally be true for fixed offshore reactor installations attached to the seabed within territorial waters.

Even within territorial seas, however, maritime considerations remain important. Coastal states must balance their sovereign regulatory authority against obligations concerning navigation rights and maritime safety where applicable. Foreign flagged nuclear-powered commercial vessels transiting territorial seas may, depending upon the circumstances, enjoy the right of innocent passage, though this right does not extend to docking at port.

The Contiguous Zone and Exclusive Economic Zone

Beyond the territorial sea lies the contiguous zone, extending up to twenty-four nautical miles from the baseline, and beyond that the Exclusive Economic Zone, extending up to two hundred nautical miles.

The EEZ represents one of the most important and often misunderstood concepts in the modern law of the sea. Within the EEZ, the coastal state does not possess full sovereignty comparable to territorial sovereignty. Rather, the coastal state possesses exclusive rights for specific economic purposes, including the exploration, exploitation, conservation, and management of natural resources. These include most importantly fishing and mineral exploitation rights. At the same time, other states and their flagged vessels retain important freedoms within the EEZ, including freedoms of navigation and overflight, and the laying of submarine cables and pipelines. Although again, this does not grant a foreign flagged vessel the right to connect those cables or pipelines to the land. The coastal state retains substantial authority over cable landings, routing, coastal-zone permitting, and associated infrastructure within its territory and territorial sea.

This distinction between sovereignty, exclusive rights, and foreign state freedoms is critically important for offshore nuclear deployment. A floating nuclear power plant located within a coastal state's EEZ may fall within the coastal state's jurisdiction insofar as it relates to energy production, resource exploitation, environmental protection, or artificial installations. Yet the coastal state's authority may not be as comprehensive as within territorial waters. Similarly, nuclear-powered commercial vessels transiting through an EEZ generally remain primarily subject to flag-state jurisdiction, though coastal states retain important environmental and resource-related authorities.

The EEZ therefore creates a more complex and potentially fragmented jurisdictional environment than either territorial waters or the high seas. I always explain the EEZ to my students as being a hybrid of sorts, containing some legal elements of both the territorial sea and the high seas. I won't bore readers with the history of how this compromise was reached.

UNCLOS also contains specialized provisions concerning artificial islands and offshore installations. Coastal states possess authority to construct and regulate artificial islands, installations, and structures within the EEZ and on the continental shelf, and may establish safety zones around such structures. These provisions may prove highly important for floating nuclear plants and offshore reactor concepts. A floating nuclear power plant anchored within an EEZ may potentially be treated as an offshore installation subject to coastal-state jurisdiction. Yet questions may arise concerning mobility, relocation, operational status, and the interaction between installation status and vessel status.

The Continental Shelf and the Seabed

So far we have been discussing zones of water column, the airspace above them, and in some cases the seabed beneath them. However as noted previously, there is a separate set of zones which governs activities occurring on or beneath the sea floor, and that is primarily measured by geography/geology. The law governing the seabed and subsoil introduces an additional layer of complexity. Under UNCLOS, coastal states possess sovereign rights over the continental shelf for purposes of exploring and exploiting natural resources located on or beneath the seabed. Importantly, continental shelf rights may extend beyond the EEZ under certain geological circumstances.

The legal treatment of the seabed and the water column above it may differ. A coastal state may possess rights relating to seabed installations attached to the continental shelf even where the waters above those installations remain part of the EEZ or, in some circumstances, the high seas. This distinction may become increasingly important if future offshore nuclear concepts involve seabed installations supporting industrial activity, mining operations, or subsea infrastructure.

For example, a nuclear-powered seabed mining installation attached to the continental shelf would likely implicate coastal-state rights over seabed resource exploitation. Yet associated

navigation or surface activities may simultaneously implicate broader international navigation freedoms. These overlapping jurisdictional layers may significantly complicate regulatory governance. I will return to this zone further below, as it is the primary potential location for seabed nuclear activities.

The High Seas, “The Area,” and Offshore Installations

Beyond national jurisdiction lie the high seas, and the deep seabed beyond national continental shelves, known under UNCLOS as “the Area.” The high seas are governed principally by the principle of freedom of the seas. No state may claim sovereignty over the high seas. Instead, vessels operating on the high seas generally fall under the jurisdiction of their flag state. This principle is highly significant for nuclear-powered commercial shipping.

