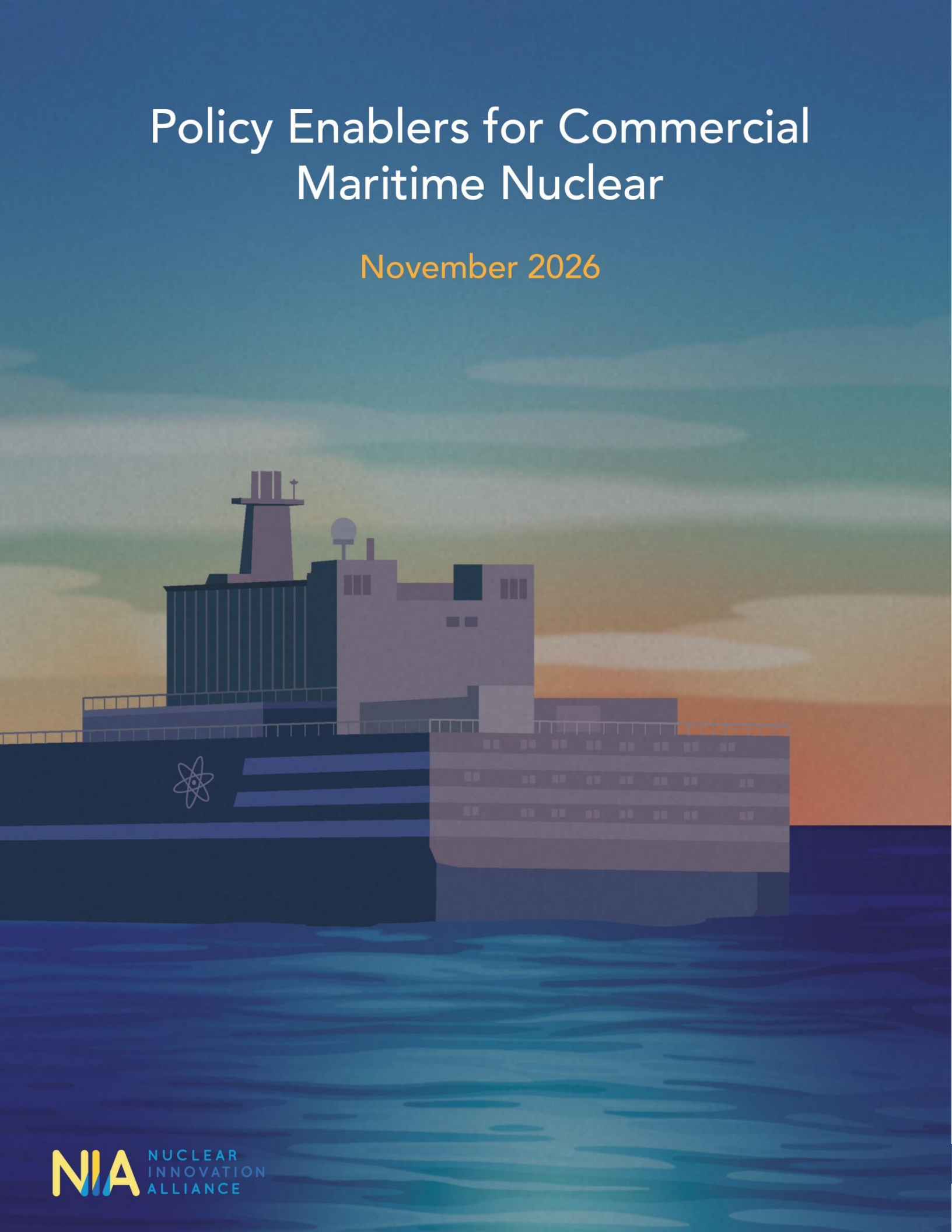
Policy Enablers for Commercial Maritime Nuclear

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Policy Enablers for Commercial Maritime Nuclear Power



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Executive Summary

Commercial maritime nuclear power could expand supplies of reliable, low-emission energy and provide new work for U.S. nuclear manufacturers and shipyards. Nuclear propulsion could reduce shipping emissions and dependence on conventional marine fuels while providing substantial operational endurance. Floating nuclear power plants (FNPPs) could supply electricity, heat, and other energy products to ports, industrial facilities, and coastal communities. Renewed interest in these applications reflects advances in smaller reactor technologies and growing attention to energy security and maritime industrial capacity.

When a smaller reactor meets a customer's need, a FNPP is a potentially simplified option for meeting growing demand for electricity. FNPPs offer a practical starting case for advancing commercial maritime nuclear power. Constructed in shipyards and transported to deployment sites, they combine the advantages of smaller reactors with repeatable marine construction, reduced on-site civil works, and centralized maintenance. Initial FNPP projects can develop shipyard capabilities, servicing infrastructure, and regulatory experience that support subsequent commercial nuclear propulsion.

Currently, the FNPP market is dominated by Russia, which operates the one and only FNPP, the dual-unit *Akademik Lomonosov*. Several U.S. companies are exploring offshore and floating nuclear designs, but the U.S. regulatory environment is challenging and has yet to be fully updated for modern commercial maritime reactors.

Recent regulatory initiatives and published roadmaps indicate that existing nuclear licensing processes and maritime capabilities provide a sufficient foundation for FNPP deployment. For a civilian U.S. FNPP, however, three potential barriers can prevent rapid development and require regulatory and policy solutions: security, spent fuel management, and nuclear liability.

This paper recommends three public actions: (1) establishing a clear division of security responsibilities between the Coast Guard and Nuclear Regulatory Commission (NRC); (2) reforming spent nuclear fuel and greater-than-class-C waste policy to support credible servicing, transfer, and interim-storage arrangements for FNPPs; and (3) clarifying and, where necessary, extending liability coverage for U.S.-licensed FNPP operations and encouraging commercial insurance. Resolving these issues for an initial FNPP would establish a useful precedent for commercial nuclear propulsion.

I. Introduction

In the last decade, broad and sustained bipartisan support for new nuclear energy in the Executive Branch and Congress has catalyzed significant industry momentum. In May 2025, the President issued four Executive Orders (EOs) to foster new nuclear reactor commercialization. These EOs build on and reinforce legislation to ensure the availability of new nuclear energy to meet national goals such as the Nuclear Energy Innovation and Capabilities Act (NEICA), the Nuclear Energy Innovation and Modernization Act (NEIMA), and the Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (ADVANCE) Act.[1] Regulatory reform efforts are now in full swing, and are establishing new performance-based and timely licensing pathways that enable a major expansion of nuclear energy, and are attracting significant amounts of private capital.

In parallel, several EOs direct efforts to restart the U.S. shipbuilding industry.[2] Commenters have called for pursuing commercial nuclear shipping as a synergistic way to build both industries to world-leading U.S. capability.[3]

Interest in maritime nuclear energy is quickly emerging. As documented in Appendix 1, more than a dozen maritime commercial projects are being explored around the world, with many racing towards demonstration milestones. In just the last six months, governments and the private sector have started investigating what it will take to deploy maritime nuclear energy systems:

- In May, the U.S. Maritime Administration (MARAD) requested industry input on the potential for small modular reactors (SMRs) or similar technology to be usable, scalable, and commercially viable.[4]
- At a June 2026 workshop of maritime companies and reactor vendors, the participants identified legal and regulatory pathways as a key barrier.[5]
- In July, MARAD and the Port of Long Beach entered into a cooperation agreement covering potential SMR integration, port microgrids, and propulsion infrastructure.

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[1] The recent executive and legislative initiatives to foster new nuclear technology to achieve national goals are discussed in other NIA reports such as; Regulatory Implementation Summary: NRC Progress Under the ADVANCE Act | NIA, Office of Information and Regulatory Affairs (OIRA) Tracker for Nuclear Regulatory Commission Rulemaking | NIA, and The Urgency of NRC Reform | NIA.

[2] For example, Executive Order 14269 promotes efforts to reinvigorate the U.S. shipbuilding industry. Restoring America's Maritime Dominance – The White House. Also America's Maritime Action Plan (Feb. 2026) calls for increased investment to meet nuclear shipbuilding demand without specifically mentioning the potential benefits of investment in maritime nuclear or FNPP.

[3] For example, see America's Nuclear Shipping Revival Is About More Than Reactors.

[4] Request for Information: Development of a Commercially Viable System-Centric Small Modular Reactor Concept for Deployment in the Marine Transportation System, 91 Fed. Reg. 24961 (May 7, 2026).

[5] Innovation Café: Small Modular Reactor Technologies for Maritime Applications, U.S. Center for Maritime Innovation (June 2026), pp. 11 and 19 and App. C.

- In August, the International Atomic Energy Agency (IAEA) launched the Atomic Technologies Licensed for Applications at Sea (ATLAS) initiative, a global effort to establish a safety and regulatory basis for maritime nuclear energy activities.

Commercial maritime nuclear encompasses two closely related applications: nuclear propulsion for ships and floating nuclear power plants supplying energy to external customers. Both could extend nuclear energy's contribution to economic security and decarbonization while creating opportunities for nuclear manufacturing, shipbuilding, and specialized services.

For commercial shipping, nuclear propulsion could substantially reduce the emissions associated with powering vessels. Nuclear reactors generate heat without fossil-fuel combustion, allowing reactor-powered systems to displace sources of carbon dioxide, sulfur oxides, nitrogen oxides, and particulate pollution. Nuclear fuel's high energy density also offers substantial operational endurance. Longer intervals between refueling could reduce dependence on conventional bunkering infrastructure and provide greater flexibility in vessel scheduling and operations. An American Bureau of Shipping (ABS) and Herbert Engineering concept study examined these possibilities for a containership and a tanker, finding potential improvements in operating speed and long refueling intervals.[6]

FNPPs offer a practical starting case. Constructed in shipyards and transported to deployment sites, they could supply electricity and heat to ports, industrial facilities, and coastal communities. Several industry concepts envision repeatable construction and centralized servicing.[7] A plant operating at a defined location provides a more bounded initial case than a ship moving between international ports. An FNPP could build practical experience before the United States takes on the additional licensing and operating problems posed by international shipping.

This paper uses U.S. FNPP deployment to examine three priorities for government action on maritime nuclear innovation: security, spent nuclear fuel management, and nuclear liability. It develops recommendations for applying maritime security approaches to FNPPs, adapting spent fuel policy to their deployment and servicing models, and explicitly addressing liability for waterborne nuclear incidents over the Outer Continental Shelf. Resolving these issues would support floating power and establish foundations for commercial nuclear shipping.

Section 2 provides a brief technical overview of FNPPs. Section 3 examines maritime nuclear licensing pathways, focusing on a civilian U.S. FNPP. Section 4 analyzes the three cross-cutting barriers and recommends policy actions. Section 5 concludes, and Sections 6 and 7 provide reference appendices.

[6] https://pressreleases.eagle.org/news/groundbreaking-abs-study-explores-potential-of-commercial-nuclear-propulsion

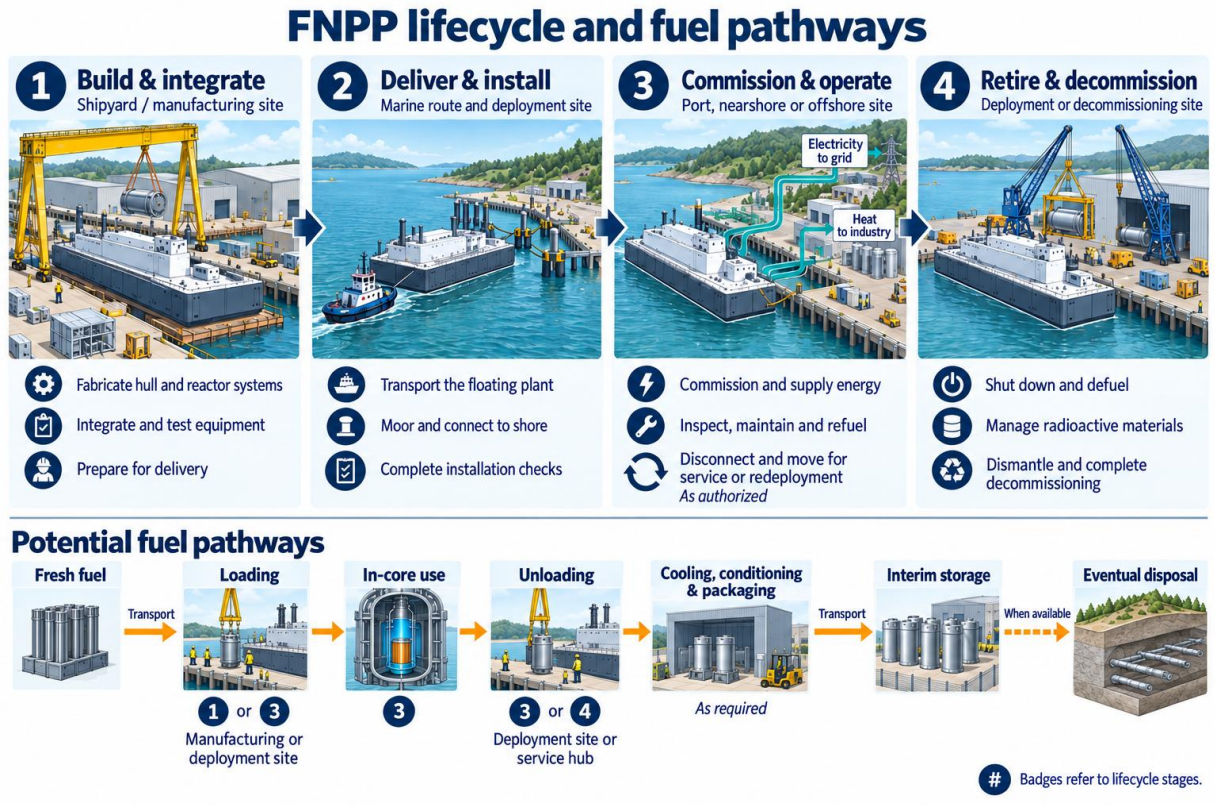
[7] World Nuclear Association

II. FNPP Concepts and Deployment Models

FNPPs are floating vessels outfitted with nuclear reactors designed to supply electricity, heat, and industrial products such as oxygen, hydrogen, ammonia, or desalinated water. Potential applications include remote coastal grids, industrial facilities, and locations where land availability or construction conditions constrain conventional power development. FNPPs can be constructed in shipyards using modular, assembly-line techniques, then towed or self-propelled to coastal or remote deployment sites.

To meet the constraints of fitting on a barge, any FNPP likely will be comparable in size to a small modular reactor (SMR), generally under 300MWe. Commercial projects are evaluating concepts over a large size range, from the mPower design (about 195 MWe) to microreactors (low 10s of MWe or less).[8] Therefore, a FNPP will share with an SMR many of the same advantages and limitations when compared to large reactors, such as relatively faster construction times and modularity, offset by relatively lower engineering efficiencies.

Figure 1. Notional FNPP lifecycle and fuel pathways



[8] WNN, 'Core Power to assess BWXT SMRs for floating power plants' (June 2026), https://world-nuclear-news.org/articles/core-power-to-assess-bwxt-smrs-for-floating-power-plants

The Cooperation in Reactor Design Evaluation and Licensing Working Group (CORDEL) published a recent paper[9] outlining the strategic benefits of FNPPs and the role FNPPs could play in meeting global climate and energy security targets. Compared to land-based SMR projects, the CORDEL report cites additional benefits for FNPP in the areas of construction, manufacturing, maintenance, refueling, and waste management. The report concluded "floating nuclear power plants offer diversification of nuclear energy applications, especially when land-based options are not feasible, or the infrastructure required for a large nuclear power plant is not available."

Project developers considering the business case for a FNPP will weigh many factors, including right-sizing reactors for the need.[10] As discussed in an ABS study,[11] sample applications that favor a FNPP over a land-based reactor include:

- **Remote coastal power demand:** Powering remote islands, archipelagos, and isolated coastal regions without large-scale land infrastructure. Such locations involve large coasts that can accommodate a FNPP while suitable land may be unavailable or restricted.
- **Land-constrained coastal or offshore loads:** If a large load, like a data center, is floating, then a FNPP could supply power near the floating load. Generally, locating a large load offshore arises because land is restricted. The land use constraints that warrant locating the load offshore would apply also to the power generator. A FNPP could be an option where data centers or other large loads are expanding near where land use is constrained.
- **Disaster response and recovery:** The mobility of a FNPP allows deployment to coastal regions affected by hurricanes, earthquakes, tsunamis, or grid collapse to rapidly restore essential services and maintain them for as long as needed for infrastructure to be rebuilt.

The only modern operating FNPP is Rosatom's dual-unit *Akademik Lomonosov*, located off the remote Siberian coast. The dual units produce a combined 70 MW-electric (MWe) (2 × 35 MWe KLT-40S units), plus up to about 58 MWth of district heat.[12] Rosatom has plans to expand that site in Siberia with larger FNPPs to support mineral extraction. These larger units

[9] CORDEL, *Facilitating Global Deployment of Floating Nuclear Power Plants*, (June 2025) Facilitating Global Deployment of Floating Nuclear Power Plants - World Nuclear Association

[10] Considerations for right-sizing reactors are discussed in a recent NIA report. https://nuclearinnovationalliance.org/sites/default/files/2026-01/NIA_Right-SizingReactors.pdf

[11] American Bureau of Shipping, Report on Potential Challenges and Impacts of Advanced Nuclear-Maritime Applications in the U.S., INL/RPT-23-75544 (July 2023). See Figure 7 and Section 3.

[12] FNPP generated its first billion kilowatt-hours in Chukotka — AKADEMIK LOMONOSOV

each produce about 55 MWe and are derived from the fifteen RITM-200 units Rosatom has delivered for nuclear powered icebreakers.[13]

Earlier civilian maritime nuclear programs demonstrated the technology's feasibility but did not establish a durable commercial market. The United States' *N.S. Savannah*, West Germany's *Otto Hahn*, and Japan's *Mutsu* operated as state-supported demonstrations of nuclear merchant propulsion, but none led to a follow-on commercial fleet. The Soviet Union, and subsequently Russia, maintained the principal civilian nuclear-powered surface fleet through its icebreaker program. The United States also established an early precedent for floating nuclear generation through the Army's *Sturgis*. Converted from a World War 2-era American Liberty Ship into an unpowered nuclear barge, *Sturgis* supplied electricity while moored in the Panama Canal Zone from 1968 to 1976. Collectively, these projects demonstrated that reactors could operate aboard civilian vessels or deliver power from floating platforms, while also exposing the challenges that prevented broader replication.