Importantly, the traditional “freedom of the seas” concept encompasses more than simple navigation rights. Under the modern law of the sea framework, high seas freedoms generally include freedom of navigation, freedom of overflight, freedom to lay submarine cables and pipelines, freedom to construct certain installations permitted under international law, freedom of fishing, and freedom of scientific research, among others. These freedoms are not unlimited, and they remain subject to various treaty obligations and environmental responsibilities. Nevertheless, they reflect the basic principle that no state may exercise territorial sovereignty over the high seas.

A nuclear-powered merchant vessel operating on the high seas would generally remain subject principally to the jurisdiction of its flag state, though potentially affected by international conventions concerning maritime safety, environmental protection, liability, and security. However, high seas freedom does not eliminate regulatory complexity. Port-state controls may become critically important. Even if a vessel may lawfully operate on the high seas, its practical commercial viability may depend upon whether states permit it to enter ports or territorial waters.

The deep seabed beyond national jurisdiction—the Area—is governed under a separate legal framework emphasizing the “common heritage of mankind.” Activities within the Area are subject to oversight through the International Seabed Authority (“ISA”). Although seabed nuclear installations beyond national jurisdiction remain largely speculative at present, future offshore industrial or mining activities powered by advanced reactors could eventually implicate these governance structures.

Environmental Law and Regulatory Geography

Before proceeding, I would note that offshore nuclear deployment may also implicate a substantial body of international and domestic environmental law extending well beyond traditional nuclear regulatory frameworks. International maritime environmental governance has developed through a complex network of treaties, conventions, customary legal principles,

and domestic implementing legislation addressing marine pollution, vessel-source emissions, dumping, protection of the marine environment, offshore installations, and environmental impact assessment.

Depending upon the deployment model involved, offshore nuclear systems may implicate legal regimes associated with the International Maritime Organization (“IMO”), the International Convention for the Prevention of Pollution from Ships (“MARPOL”), the London Convention and Protocol governing ocean dumping, regional marine protection agreements, fisheries regulation, and domestic coastal environmental review systems. Offshore installations may additionally implicate legal and political concerns surrounding marine ecosystems, coastal resilience, biodiversity protection, and subsea infrastructure vulnerability.

A full treatment of these environmental regimes is beyond the scope of this paper. Nevertheless, their existence further illustrates the extent to which offshore nuclear deployment may require navigation through multiple overlapping systems of international and domestic governance simultaneously.

III. Nuclear-Powered Commercial Shipping

Among the most visible and historically familiar forms of maritime nuclear deployment is nuclear-powered shipping. Nuclear propulsion at sea is not itself new. Naval nuclear propulsion has existed for decades, particularly among major military powers. Civilian commercial nuclear propulsion, however, has historically remained limited.

Several factors may now be changing this equation. The shipping industry faces increasing pressure to decarbonize. Maritime shipping remains heavily dependent upon fossil fuels and constitutes a significant source of global greenhouse gas emissions. Nuclear propulsion offers the potential for extremely long-duration operations without carbon emissions. Advances in small modular reactor and microreactor technologies may also make civilian maritime propulsion more commercially practical than in previous decades. Strategic concerns regarding fuel security, Arctic operations, and maritime logistics may further increase interest in long-duration nuclear-powered vessels, particularly as major shipping actors and governments evaluate how IMO decarbonization requirements may affect the long-term economics of global shipping fleets.

Yet the regulatory architecture governing civilian nuclear shipping remains underdeveloped and fragmented.

Under traditional law-of-the-sea principles, vessels operating on the high seas generally fall under the jurisdiction of their flag state. Accordingly, nuclear-powered commercial vessels would likely depend heavily upon the willingness and capability of particular flag states to regulate, license,

and certify such vessels. This reality may create strategic competition among flag states seeking to position themselves as favorable jurisdictions for advanced maritime nuclear technologies.

At the same time, high seas freedom does not guarantee practical commercial operability. Commercial shipping depends fundamentally upon access to ports. Historically, one of the major constraints on civilian nuclear shipping has not been reactor technology itself, but uncertainty concerning whether port states would consistently permit entry by nuclear-powered merchant vessels. Port states possess substantial authority to regulate entry into ports and internal waters. Even if nuclear-powered vessels may lawfully operate on the high seas and EEZ, and would enjoy the right of innocent passage through the territorial sea, widespread port restrictions could significantly impair commercial viability.