Renewed U.S. activities in pursuit of both reactor integration and the broader systems needed to deploy FNPPs, include the following:

- In 2023, BWXT and Crowley unveiled a concept for a shallow-draft vessel carrying a transportable microreactor capable of supplying 5-50 MWe to military installations, disaster-affected grids, and other shoreside users.
- In 2024, Westinghouse and CORE POWER agreed to develop an FNPP using Westinghouse's eVinci microreactor and to examine an associated licensing approach.
- CORE POWER subsequently launched a June 2026 feasibility study of integrating BWXT's larger, 195-MWe mPower reactor into shipyard-built FNPPs.
- In August 2026, Deployable Energy announced its selection for a National Reactor Innovation Center (NRIC) Nuclear Energy Launch Pad USA maritime demonstration with Hornbeck Offshore. The planned project would integrate the company's 1-MWe Unity Nuclear Battery into a maritime vessel and evaluate operations in an offshore environment.
- In summer 2026, Bluecore Energy emerged from stealth with a $50 million seed round dedicated towards building FNPPs for ports and other critical infrastructure.

See Appendix 1 for a more comprehensive list of U.S. and allied developments.

Federal activity is beginning to develop an enabling environment around these private concepts. DOE and NRIC have supported research connecting advanced-reactor developers with the maritime industry. The Navy's announced test of exporting electricity from the *USS Gerald R. Ford* to Naval Station Norfolk provides an adjacent demonstration of shoreside

[13] Russia builds 15 small marine nuclear reactors with 175-MWt capacity for icebreakers.

power delivery from a mobile nuclear platform, although it is neither a civilian FNPP nor a commercial licensing precedent.[14]

Comparable projects are advancing internationally. In South Korea, Samsung Heavy Industries received approval in principle for a floating platform concept and, in July 2026, partnered with U.S. engineering firm Sargent & Lundy to develop a technology-agnostic floating-SMR platform. Samsung is also part of a Korean-Danish effort with Saltfoss Energy and Korea Hydro & Nuclear Power to develop shipyard-produced molten-salt-reactor power barges. In Canada, Prodigy Clean Energy completed government-supported development work on marine and land-based transportable nuclear plants and recently announced a proposed First Nations-owned pilot of up to 50 MWe in New Brunswick, targeting operation in the early 2030s. Other European programs, such as Allseas' development of a small high-temperature gas reactor for offshore vessels and the newcleo–Fincantieri–RINA propulsion study, further illustrate the convergence of floating-power and propulsion development.

Nevertheless, outside Russia, no modern FNPP has yet entered commercial operation, nor received all required licensing and approvals.

III. Licensing Pathways for Maritime Nuclear Power

In the 1970s and 1980s, Offshore Power Systems (OPS), a joint venture of Westinghouse and Tenneco, proposed a large, one gigawatt electric nuclear power plant that would be built on a huge floating concrete slab.[15] The proposed plant was similar to the McGuire plant built in North Carolina, but would be floating to account for seismic considerations.[16] Basing nuclear power plants on floating platforms was touted by some utilities in New Jersey and California as a viable alternative to the challenges of land-based reactors on coastal sites.[17]

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[14] For example, see press reports such as USS Gerald R. Ford will power Naval Station Norfolk this summer.

[15] https://www.nrc.gov/reading-rm/basic-ref/students/history-101/floating-nuclear-power-plants

[16] NRC Safety Evaluation Report for Off-Shore Power Systems Floating Plants 1 to 8 (NUREG-75/100), Table 1-1. NUREG-75/100, Safety Evaluation Report Related to Offshore Power Systems Safety Floating Nuclear Plants (1-8). Besides earthquake resistance, other benefits of the plant were access to cooling water, remoteness from populations, and less use of land.

[17] In the early 1970's, a New Jersey utility proposed locating a FNPP at a site 10 miles north of Atlantic City as the only solution to the problem of site selection. Siting nuclear power plants had practically stopped in the Northeast and the West Coast due to public opposition, seismic worries and environmental concerns. Floating Nuclear Power Plants: A Technical Solution to a Land-based Problem (Part I) | Nuclear Regulatory Commission

This joint venture was formed in 1970, and OPS received a manufacturing license for 8 reactors from NRC in 1982. The NRC and U.S. Coast Guard cooperated on the nuclear and ship safety reviews pursuant to a memorandum of understanding (MOU) between the two agencies. The MOU assigned responsibilities for determining nuclear safety and ship safety classification and the needed interfaces. While the NRC issued a manufacturing license, the actual site licensing and deployment of a FNPP was not completed due to a lack of demand resulting from low load growth. Nevertheless, the experience with OPS, as well as the broader lessons from the N.S. Savannah, indicate there is sufficient precedent for the U.S. NRC and industry to license and approve FNPPs.

Modern commercial maritime nuclear development can build on existing nuclear licensing processes and maritime regulation. The NRC expressly identifies Parts 50, 52, and 53 of its regulations as available frameworks for licensing maritime reactors, including floating nuclear power plants (FNPPs).[18] Presumably, the recently proposed Part 57 for microreactors and other low-consequence reactors could also be a viable pathway for certain FNPP applications. The central task is to connect those frameworks with the additional approvals needed to construct, transport, operate, and service a nuclear facility in a marine environment. Specific architectural decisions for a FNPP installation can impact the regulatory pathway: transporting a fueled reactor at sea could implicate multiple transportation standards, a foreign built FNPP would require import licensing, and fueling on-site requires fuel-handling capabilities and may need separate licensing.

Several published analyses provide useful starting points for developers and policymakers to understand these pathways, both domestically and internationally:

- **The NRIC's maritime regulatory review**[19] maps U.S. nuclear and maritime authorities across licensing, siting, security, fuel management, and end-of-life activities.
- **Lloyd's Register's maritime nuclear guidance**[20] connects regulatory planning with technical design, security, operating arrangements, and insurance.
- **The World Nuclear Association's CORDEL report**[21] examines FNPP deployment across national boundaries, including the relationships among manufacturing, transport, and host jurisdictions.

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[18] NRC, *Maritime Nuclear Applications*

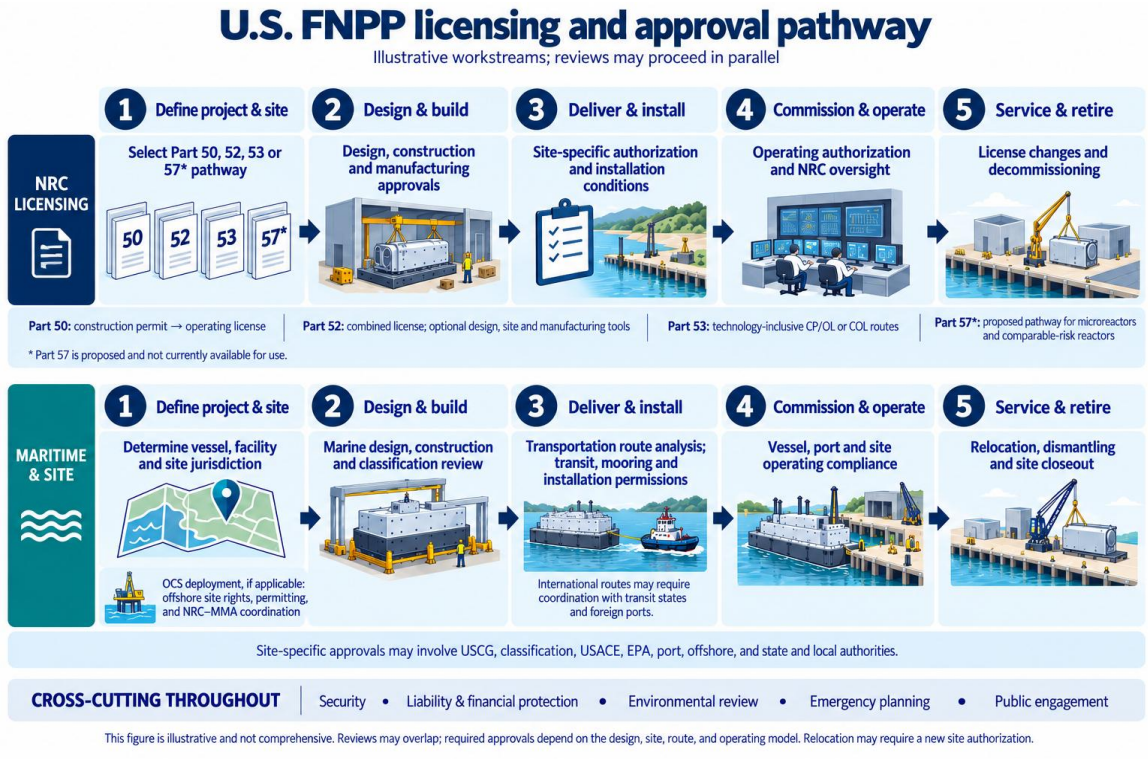
[19] Introductory Review of the Maritime Nuclear Regulatory Landscape. https://nric.inl.gov/content/uploads/34/2025/09/RPT-23-75822-Rev-1-Introductory-Review-of-the-Maritime-Nuclear-Regulatory-Landscape.pdf

[20] Navigating Nuclear Energy in Maritime. https://www.lr.org/en/knowledge/research-reports/2025/navigating-nuclear-energy-in-maritime/

[21] Facilitating Global Deployment of Floating Nuclear Power Plants. https://world-nuclear.org/images/articles/Floating-NPPs-Report-130625.pdf

These regulatory surveys generally establish that: maritime nuclear deployment involves distinct lifecycle stages; these stages involve a "stack" of separate approvals across nuclear and maritime authorities; and existing maritime/nuclear regulatory frameworks can generally support deploying commercial maritime nuclear power but require implementation and potentially regulatory deconfliction.

Figure 2. General FNPP licensing and approval pathway



Generally, the nuclear reactors of FNPP projects face many of the same regulatory challenges that face land-based commercial SMRs. In addition, FNPP projects face unique regulatory challenges due to the need to coordinate with maritime regulators and the constraints of Admiralty law not applicable to land-based projects.

In 2024, ABS issued a report on the challenges of evaluating an operating reactor in a vessel for maritime safety.[22] The report provides mandatory requirements for design, construction, and survey to ensure a FNPP meets vessel safety standards. Meeting these classification requirements is necessary to allow operation in commerce of vessels having onboard nuclear

[22] The American Bureau of Shipping (ABS) issued a report on the challenges to classifying a vessel with nuclear power generation for purposes other than self-propulsion, defining "vessel" as including ships, barges, offshore units, and installations. *Requirements for Nuclear Power Systems for Marine and Offshore Applications,* ABS, (Oct. 2024) https://pub-rm20.apps.eagle.org/r/1/2024-10-01/Nuclear-Power-Systems-for-Marine-and-Offshore-Applications.

power system installations. The requirements include an interface agreement amongst regulatory bodies, including the nuclear regulator, but may not be fully applicable to a FNPP.

In the United States, the NRC and the U.S. Coast Guard share responsibility for floating nuclear power plant safety, with the former responsible for reactor inspections and the latter for vessel inspections. The regulatory interfaces are not just administrative but also entail conflicting technical challenges. For example, a flooding event on a FNPP may require power for the emergency dewatering pumps while nuclear safety mandates carefully managing the reactor power.

Recent U.S. domestic activities have started initiatives to address these challenges:

- NRC licensing modernization, starting in the 2010s and continuing through recent rulemakings, has established Part 53 as a technology-inclusive approach, with other potential changes across Parts 37, 50, 51, 52, 57, 70, and 71 that could facilitate FNPPs.
- The NRC is preparing a maritime nuclear white paper explaining how existing licensing frameworks apply to FNPPs and nuclear propulsion.
- Multiple multi-stakeholder groups have been convened to address regulatory, operational, and other considerations (see Appendix 2).
- In June 2026, the NRC and Coast Guard signed an updated MOU on civilian maritime nuclear projects.[23] It divides responsibility for nuclear regulation and maritime oversight while providing for coordinated reviews.
- In July 2026, the NRC and newly formed Marine Minerals Administration (MMA) signed an MOU for potential Outer Continental Shelf (OCS) nuclear projects.[24] It clarifies jurisdiction and establishes a process for coordinated federal review.
- ABS issued classification requirements for floating nuclear facilities in 2024 and has since granted several approvals in principle (these are preliminary classification findings, not reactor licenses or construction approvals).[25]

These initial efforts do not solve every regulatory problem, but rather provide a foundation for initial licensing and experimentation.

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[23] Memorandum Of Understanding Between the U.S. Coast Guard and the Nuclear Regulatory Commission Regarding Civilian Maritime Nuclear Projects, (June 2026) https://www.nrc.gov/docs/ML2609/ML26096A081.pdf.

[24] Memorandum Of Understanding Between the Marine Minerals Administration and the Nuclear Regulatory Commission, (July 2026). https://www.nrc.gov/docs/ML2435/ML24354A066.pdf. The MMA combined two smaller agencies into the MMA in early July 2026.

[25] ABS Requirements for Nuclear Power Systems for Marine and Offshore Applications. https://pub-rm20.apps.eagle.org/r/1/2024-10-01/Nuclear-Power-Systems-for-Marine-and-Offshore-Applications

Compared to civil maritime nuclear propulsion, FNPPs offer several regulatory advantages for such experimentation:

- For FNPPs intended solely for domestic use, NRC would generally be the principal U.S. nuclear-safety licensor. Comparably, nuclear propulsion could require licensing in two or more port states, most likely with differing regulatory frameworks.
- Fixed operating sites, just like terrestrial nuclear plants, simplify siting, environmental permitting, operations, and emergency planning compared to operationally mobile reactors.
- By operating in one location, a FNPP will generally be subject to one set of maritime regulatory authorizations, whereas a travelling vessel could implicate multiple federal and international jurisdictions.

Together, these advantages make domestic FNPPs jurisdictionally simpler to regulate than nuclear propulsion, and therefore an ideal first case to begin building precedent for more complicated deployment situations.

Table 1. Precedent from Successful FNPP Deployment can Inform Nuclear Shipping

Capability	FNPP deployment can establish	Commercial nuclear shipping additionally requires
Licensing and classification	Working relationships among the NRC, Coast Guard, classification societies, ports, and site authorities	Flag-state and port-state acceptance, multi-jurisdictional/harmonized licensing, International Maritime Organization requirements, route approvals, and foreign-port access
Shipyard and supply chain	Nuclear-quality shipyard construction, repeatable integration processes, qualified suppliers, and manufacturing oversight	Production integrated with commercial shipbuilding schedules and propulsion-specific equipment and supply chains
Operations and workforce	Maritime nuclear operator training, inspection programs, maintenance practices, and site-specific emergency exercises	Seagoing nuclear qualifications, international crews, vessel-command responsibilities, and emergency arrangements across multiple ports
Security and safeguards	Defined operator and government responsibilities, waterside protection, response exercises, and material-accounting practices	Protection during international voyages, mobile threat response, safeguards continuity, and coordination in foreign waters
Liability and insurance	Financial-protection arrangements for operation at defined sites and authorized domestic movements	Predictable treatment of cross-border incidents, foreign claims, port exposure, and the interaction of nuclear and marine insurance

IV. Cross-Cutting Barriers to Deploying FNPPs

FNPP applicants can navigate the existing set of regulatory pathways. However, three high-leverage U.S. policy gaps cannot be resolved solely through reactor design or ordinary applicant–regulator engagement: the allocation of public and private security responsibilities; a credible system for managing spent nuclear fuel (SNF) and greater-than-Class C (GTCC) waste; and a liability and insurance framework that follows an FNPP through its operating, movement, servicing, and other phases. The following sub-sections provide an initial survey of the challenges for each barrier; significantly more technical, legal, and regulatory work is required for resolution of each.

A. Standardizing Security for a FNPP

Security[26] is a leading example of the type of regulatory barrier that an FNPP project cannot resolve on its own. A floating nuclear power plant sits at the intersection of two established but different security regulatory frameworks:

- NRC physical-protection requirements generally place responsibility on the nuclear licensee.
- Coast Guard and port-security regimes depend on federal, state, local, port, and private maritime capabilities.

Security and safeguards for a FNPP are thus at an intersection of multiple overlapping jurisdictions of Federal, State and local agencies.[27] The NRC security regulations expect the NRC licensee to be responsible for facility security and response, including armed response and the use of lethal force.[28] Ships in port rely on a mix of Federal and local law enforcement led by the U.S. Coast Guard.[29] The crew is not expected to defend the vessel except in *extremis*.[30] Any FNPP in the United States will therefore need to establish adequate security without duplicating public maritime capabilities or leaving gaps at the hull-to-shore boundary.

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[26] The focus here is physical security. For purposes of this paper, material control and accounting and applicable IAEA safeguards and verification arrangements

[27] Adam D. Williams and Doug Osborn, System Studies for Global Nuclear Assurance and Security, SAND 2020-4688, Sandia National laboratory (2020), Section 2.3. System Studies for Global Nuclear Assurance and Security (GNAS): 3S Risk Analysis for Portable Nuclear Reactors (Volume II) ? Conclusions and Implications

[28] 10 CFR Part 73.

[29] 46 U.S.C. § 70116, *Port, Harbor, and Coastal Facility Security.*

[30] See generally, 46 U.S.C. § 8107(b), encouraging the U.S. Coast Guard to work with international organizations "to deter, protect against, and rapidly respond to" security threats to vessels.