Port-state acceptance may therefore become one of the central governance questions for civilian nuclear shipping. Safety standards, liability arrangements, emergency response capabilities, insurance, and environmental protection will all influence whether states permit nuclear-powered merchant vessels to enter their ports.

Liability and insurance issues may prove particularly significant. The existing international nuclear liability regime evolved principally around terrestrial nuclear installations. Maritime law, meanwhile, possesses its own distinct liability traditions and conventions. The interaction between maritime liability systems and nuclear liability systems remains comparatively underdeveloped. Questions may arise concerning the allocation of liability among operators, flag states, and coastal states; applicable insurance requirements; treatment of transboundary incidents; salvage and wreck removal obligations; and the interaction between traditional nuclear liability conventions and maritime liability frameworks.

Civilian nuclear-powered vessels may also implicate security and nonproliferation concerns. Advanced reactor systems operating internationally may involve sensitive fuel cycles, export-controlled technologies, cybersecurity considerations, and physical protection requirements. Some maritime deployments may additionally involve dual-use or defense-adjacent operational environments. Civilian maritime nuclear deployment may therefore increasingly sit at the intersection not only of maritime law and nuclear regulation, but also of export control law, national security regulation, and international nonproliferation governance.

Recent years have also seen increasing engagement by international organizations and maritime governance institutions with the prospect of civilian nuclear propulsion. In 2025, for example, the International Maritime Organization reportedly agreed to begin revising outdated international regulations governing nuclear-powered merchant ships, including portions of the SOLAS framework and the Code of Safety for Nuclear Merchant Ships. At the same time, the International Atomic Energy Agency has begun increasing its engagement with maritime nuclear deployment issues, including initiatives aimed at supporting development of regulatory frameworks for nuclear technologies at sea. Classification societies and major shipping actors have likewise begun

evaluating the regulatory and commercial feasibility of advanced nuclear propulsion for commercial shipping. These developments suggest that maritime nuclear propulsion is increasingly being treated not merely as a theoretical possibility, but as a potential future commercial reality requiring active regulatory modernization.

But again, significant legal regulatory challenges remain.

IV. Floating Nuclear Power Plants

Floating nuclear power plants may ultimately represent one of the most commercially significant, and regulatorily complex, forms of offshore nuclear deployment.

Unlike nuclear-powered commercial vessels, which principally use reactors for propulsion, floating nuclear plants are generally intended to generate electricity or industrial power for external use. Some involve mobile barge-like facilities capable of relocation between sites. Others resemble semi-permanent offshore energy platforms conceptually similar to offshore oil and gas infrastructure. Still others envision offshore generating facilities connected to coastal grids or industrial infrastructure through subsea transmission systems.

Floating nuclear concepts may offer several advantages. They may allow states or developers to provide reliable baseload electricity to coastal industrial facilities, island communities, desalination projects, remote infrastructure, military facilities, or offshore industrial sites without requiring large terrestrial reactor sites. They may also permit centralized manufacturing and modular deployment approaches.

At the same time, floating nuclear plants raise especially difficult and complex jurisdictional and regulatory questions.

A floating nuclear facility located within a state's territorial waters, that was not a foreign flagged vessel exercising the right of innocent passage, would likely fall principally under the sovereign regulatory authority of the coastal state. Deployment within an EEZ, however, may create more complex jurisdictional interactions. Within the EEZ, the coastal state possesses significant authority relating to artificial installations, environmental protection, and resource exploitation. Yet the coastal state does not possess unrestricted sovereignty equivalent to territorial sovereignty. Questions may therefore arise concerning the legal characterization of floating plants, the extent of coastal-state regulatory authority, navigation rights around installations, environmental permitting obligations, and the interaction between installation status and vessel status.

Mobility adds another layer of complexity. A floating nuclear plant may possess characteristics both of a vessel and of a fixed offshore installation. If movable, relocatable, or capable of navigation, a floating reactor facility may implicate maritime vessel regulation. Yet while

anchored and supplying power to coastal infrastructure, it may also resemble a stationary energy installation. The interaction between these legal categories may significantly affect licensing and regulatory treatment.

This is where floating nuclear plants differ in important respects from nuclear-powered commercial vessels. Maritime law has long possessed established legal categories and jurisdictional principles governing ships and navigation, even if civilian nuclear propulsion introduces new complexities within those frameworks. Floating nuclear plants, by contrast, exist in a more ambiguous legal and regulatory space.