Compared to the situation when the NRC issued a manufacturing license to OPS for up to eight FNPPs in the 1980s, security considerations both for transportation and nuclear power plants have significantly evolved and become more complex. Modern analyses should consider, as applicable, threats from the air, surface, subsurface, cyber, and insider domains, as well as changes in risk across the reactor lifecycle.[31]

The June 2026 MOU between the NRC and Coast Guard is an important step because it replaces the agencies' 1973 agreement and creates a contemporary framework for civilian maritime nuclear projects. Its central operating rule is worth stating directly:

> "The NRC and USCG will coordinate their inspections, reviews, examinations, approvals, and related compliance activities through the appropriate offices, while each retains and exercises its independent authorities." When either agency receives a preapplication or application, it will "promptly notify the other and jointly develop a coordinated review schedule and milestones."[32]

The MOU also calls for early communication, coordinated schedules and technical reviews, and cooperation on safety, security, and environmental protection. Under it, the NRC independently licenses and inspects reactor and radiological safety and security, while the Coast Guard independently inspects vessels and maritime facilities and exercises maritime safety and security authority. The MOU is intended to, and could, materially reduce process risk. But it does not itself amend the substantive duties imposed by NRC or Coast Guard regulations, transfer either agency's statutory authority, or determine which security functions belong to public response forces. That remaining allocation is the core policy question.

The costs of providing adequate security under the existing NRC framework could be significant. For example, a 2019 study of one offshore nuclear plant concept estimated that as many as 96 annual full-time-equivalent employees might be required to fill necessary security roles across shifts. A later nuclear-maritime regulatory study repeated that estimate.[33] A developer can reduce these costs through design and potentially licensing exemptions, but cannot alone establish public-response commitments. Allocating functions to the licensee or public responders calls for coordination among the federal, state, and local

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[31] Adam D. Williams & Doug Osborn, System Studies for Global Nuclear Assurance and Security: 3S Risk Analysis for Portable Nuclear Reactors (Volume II)—Conclusions and Implications, SAND2020-4688, § 2.3 (Sandia National Laboratories 2020); National Reactor Innovation Center & American Bureau of Shipping, Overcoming Challenges to Nuclear-Maritime Applications, INL/RPT-25-87321, § 2.2.4 (June 2024).

[32] U.S. Coast Guard & U.S. Nuclear Regulatory Commission, Memorandum of Understanding Regarding Civilian Maritime Nuclear Projects §§ 4.1-4.2, 10, 14-15 & encl. 1, at 2-3, 6-8 (effective June 22, 2026), ADAMS Accession No. ML26096A081.

[33] Jared Thomas Conway et al., "Physical Security Analysis and Simulation of the Multi-Layer Security System for the Offshore Nuclear Power Plant," 352 Nuclear Engineering and Design 110160 (2019); National Reactor Innovation Center & American Bureau of Shipping, Overcoming Challenges to Nuclear-Maritime Applications, INL/RPT-25-87321, § 2.2.4 (June 2024).

agencies with jurisdiction.[34] In a comparable situation, the initial licensing of Turkey Point nuclear facility in South Florida concluded that a security threat of an air attack from Cuba was a national responsibility, not the NRC licensee's duty.[35] The Atomic Energy Act does authorize the NRC to rely on other agencies for functions, though it rarely does so.[36]

Because the owner or operator may not control all waterside and shoreside areas, the protection concept must define security boundaries and each planned reliance on public forces. Nuclear-security measures should not diminish safety, operation, or survivability, and safety measures should not diminish security.[37] The NRC's proposed 2026 security rule points in the useful direction of more performance-based, risk-informed, and technology-inclusive requirements.[38] In particular, the proposal would allow partial or complete reliance on law-enforcement or other offsite armed responders (with prior Commission approval required for complete reliance), while retaining specified licensee responsibilities. The rule remains proposed, however, and does not itself resolve how those provisions should work in a maritime setting.

From a technical point of view, FNPP projects may provide opportunities for optimization of security. With the construction of a compact integral layout of a nuclear reactor within a floating hull, a FNPP provides an opportunity for use of a modern Security by Design (SBD) approach.[39] Recent guidance on SBD, such as that issued by the IAEA, provides technical detail on how to design and evaluate a plant for physical protection with respect to the selection and integration of appropriate, effective physical protection measures (including equipment). Such guidance helps ensure the design of physical protection systems for FNPPs provide due consideration of FNPP innovations, relocation, maritime operating conditions, and multiple siting locations.

Physical protection analyses should take into account new potential threat scenarios such as drone, surface, and submersible threats to FNPPs. Special consideration should also be given

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[34] See 46 U.S.C. § 70103(a)-(c); National Reactor Innovation Center & American Bureau of Shipping, Overcoming Challenges to Nuclear-Maritime Applications, INL/RPT-25-87321, § 2.6 (June 2024) (discussing cooperation among regulators and classification societies).

[35] See 10 CFR 50.13 and 32 Fed. Reg 13445 (Sept. 26, 1967)

[36] The NRC "with the consent of the agency concerned, utilize or employ the services or personnel of any Government agency or any State or local government, or voluntary or uncompensated personnel, to perform such functions on its behalf as may appear desirable", 42 U.S.C. § 2201(f).

[37] International Atomic Energy Agency, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), Nuclear Security Series No. 13, ¶¶ 4.11, 5.18 (Vienna 2011).

[38] Modernizing Security Requirements, Proposed Rule, 91 Fed. Reg. 38,928, 38,941, 38,973-74 (June 26, 2026) (proposing 10 C.F.R. § 73.55(k)(5)-(6)). This rule is expected to be finalized on January 12, 2027.

[39] IAEA, *Handbook on the Design of Physical Protection Systems for Nuclear Material and Nuclear Facilities*, Nuclear Security Series No. 40-T, IAEA Vienna (2021). Handbook on the Design of Physical Protection Systems for Nuclear Material and Nuclear Facilities | IAEA.

to protection of FNPP connections with the shore and protection of the whole infrastructure that is created for the operation of the FNPP at the mooring place.

Recommendations: The NRC and Coast Guard should implement their MOU through a joint maritime nuclear security framework before the first FNPP application reaches detailed review. The framework should include:

- a lifecycle responsibility matrix allocating functions of the licensee, Coast Guard, port authorities, state and local agencies, and other federal agencies during all lifecycle phases;
- a common threat-and-response planning basis that distinguishes the threats the licensee must handle from those for which public forces take the lead;
- a model integrated document set and crosswalk that maps various nuclear and maritime security plans;
- an early security-by-design review, with a defined method for crediting passive features, automation, protected siting, Coast Guard measures, and timely law-enforcement response; and
- operational activities including joint drills, inspection protocols, information-sharing rules, escalation procedures, and a transparent policy for allocating the recurring cost of public and private measures.

The result should be one defensible security framework implemented through the plans required of the licensees. The immediate deliverable should be a civilian-maritime-nuclear implementation instrument or model integrated plan developed under the MOU. To the degree possible considering security restrictions, the framework should be public, with stakeholder input during its development and implementation. Targeted rule changes should follow where a generic crediting approach or a different allocation of legal responsibility cannot be supported by current regulations.

B. SNF and GTCC Management

FNPPs face two distinct end-of-life management challenges: first, the need for offsite/interim storage of SNF as compared to the prevailing practice of storing SNF onsite, and second, the generation of GTCC waste requiring permanent disposal, the lack of a permanent disposal pathway for such waste, and limited temporary alternatives.

The current practice of storing commercial spent nuclear fuel (SNF) on-site in the U.S. presents unique challenges for FNPPs due to the lack of a permanent fixed terrestrial location. For an FNPP project, long-term storage at the deployment site is likely not feasible once the vessel departs, and storage at the initial port facilities is unlikely due to the mixed and industrial use nature of such ports. Depending on the concept of operations, defueling at end of life could occur at the deployment site, at a centralized maintenance facility such as a shipyard, or through removal and return of a sealed reactor module. Each model requires an

identified receiving facility, license, transport package, cooling period, custody arrangement, and funding mechanism. Part 72 authorizes an independent spent fuel storage installation to receive and store power-reactor SNF aged for at least one year, thus offering an option though still potentially requiring some short-term storage.[40]

Progress toward a centralized permanent repository for commercial SNF in the U.S. has been at a standstill since the report of the *Blue Ribbon Commission on America's Nuclear Future* in 2012.[41] In 2026, the DOE launched an initiative to develop Nuclear Lifecycle Innovation Campuses that would move forward with managing SNF, including permanent disposal. In July, DOE and Utah, Tennessee, Oklahoma, Louisiana, and Idaho signed MOUs to continue exploring potential campuses, which may include reprocessing and disposition of used fuel and waste; West Virginia signed a sixth exploratory MOU in September. Those MOUs identify states exploring possible campuses, not licensed host sites or commitments to accept FNPP material.[42] Only Louisiana is coastal. A recent PNNL study evaluated the Port of Beaumont and fourteen other ports for potential small-reactor deployment, while emphasizing that feasibility is highly site dependent, that further data and analysis are required, and that inclusion did not imply port endorsement.[43]

Although federal and private initiatives have continued since the Blue Ribbon Commission on America's Nuclear Future reported in 2012, none has yet produced an operating federal acceptance facility or permanent repository for commercial SNF.[44] The current SNF management practices in the U.S. for land-based reactors use a mix of wet pool storage and dry cask storage, primarily on site.[45] Many advanced-reactor fuel forms appear technically manageable in interim storage, but fuel, package, cooling, and licensing analyses remain design specific.