Most existing national nuclear licensing systems were developed principally around terrestrial nuclear power plants situated firmly within national territory. Contemporary civilian nuclear licensing frameworks generally assume a fixed land-based installation connected to terrestrial infrastructure and regulated within relatively clear territorial jurisdictional boundaries. Floating nuclear power plants complicate many of these assumptions.

A mobile or semi-mobile offshore reactor may not fit comfortably within licensing categories originally designed for terrestrial generating stations. Questions may arise concerning which domestic regulator possesses primary authority, how offshore emergency planning zones should be conceptualized, whether maritime mobility affects licensing status, and how offshore installations should be treated in relation to existing nuclear siting and environmental review requirements.

The problem becomes especially complicated for floating facilities located outside territorial seas but still connected economically and operationally to coastal infrastructure. Such systems may exist in a hybrid legal space: neither fully analogous to traditional terrestrial nuclear plants nor fully analogous to conventional maritime vessels. Although physically offshore, floating nuclear plants are often integrated into terrestrial infrastructure through grid interconnections, industrial supply relationships, and long-duration stationary deployment. As a result, FNPPs may implicate a denser interaction between offshore maritime governance and territorially grounded domestic nuclear licensing systems than conventional commercial shipping.

At present, very few national nuclear regulatory systems appear comprehensively designed for the licensing of offshore civilian floating nuclear power plants operating in maritime environments. Existing frameworks may therefore require substantial adaptation before such concepts can be deployed at significant commercial scale. This gap between existing terrestrial licensing architecture and emerging offshore deployment concepts may become one of the most important regulatory evolution challenges facing floating nuclear systems over the coming decades.

The grid interconnection issue illustrates the point. Many floating nuclear deployment concepts envision reactors located offshore but connected to terrestrial infrastructure through subsea transmission lines. In practical terms, this means that even where the reactor itself is positioned

outside traditional terrestrial jurisdictional space — whether in territorial waters or in the EEZ — the project may remain deeply interconnected with land-based infrastructure and regulatory systems.

Subsea transmission systems may require extensive permitting and environmental review. Transmission corridors crossing territorial waters, coastal zones, or environmentally sensitive marine areas may implicate multiple domestic regulatory authorities, fisheries concerns, navigation considerations, and offshore infrastructure regulations. The physical connection between offshore reactors and terrestrial grids may also complicate arguments that offshore deployment meaningfully reduces terrestrial regulatory involvement. Even if the reactor facility itself is offshore, the electrical interconnection point may effectively pull portions of the project back into traditional domestic energy regulation and infrastructure oversight.

Transmission systems also create security and resilience considerations. Subsea infrastructure has become an increasingly important strategic concern in recent years, particularly following growing attention to the vulnerability of undersea cables, pipelines, and maritime infrastructure. A floating nuclear plant connected to shore through subsea transmission systems may therefore require physical security, cybersecurity, and infrastructure protection measures extending well beyond the reactor facility itself.

Finally, the existence of transmission interconnections may affect how offshore nuclear systems are legally characterized. A floating nuclear facility closely integrated into a terrestrial electrical grid may in practice be treated less like a mobile maritime platform and more like an offshore extension of domestic energy infrastructure.

Floating nuclear plants also raise distinctive security and emergency planning considerations. Offshore installations may face maritime security threats, including sabotage, piracy, interference with subsea infrastructure, or disruption of offshore support systems. Emergency response planning may differ substantially from terrestrial reactor models and may require adaptation of existing nuclear security and emergency preparedness frameworks.

V. Offshore and Seabed Nuclear Installations

Beyond shipping and floating power plants lies a broader and more speculative category of offshore nuclear deployment concepts. These include offshore industrial facilities powered by advanced reactors, seabed mining support infrastructure, remote Arctic installations, offshore hydrogen or ammonia production, subsea industrial systems, and other forms of maritime industrial activity requiring reliable long-duration power generation.

Although many such concepts remain at early stages of development, they illustrate the potentially expanding role of advanced reactors in maritime and offshore environments.

Many such installations would likely implicate continental shelf jurisdiction. Under UNCLOS, coastal states possess sovereign rights over the exploration and exploitation of natural resources on and beneath the continental shelf. Those rights include authority relating to installations attached to the seabed and to activities associated with seabed resource exploitation.