While not directly applicable to commercial SNF management, the U.S. Navy's practice is a useful technical precedent. Naval SNF is removed at specialized shipyards, shipped inland to the Naval Reactors Facility at Idaho National Laboratory, examined or processed as necessary, and stored pending ultimate disposition. The Idaho arrangements also

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[40] 10 C.F.R. § 72.2(a); see also 10 C.F.R. pts. 50, 71-72.

[41] Congressional Research Service, Nuclear Energy: Overview of Congressional Issues, (2021) pp 4-5. R42853.25.pdf

[42] U.S. Department of Energy, "Nuclear Lifecycle Innovation Campuses" (listing six exploratory state MOUs, including West Virginia in Sept. 2026).

[43] Jeriah A. Whitley, Ryan A. Calkins & Dina E. Carpenter-Graffy, Small Nuclear Reactors for Maritime Ports: A Feasibility Study, PNNL-39328, at ii, 23-27, A.20-A.21 (Pacific Northwest National Laboratory Mar. 2026).

[44] Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy (Jan. 2012); Mark Holt, Nuclear Energy: Overview of Congressional Issues, Congressional Research Service Report R42853 (Mar. 26, 2025); U.S. Department of Energy, "Department of Energy Moves Forward with Consolidated Interim Storage Facility Project for Spent Nuclear Fuel" (May 15, 2024).

[45] For a discussion of spent fuel management practices and considerations for advanced reactors, see Fuel Cycle | NIA and Guide for State Policymakers (Final) (3).pdf (pp. 22-3).

accommodate a defined cooling period before dry storage.[46] This experience shows that maritime defueling can be integrated with specialized servicing, a cooling or conditioning period, a qualified transport system, and inland storage.

GTCC creates a parallel but different institutional gap. Congress assigned the federal government responsibility for disposal of commercial GTCC waste, but the United States still lacks an operating disposal pathway for most of that inventory. As Matt Bowen, Marine Gapihan, and Maya Lameche explain in their report, "*Revisiting GTCC and GTCC-Like Nuclear Waste Disposal in the United States*", commercial reactors can generate GTCC waste through activated metals and operational wastes.[47] Shutdown sites commonly retain GTCC in storage near their SNF because no disposal destination is available.[48] The authors also caution that removing GTCC alone is unlikely to reduce a shutdown site's security and maintenance costs materially while SNF remains.[49] Future FNPP designs may generate different radionuclide inventories and waste forms than prevailing terrestrial designs, so each specific deployment may bring different GTCC implications.

Existing law does provide interim tools. A site-specific Part 72 license may authorize storage of solid, reactor-related GTCC waste at an independent spent fuel storage installation. NRC guidance requires that such waste be in solid form and stored in a container separate from spent fuel.[50] Interim storage is not disposal, however. The NRC's July 2026 proposed Integrated Low-Level Radioactive Waste Disposal rule would establish site-specific, risk-informed requirements for facilities seeking to dispose of GTCC and other long-lived waste streams and would reserve GTCC disposal licensing to the NRC.[51] GAO's recommendation-status page reported that, as of February 2026, Congress had not acted on its recommendations to clarify regulatory authority and direct DOE on GTCC disposal.[52]

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[46] U.S. Department of the Navy & U.S. Department of Energy, Final Environmental Impact Statement for a Container System for the Management of Naval Spent Nuclear Fuel, DOE/EIS-0251 (Nov. 1996); U.S. Department of Energy, "Explaining Idaho's Unique Settlement Agreement" (Aug. 17, 2021).

[47] Matt Bowen, Marine Gapihan & Maya Lameche, Revisiting GTCC and GTCC-Like Nuclear Waste Disposal in the United States, at 8-9, 12-20, 27-31 (Center on Global Energy Policy, Columbia University SIPA, July 2024).

[48] *Ibid*.

[49] *Ibid*.

[50] 10 C.F.R. § 72.2(a); U.S. Nuclear Regulatory Commission, Interim Staff Guidance-17, Interim Storage of Greater Than Class C Waste (July 2002).

[51] Integrated Low-Level Radioactive Waste Disposal, Proposed Rule, 91 Fed. Reg. 40,290, 40,296, 40,302-03, 40,311-12 (July 1, 2026).

[52] U.S. Government Accountability Office, Nuclear Waste: DOE Needs to Improve Transparency in Planning for Disposal of Certain Low-Level Waste, GAO-22-105636 (Sept. 2022), recommendation-status page updated Feb. 2026.

Recommendations.

- **Establish a maritime back-end initiative:** DOE and the NRC should establish a maritime nuclear back-end initiative with two coordinated workstreams (one for SNF and one for GTCC) built around a defined reference FNPP and its full service life. This initiative should address: where defueling, cooling, conditioning, and packaging may occur; which approvals govern each handoff; what casks or transport systems must be developed for the proposed fuel or sealed module; who holds title, custody, security, and emergency-response duties at each stage; and what receiving facility will accept the material. Then, DOE and the NRC should publish a public report that presents the initiative's findings.
- **Revise Standard Contracts:** DOE should review and, where necessary, revise its Standard Contract so that existing provisions expressly cover FNPPs, advanced fuel forms, module-return concepts, and nonstandard output and fee cases. Until federal acceptance occurs, the FNPP license should require a design-specific fallback storage or service-hub plan with adequate funding.
- **Proactively address GTCC issues:** For GTCC, FNPP developers should complete a design-stage activation inventory and decommissioning waste forecast, and identify waste forms and packages. NRC should complete its Part 61 rulemaking, while DOE should provide technical assistance and criteria to NRC. Waste that cannot meet the performance requirements of any available Part 61 facility would require another disposal path and may require statutory action.

In evaluating both SNF and GTCC options, NRC and DOE should consider any required statutory changes needed and identify options for Congress.

Given the complexity of the issue and the potential for a lack of a waste pathway to be a show stopper, federal stakeholders and industry should prioritize coordination to establish pathways forward. These could include workshops or pilot projects to facilitate technical interchange and understanding of the quantities, form, and timing of the two disposal streams.

C. Liability, Insurance, and Indemnification

Given their different geographic and technological contexts, the maritime and nuclear sectors are governed by distinct liability frameworks, with subsequent impacts on available insurance. When dealing with novel systems like maritime nuclear power, these existing regimes do not necessarily handle all aspects of third-party liability, nor associated first-party insurance requirements. Compared to propulsion systems that can cross multiple jurisdictions, FNPPs present a more straightforward case to develop an effective regime for commercial maritime nuclear power.

Three questions require resolution:

- How the Price-Anderson Act (PAA) financial protection and indemnity apply by lifecycle stage, location, and reactor size;
- whether a fixed FNPP qualifies as a nuclear installation under the Convention on Supplementary Compensation (CSC); and
- how third-party nuclear liability, first-party property loss, and ordinary marine liabilities interact without a coverage gap.

Congress designed the PAA to protect the public and encourage development of the atomic-energy industry. It does so through a set of interlocking provisions, critically including federal supremacy of third-party liability as well as relevant definitions.[53] "Public liability" generally means legal liability arising from a nuclear incident or precautionary evacuation. A "nuclear incident" generally means an occurrence within the United States that causes specified injury, death, property loss, or loss of use, within or outside the United States, arising from the hazardous properties of source, special nuclear, or byproduct material.[54] NRC regulations implement financial-protection and indemnity requirements in Part 140.[55]

The familiar two-tier PAA system for power reactors applies to licensees required to maintain maximum financial protection. Other types of NRC licensees may be subject to a different level of required financial protection and an NRC indemnity under section 170(c), with a different aggregate limit.[56] Thus, reactor size, license type, and the Commission's financial-protection determination matter.

FNPP projects could be located within the twelve-nautical-mile U.S. territorial sea, on the Outer Continental Shelf (OCS), or in areas where those legal categories overlap. The OCS is a category of submerged lands seaward of state submerged lands, not simply the band of water from twelve to 200 nautical miles. The Outer Continental Shelf Lands Act (OCSLA) extends federal law to the seabed and specified attached installations and, in one category, expressly excludes a ship or vessel.[57] Although NRC licensing authority may reach relevant offshore activities, the PAA's geographic definitions and insurance mechanisms do not map neatly onto every FNPP location or phase. In a recent public meeting regarding its upcoming maritime white paper, NRC staff indicated that they may interpret the PAA's geographic definitions as limiting it to the territorial sea, and not the OCS. Thus it may cover coastal and near-shore installations but not off-shore FNPPs.

Reinforcing this ambiguity, the definition of nuclear incident includes an exception to the limitation that nuclear incidents are events occurring inside the U.S. as the AEA provides for

[53] The PAA displaces state tort claims for specifically defined nuclear damages.

[54] Atomic Energy Act of 1954 §§ 2(i), 11(q), (w), 42 U.S.C. §§ 2012(i), 2014(q), (w).

[55] Price-Anderson Act, Atomic Energy Act of 1954 § 170, 42 U.S.C. § 2210; 10 C.F.R. §§ 140.11, 140.91.