This may prove especially important because many realistic forms of long-term offshore nuclear deployment are likely to occur not on the high seas in a fully detached sense, but rather on or beneath continental shelves located relatively near economically important coastal regions.

Potential applications could include nuclear-powered seabed mining systems, offshore industrial infrastructure, subsea processing facilities, underwater data and communications infrastructure, offshore hydrogen or ammonia production, remote Arctic industrial facilities, autonomous underwater systems, and long-duration nuclear battery installations designed to provide persistent power for subsea infrastructure or monitoring systems.

Compact advanced reactors or radioisotope power systems could prove particularly attractive in such environments because of their energy density, long operational duration, and reduced fuel logistics requirements. In many remote offshore environments, conventional fuel supply chains may be operationally difficult or economically prohibitive.

At the same time, these concepts raise unusually complex legal questions because the continental shelf regime creates a layered jurisdictional environment. A coastal state possesses sovereign rights relating to seabed exploitation and associated installations, yet the waters above the continental shelf may simultaneously remain part of the EEZ or, in some circumstances, even the high seas. As a result, different legal regimes may govern the seabed, the water column above it, navigation rights through the area, and infrastructure connected to the installation.

For example, a nuclear-powered seabed mining installation attached to the continental shelf would likely implicate coastal-state rights over seabed resource exploitation and environmental protection. Yet vessels operating above the installation could continue to enjoy navigation freedoms associated with the EEZ or high seas regime. Similarly, subsea nuclear battery systems powering offshore infrastructure or communications systems might implicate coastal-state jurisdiction over seabed installations while also intersecting with international rules governing submarine cables, pipelines, marine environmental protection, and offshore security.

These layered jurisdictional structures may significantly complicate regulatory governance. A single continental shelf nuclear installation could potentially implicate domestic nuclear licensing law, offshore energy regulation, maritime safety law, environmental impact assessment requirements, subsea infrastructure regulation, export control systems, cybersecurity obligations, physical security regulation, and law-of-the-sea rules governing seabed jurisdiction simultaneously.

The continental shelf may therefore emerge as one of the most important long-term legal environments for offshore nuclear deployment. Unlike floating nuclear plants, which remain closely tied to terrestrial electrical systems, continental shelf nuclear systems may increasingly support offshore industrial ecosystems operating semi-independently from land-based infrastructure. Yet because these systems would often remain within areas subject to coastal-state sovereign rights, they may also remain deeply connected to domestic regulatory and geopolitical considerations.

In this respect, the continental shelf may ultimately become not merely a location for offshore nuclear deployment, but a distinct strategic and regulatory domain in its own right.

More speculative still are concepts involving nuclear-powered infrastructure associated with deep seabed activity beyond national jurisdiction. Under UNCLOS, the deep seabed beyond national continental shelves is treated as the “common heritage of mankind” and governed through the International Seabed Authority. Although commercial-scale deep seabed mining remains controversial and relatively undeveloped, growing strategic interest in rare earth minerals and seabed resources has renewed attention to these governance frameworks.

Future offshore industrial activity in these environments could eventually create demand for long-duration, energy-dense power systems capable of operating far from terrestrial infrastructure. Advanced microreactors or other compact reactor systems may ultimately prove attractive for such applications. If that occurs, however, significant legal questions would arise concerning ISA authority and oversight, environmental review obligations, liability for offshore nuclear incidents, physical protection and security obligations, transportation of nuclear fuel and materials, and the interaction between international seabed governance and domestic nuclear regulatory systems. At present, the legal architecture governing such activities remains highly underdeveloped, and in some cases legally contested.

More immediately plausible are concepts involving advanced reactors supporting offshore industrial ecosystems within national jurisdiction. Advanced reactors may eventually support offshore hydrogen production, offshore ammonia production, desalination, Arctic logistics hubs, remote industrial operations, and other forms of energy-intensive maritime infrastructure. Some concepts may involve reactors integrated into existing offshore industrial platforms, including modified oil and gas infrastructure. Concepts involving offshore hydrogen production or energy-intensive maritime industrial activity could prove particularly attractive in jurisdictions possessing significant offshore economic zones but limited terrestrial energy infrastructure.

These deployments would likely involve overlapping regulatory systems extending well beyond traditional nuclear regulation alone. Offshore reactor systems associated with industrial platforms may simultaneously implicate maritime safety regulation, offshore energy regulation, environmental impact assessment requirements, subsea infrastructure permitting, cybersecurity obligations, export controls, physical security regulation, and potentially defense or dual-use

oversight. In many cases, the principal governance challenge may not be the absence of regulation, but rather the existence of partially overlapping regulatory systems developed independently over decades.

Arctic deployment concepts may present particularly important strategic and legal questions which are too complex to wade into here. As Arctic shipping routes become increasingly navigable due to climate change and shifting commercial patterns, interest in remote Arctic infrastructure, maritime logistics, and long-duration energy systems may increase significantly. Advanced nuclear systems may offer substantial operational advantages in these environments due to their energy density and reduced fuel logistics requirements.

At the same time, Arctic operations may implicate overlapping maritime claims, heightened environmental sensitivities, indigenous rights concerns, strategic competition among major powers, and national security considerations. In these contexts, offshore nuclear deployment may become deeply intertwined with geopolitics as well as commercial energy development.

VI. The Coming Fragmentation Problem

One of the central themes emerging across all categories of offshore nuclear deployment is regulatory fragmentation.

The legal systems potentially governing offshore nuclear activity were not developed as components of a single integrated framework. International maritime law evolved principally to govern navigation, resource rights, maritime commerce, and allocation of jurisdiction among states. Nuclear regulatory systems evolved principally around terrestrial civilian nuclear installations and national security concerns. Environmental regimes evolved through still other institutional pathways.

As advanced nuclear technologies move increasingly into maritime environments, these systems are beginning to intersect in ways that may create significant governance complexity. A single offshore nuclear deployment may simultaneously implicate domestic nuclear licensing requirements, maritime safety regulation, law-of-the-sea jurisdictional rules, environmental impact review, port-state controls, offshore infrastructure regulation, export control systems, cybersecurity obligations, physical security requirements, and international liability frameworks. In many cases, no single regulator or legal regime may possess complete authority.

This fragmentation may create several practical consequences. Regulatory uncertainty itself may become a significant investment risk factor. Early deployment decisions may significantly constrain later operational flexibility, particularly where choices concerning location, mobility, operational model, flag state, or infrastructure architecture lock projects into particular regulatory pathways. States may also increasingly compete to position themselves as favorable

jurisdictions for offshore advanced nuclear deployment, much as states today compete in areas such as shipping registries, offshore finance, or energy infrastructure development. Over time, offshore nuclear systems may create pressure for new international governance frameworks or harmonization efforts.

These dynamics are likely to emerge at precisely the same time that advanced nuclear developers are already navigating substantial uncertainty concerning domestic licensing modernization, export control frameworks, fuel supply chains, and financing models. For developers and investors alike, offshore deployment therefore represents not merely a technological challenge, but also a strategic governance challenge.

VII. Conclusion

For decades, civilian nuclear energy has been understood principally as a terrestrial enterprise. Yet advanced reactor technologies, maritime decarbonization pressures, offshore industrial development, Arctic operations, and remote infrastructure demands may increasingly push portions of the nuclear sector offshore.

This transition has implications extending far beyond engineering. The oceans are governed through a layered and differentiated legal architecture in which jurisdiction varies according to location, operational model, and legal characterization. Territorial seas, Exclusive Economic Zones, continental shelves, the high seas, and the deep seabed each involve different allocations of authority and different legal obligations.

As nuclear systems move into these maritime environments, questions of legal geography may increasingly become questions of deployment strategy. The future commercial viability of offshore nuclear systems may depend not only upon reactor technology itself, but also upon whether developers can successfully navigate fragmented systems of maritime governance, environmental regulation, nuclear licensing, and offshore infrastructure law in ways that preserve long-term operational flexibility and commercial certainty.

In practical terms, the next generation of advanced nuclear deployment strategy may increasingly require developers and investors to think not only like reactor designers or energy companies, but also like maritime legal strategists and international regulatory architects.

The offshore migration of nuclear energy infrastructure may therefore represent not simply the expansion of nuclear energy into a new physical environment, but the emergence of a new jurisdictional domain for civilian nuclear development.

Understanding that emerging legal architecture will likely become increasingly important for policymakers, developers, investors, and regulators alike. Much of the detailed legal architecture



governing offshore nuclear deployment remains undeveloped. Yet the convergence between advanced nuclear technologies and maritime governance is already underway.

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The future of nuclear energy may, increasingly, be offshore.

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