[56] 42 U.S.C. § 2210(b)(1), (c), (e)(1)(A); 10 C.F.R. § 140.11(a)(4); U.S. Nuclear Regulatory Commission, "Backgrounder on Nuclear Insurance and Disaster Relief."

[57] Proclamation No. 5928, Territorial Sea of the United States of America, 54 Fed. Reg. 777 (Jan. 9, 1989); Outer Continental Shelf Lands Act §§ 3(a), 4(a)(1)(A), 8(p), 43 U.S.C. §§ 1331(a), 1333(a)(1)(A), 1337(p).

extraterritorial indemnity of NRC licensees, but not extraterritorial coverage of the liability insurance and limits. The AEA adds to the definition of nuclear incident, stating "… And provided further, That as the term is used in section 170 c., it shall include any such occurrence outside both the United States and any other nation if such occurrence arises out of or results from the radioactive, toxic, explosive, or other hazardous properties of source, special nuclear, or byproduct material licensed pursuant to chapters 6, 7, 8, and 10 of this Act, which is used in connection with the operation of a licensed stationary production or utilization facility …."[58] By explicitly extending the definition of nuclear incident to include extraterritorial indemnity of NRC licensees pursuant to paragraph c of the PAA, the definition in the statute creates ambiguity whether the two-tiered insurance and liability limitations of other parts of the PAA apply to NRC licensees outside the U.S., like in the OCS. International law adds a separate problem. The Convention on Supplementary Compensation for Nuclear Damage (CSC) facilitates international trade in nuclear power by harmonizing nuclear liability provisions and it also provides a supplier retrospective pool.[59] The CSC Annex defines "nuclear installation" to exclude a reactor with which a means of sea or air transport is equipped for use as a source of power, whether for propulsion or any other purpose.[60] Read alone, that language presents a serious issue for a vessel-mounted reactor. A nonbinding IAEA expert interpretation has concluded, however, that a fixed FNPP can fall within the convention definition of a nuclear installation.[61] Without clarification, application of international conventions may impede foreign supply chains, deployments, and potentially transits.

Finally, statutory and international frameworks for nuclear and maritime liability shape the availability, structure, and cost of insurance offerings. PAA is primarily concerned with third-party liability from nuclear damage, but NRC regulations also require first-party coverage for the reactor itself. That requirement does not necessarily cover the full scope of first-party

[58] Whether a moored or otherwise fixed FNPP is "stationary" is undefined by statute.

[59] Convention on Supplementary Compensation for Nuclear Damage, Sept. 12, 1997, 36 I.L.M. 1473, entered into force Apr. 15, 2015; International Atomic Energy Agency, Office of Legal Affairs, Country Factsheet: United States of America (updated Feb. 24, 2026) (signature Sept. 29, 1997; ratification May 21, 2008; in force Apr. 15, 2015); 42 U.S.C. § 17373. The supplier retrospective pool creates a fund that CSC participating states would contribute in the event of a nuclear incident in a covered stated, with potentially several hundred million in international compensation available this way.

[60] Convention on Supplementary Compensation for Nuclear Damage, annex art. 1(1)(b)(i).

[61] International Atomic Energy Agency, Office of Legal Affairs, "Legal Considerations for Floating Nuclear Power Plants," International Symposium on the Deployment of Floating Nuclear Power Plants, at 41 (Nov. 14-15, 2023); International Atomic Energy Agency, The 1997 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation for Nuclear Damage—Explanatory Texts, IAEA International Law Series No. 3, at 27-28 & nn. 91-92 (rev. ed. 2020).

coverage that a FNPP may require, such as a complete hull-and-machinery, loss-of-hire, salvage, sue-and-labor, or wreck-removal program.[62]

Conventional marine markets usually supply hull and machinery and protection-and-indemnity (P&I) cover for vessel damage and shipowner liabilities, but standard marine wordings contain broad nuclear-peril exclusions. Marine insurers themselves have identified that interface as a fundamental barrier to nuclear-powered commercial vessels.[63] Critically, ordinary marine losses (collision damage, wreck removal, nonnuclear pollution, cargo damage, crew claims, and business interruption) do not necessarily become "public liability" under PAA merely because a reactor is aboard. Mixed-cause casualties could trigger allocation disputes precisely when prompt payment matters most.

Recommendations. The NRC, DOE, the Departments of Justice and State, the Coast Guard, and the Marine Minerals Administration should resolve the liability framework across the lifecycle and recommend any legislation Congress should enact.

- First, the agencies should publish a joint legal analysis identifying, for each location and phase, the governing license, the PAA financial-protection tier and indemnity, the aggregate liability limit, the competent court and applicable claims rules, and the treatment of various entities.
- Second, if that analysis confirms a geographic or phase gap, Congress should make a precise amendment keyed to licensed maritime nuclear activity and the relevant PAA mechanisms.
- Third, the United States should state its formal CSC position that the CSC covers a fixed operating FNPP and its associated transportation phases.
- Fourth, government and industry should build an insurance-interface matrix with both nuclear and maritime insurance offerings, as well as first and third party insurances. If necessary, any policy changes should encourage the expansion of private insurance coverage to fill any gaps.

[62] 10 C.F.R. § 50.54(w); U.S. Nuclear Regulatory Commission, "Backgrounder on Nuclear Insurance and Disaster Relief."

[63] International Union of Marine Insurance, "Nuclear Propulsion" (May 7, 2026); Institute Radioactive Contamination, Chemical, Biological, Bio-Chemical and Electromagnetic Weapons Exclusion Clause, CL 370 (Nov. 10, 2003); Gard Rules for Ships, Rule 73 & Guidance to Rule 73—Nuclear Perils (2026).

V. Conclusion

Existing NRC licensing pathways, Coast Guard maritime authorities, Outer Continental Shelf siting authorities, and classification standards provide a credible starting point for an initial floating nuclear power plant. The central task is to connect those authorities across the plant's lifecycle. The 2026 NRC–Coast Guard and NRC–Marine Minerals Administration memoranda of understanding provide useful mechanisms for coordination, but they do not alter the agencies' underlying authority or resolve the policy gaps identified in this paper.

The three policy priorities examined in this paper offer corresponding opportunities for institutional learning. An initial FNPP project can establish how nuclear operators, the Coast Guard, and other public authorities divide security responsibilities. It can require credible arrangements for spent-fuel custody, servicing, and removal. It can also bring regulators, legislators, insurers, and project participants together to clarify accident compensation and financial responsibility. Experience addressing these questions would inform subsequent maritime nuclear projects and help identify which arrangements can be adapted to propulsion.

Table 2. Policy Recommendations for FNPP Demonstrations and Commercialization

Recommendation	Lead agency and partners
Establish an integrated maritime nuclear security framework, including responsibilities, response arrangements, and coordinated plans.	NRC and Coast Guard, with relevant port, state, and local authorities
Establish a maritime spent-fuel and GTCC management initiative, identifying servicing, cooling, transport, custody, and receiving arrangements.	DOE and NRC, with developers and prospective receiving facilities
Clarify DOE Standard Contract coverage and establish funded fallback arrangements for storage or servicing pending federal acceptance.	DOE for contracts; NRC for licensing arrangements
Develop a design-specific GTCC management pathway, supported by activation inventories, waste forecasts, and suitable packaging.	NRC, with DOE technical support and developer analyses
Clarify lifecycle liability coverage and close confirmed gaps, including those affecting OCS operations.	NRC, coordinating with Justice, DOE, State, Coast Guard, and Interior
Clarify the U.S. position on CSC coverage for fixed FNPPs and associated transportation.	State, with NRC, DOE, and Justice
Develop a nuclear–maritime insurance coverage matrix, identifying exclusions, overlaps, and gaps.	NRC and Coast Guard convening insurers and developers

Commercial propulsion will require additional solutions. Reactor and vessel designs must accommodate their intended operating conditions, and ships traveling internationally need workable arrangements for voyages, foreign-port access, security, and liability. The value of FNPP experience lies in the capabilities and practical knowledge it can establish; the approvals and operating arrangements for subsequent vessels must address their own applications.

FNPP projects therefore offer both an energy-development opportunity and a foundation for a broader U.S. maritime nuclear industry.

VI. Appendix 1. List of Civil Maritime Nuclear Activities

As of September 2026, some of the main projects are:[64]

- *September 2026* Lloyd's Register, A.P. Moller-Maersk, the Port of Charleston, and the Port of Felixstowe launched the Pink Corridor project to examine requirements for a potential nuclear-powered transatlantic container route.[65]
- *September 2026* BlueCore Energy advanced a proposed 10-MWe barge-mounted reactor system at the Port of Long Beach, where it has secured a lease for prototype assembly, testing, and barge berthing.[66]
- *August 2026* MARAD and CORE POWER signed a Memorandum of Cooperation to develop commercial, regulatory, industrial, and lifecycle frameworks for a future fleet of U.S.-flagged nuclear-powered merchant ships.[67]
- *August 2026* MARAD and the Port of Corpus Christi signed an agreement to explore maritime nuclear technologies, including SMRs, port microgrids, shoreside infrastructure, and advanced vessel propulsion.[68]
- *July 2026* MARAD and the Port of Long Beach signed a Memorandum of Cooperation covering SMRs, resilient port microgrids, shoreside power, vessel-support infrastructure, and workforce development.[69]
- *July 2026* Samsung Heavy Industries and Sargent & Lundy (a major nuclear A&E firm) signed an MoU to develop a standardized, technology-agnostic floating SMR platform.[70]

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[64] See generally, Maritime - NRIC.

[65] Lloyd's Register, "Pink Corridor Project to Explore Safety Requirements of Nuclear-Powered Transatlantic Container Shipping Route" (Sept. 2, 2026), https://www.lr.org/en/knowledge/press-room/press-listing/press-release/2026/pink-corridor-project-to-explore-safety-requirements-of-nuclear-powered-transatlantic-container-shipping-route/.

[66] Mike Schuler, "BlueCore Advances Floating Nuclear Power Project at Port of Long Beach," gCaptain (Sept. 10, 2026), https://gcaptain.com/bluecore-advances-floating-nuclear-power-project-at-port-of-long-beach/.

[67] CORE POWER, "Turning Policy into Steel. Turning Vision into Ships." (Aug. 24, 2026), https://www.corepower.energy/news-resources/turning-policy-into-steel-turning-vision-into-ships.

[68] U.S. Maritime Administration, "Trump's Transportation Secretary Sean P. Duffy and Port of Corpus Christi Sign Agreement to Explore Nuclear Maritime Technologies" (Aug. 19, 2026), https://www.maritime.dot.gov/newsroom/trumps-transportation-secretary-sean-duffy-and-port-corpus-christi-sign-agreement.

[69] U.S. Maritime Administration, "Trump's Transportation Department and Port of Long Beach Sign Agreement to Test Nuclear-Powered Vessels" (July 22, 2026), https://www.maritime.dot.gov/newsroom/trumps-transportation-department-and-port-long-beach-sign-agreement-test-nuclear-powered.

[70] World Nuclear News. https://www.world-nuclear-news.org/articles/korean-us-partnership-for-floating-smr-platform.

- *June 2026* Core Power announced an effort to develop a FNPP based on the BWXT mPower SMR design.[71]
- *December 2025* ABS granted approval in principle to Samsung Heavy Industries' floating nuclear power plant design incorporating two KAERI SMART100 reactors.[72]
- *June 2025* Allseas announced an effort to develop maritime nuclear power based on a TRISO fueled high temperature gas reactor, including for industrial applications.[73]
- *November 2024* Westinghouse and Core Power formalized an agreement for the design and development of a floating nuclear power plant using the eVinci™ microreactor.
- *September 2023* BWXT and Crowley announced a collaboration to explore deploying a microreactor on a shallow-draft hull ship to supply small-scale nuclear energy to shoreside locations.
- *July 2023* Fincantieri, RINA, and Newcleo initiated a feasibility study for potential maritime application of lead-cooled fast reactor (LFR) technology for the shipping industry.[74]
- *April 2023* X-Energy and RBC Logistics signed a memorandum of understanding for joint development of the XE-Mobile Marine Project, which is a high-temperature gas reactor (HTGR).
- *April 2023* Seaborg (now Saltfoss Energy), Samsung Heavy Industries, and Korea Hydro & Nuclear Power announced a consortium to develop floating nuclear power plants utilizing molten salt reactor (MSR) technology.[75]
- November 2021 NuScale, Prodigy, and Kinectrics started to explore a regulatory framework to license and deploy a Prodigy Marine Power Station integrated with NuScale Power Modules, a light water reactor (LWR).[76]
- September 2021 Wison Offshore & Marine Shipyard, a Chinese company, contracted to build two Floating Nuclear Power Plants (FNPP) for Rosatom to be deployed offshore Russia and supply power to remote mining sites.
- *December 2020* Danish nuclear company Saltfoss received the first step in certifying its barge design as feasible for a compact MSR installed on a barge for clean energy in Southeast Asia. In January 2023, this feasibility approval for the barge design was finalized.[77]

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[71] CORE POWER Launches Assessment of BWXT's mPower SMR for Floating Nuclear Power Plants.

[72] "ABS Approval for SHI Floating Nuclear Power Plant Design with Twin Korea Atomic Energy Research Institute Reactors" (Dec. 22, 2025), https://pressreleases.eagle.org/news/abs-approval-for-shi-floating-nuclear-power-plant-design-with-twin-korea-atomic-energy-research-institute-reactors.

[73] https://www.allseas.com/en/who-we-are/news-and-media/allseas-pioneers-nuclear-technology.

[74] https://www.fincantieri.com/globalassets/press-releases/non-price-sensitive/2023/cs_newcleo_fincantieri_rinadefeng_672290608.pdf

[75] https://world-nuclear-news.org/articles/partnership-formed-to-deploy-seaborg-s-power-barge

[76] https://world-nuclear-news.org/articles/nuscale-teams-up-with-prodigy-and-kinectrics-for-m

[77] Samsung completes design of CMSR Power Barge - World Nuclear News

VII. Appendix 2. Organizations Striving to Overcome Regulatory Barriers to Deploying Floating Nuclear Power Plants

A number of government and non-government organizations are studying potential issues with respect to maritime nuclear operations. There are international industry organizations like the Nuclear Energy Maritime Organization (NEMO). Within the U.S., several working groups of government, academic and industry players are laying the foundation for maritime nuclear, including FNPPs. Examples include, the Maritime Nuclear working group at the National Reactor Innovation Center (NRIC) at the U.S. Department of Energy Idaho National Laboratory (INL), the Massachusetts Institute of Technology (MIT) Maritime Consortium's nuclear propulsion research focus, and the U.S. Center for Maritime Innovation (USCMI).

A. Nuclear Energy Maritime Organization (NEMO)

NEMO is an international membership organization for stakeholders involved in all aspects of nuclear maritime including FNPP as well as nuclear-powered propulsion. Founded in 2024, NEMO is recognized to provide expert knowledge, technical input, and strategic recommendations to both the International Maritime Organization (IMO) and the International Atomic Energy Agency (IAEA), providing industry perspectives to these international organizations on issues of the intersection of maritime propulsion and nuclear technology. Also, NEMO works with maritime regulators, the industry groups that set consensus safety standards (class societies) and insurers to ensure that current standards are tailored to allow FNPP to operate at sea, offshore, in ports and in nearshore environments. NEMO's mission is to help national and international regulators create appropriate future-oriented standards and rules for the deployment, operation and decommissioning of floating nuclear power allowing floating nuclear power solutions to be deployed with the highest standards of safety, security, and environmental justice.[78]

B. National Reactor Innovation Center (NRIC)

NRIC is a DOE program based at the INL. NRIC is involved in the maritime sector to support nuclear investment decisions by connecting the maritime and nuclear industries, and to encourage the demonstration and commercialization of maritime projects. Current efforts by NRIC to identify regulatory barriers to maritime nuclear deployment include examining safety, security, safeguards and liability for maritime applications and developing computer codes to assess environmental impacts caused by sabotage or acts of terrorism.[79] A recent

[78] NEMO | Nuclear Energy Maritime Organisation.

[79] 01-NRIC-Program-Update.pdf, slide 19.

NRIC-sponsored effort found that determining "the necessary policy and regulations that will be relevant for small nuclear reactor deployment" is a future area needing research.[80]

C. MIT Maritime Consortium

The MIT Maritime Consortium was formed to address critical gaps in the modernization of the commercial fleet through cutting-edge interdisciplinary research. The Consortium includes maritime nuclear as a research area. A 2025 report by the Consortium highlighted the need for regulatory policy action to clarify the outdated regulations governing maritime nuclear applications.[81]

D. U.S. Center for Maritime Innovation (USCMI)

In 2023, the National Defense Authorization Act directed the Secretary of Transportation to create USCMI. USCMI is a clearinghouse collecting input from experts and others in the field of innovative approaches that will enable the restoration of U.S. dominance in maritime commerce. The avenues of collection include a working group on Maritime Advanced Nuclear. That working group is pursuing several projects to gather information on how nuclear propulsion, proven in naval applications, offers an efficient alternative with high energy density and operational endurance. USCMI has gathered input that raises concerns that commercial adoption is hindered in part by regulatory uncertainty and public perception.[82] Recent efforts by USCMI have expanded to include fostering FNPP projects.[83]

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[80] Pacific Northwest National Laboratory, *Small Nuclear Reactors for Maritime Ports -- A Feasibility Study*, PNNL-39328 (March 2026). https://nric.inl.gov/content/uploads/34/2026/07/Small_Nuclear_Reactors_for_Maritime_Ports_PNNL-39328.pdf.

[81] A.R. Valiaveedu, et al., *Navigating the Regulatory Seas for Commercial Maritime Nuclear Propulsion*, MIT Science Policy Review, (August 5, 2025), concluding "outdated regulations pose a major barrier to implementation."

[82] https://www.uscmi.org/solicitations/port-readiness-assessment, Background.

[83] U.S. Center for Maritime Innovation Convenes Leaders to Address Regulatory Barriers to Maritime Nuclear Technologies — U.S. Center for Maritime Innovation.