CONVOY 2026 – Session #2 Read Ahead
Unbridled Power at Sea: Reactors and Fuels

4 June 2026 | Online | AM & PM Sessions

Session #2 of the CONVOY 2026 programme moves the discussion from market context into technology selection and operational integration. Session #1 established why maritime nuclear is attracting renewed attention across shipping, energy, industrial infrastructure and government policy. This session examines the next question: as maritime nuclear moves from concept into deployment, what kinds of reactors and fuels are most likely to underpin it, and how do those choices affect real-world operations?

The session focuses on decision-making rather than just reactor physics, although there will be a Nuclear 101 or 'primer' at the outset. In practice, reactor technology, fuel strategy and operational design cannot be separated. Choices about fuel enrichment, reactor type, power output, core-life / refueling intervals and system architecture influence licensing pathways, insurance considerations, shipyard integration, crewing models, safeguards requirements and commercial viability.

Participants do not need a technical background in nuclear engineering to engage with the session. The presentations are designed to provide a structured overview of the main concepts, terminology and trade-offs that shape current maritime nuclear discussions. The emphasis throughout is on helping participants understand how developers and operators evaluate different pathways, rather than advocating for a single "correct" technology solution.

A sector with precedent, but not yet a settled commercial model

Naval propulsion programmes have accumulated decades of operational experience, while Russia operates nuclear-powered icebreakers and the Akademik Lomonosov floating nuclear power plant (FNPP). Historical projects such as NS Savannah also demonstrated that nuclear-powered commercial vessels were technically feasible many decades ago.

However, those examples do not automatically provide a direct template for civilian deployment today. Modern maritime nuclear projects face a different operating environment. Commercial operators must consider licensing, safeguards, financing, public confidence, fuel logistics and long-term lifecycle responsibility in ways that differ substantially from military programmes.

One of the central themes of the session is therefore that maritime nuclear is not only an engineering challenge, it also poses a number of fundamental questions around systems integration. A technically capable (or 'marine ready') reactor still requires a commercially workable operating model, a credible regulatory pathway and a shipyard facility / supply chain that can support fuel handling, maintenance and eventual decommissioning.

The session will also distinguish between the two broad deployment pathways, introduced in Session #1. The first involves FNPPs, which act as stationary or semi-stationary energy assets supplying electricity, heat or industrial energy services. The second involves nuclear propulsion, where the reactor becomes part of a moving vessel whose primary function is transportation.

Different applications drive different technology choices

A key message is that although the same family of reactor technologies may appear in both sub-sectors, floating power plants and propulsion systems optimise for different outcomes.

FNPPs generally prioritise long-duration reliability, maintainability, grid stability and predictable power delivery. Because they are stationary or semi-stationary, designers often have greater flexibility around shielding, layout and supporting infrastructure. These projects may therefore favour mature technologies with well-understood operating histories and clearer licensing precedents.

Propulsion systems face a different set of constraints. A propulsion reactor must fit within the space, weight and operational limits of a vessel while maintaining reliable performance under continuous marine motion. Compactness, power density, dynamic response and operational flexibility become more important. Shielding and containment must coexist in a finite area adjacent to cargo

arrangements and marine systems, as well as crew spaces, while refuelling strategies (whilst infrequent) must minimise disruption to vessel schedules and trading patterns.

The session will explore how these different priorities shape reactor selection, fuel choice and operational philosophy. Participants will hear why a technology that appears attractive for an FNPP may not be optimal for propulsion, and vice versa.

Understanding the reactor landscape

A portion of the session will introduce the main reactor families under discussion within maritime nuclear development.

The presentations will begin with a concise “Nuclear Reactors 101” overview intended for non-specialists. This section will explain the basic principles of nuclear fission, how reactors produce heat and electricity (via power conversion systems), and why nuclear fuel differs fundamentally from conventional marine fuels.

From there, the session will compare a range of reactor technologies. Proven Generation III and III+ light water reactors, particularly pressurised water reactors, remain the most mature and commercially familiar pathway. They benefit from established supply chains, extensive operating experience and stronger regulatory familiarity. At the same time, they carry integration challenges linked to plant size, high-pressure systems, shielding requirements and refuelling outages.

The session will also introduce advanced reactor concepts often grouped under the Generation IV label. These include high-temperature gas reactors, molten salt reactors, metal-cooled reactors, fast reactors and microreactors. Many of these systems promise advantages such as higher temperatures, lower operating pressures, improved fuel utilisation or greater compactness. However, they also introduce new questions around materials performance, licensing maturity, fuel qualification and supply chain readiness.

Rather than adjudicating these technologies as potential winners or losers, the focus will be on trade-offs. Participants should leave with a clearer understanding

that reactor selection involves balancing maturity, operational performance, regulatory familiarity and commercial risk.

Fuel choices shape the entire operating model

Fuel strategy forms the second major pillar of the session. In public discussion, reactor technologies often receive greater attention than fuel cycles, yet fuel decisions frequently shape the practical realities of deployment.

The presenters will examine the distinctions between conventional low enriched uranium fuel, higher enrichment HALEU fuel, TRISO fuel forms and more advanced liquid or metallic fuel concepts. These choices influence reactor compactness, refuelling intervals, operational endurance and thermal performance. They also influence safeguards requirements, transport arrangements, fuel fabrication pathways and end-of-life management.

Participants will hear why fuel cannot be treated as an isolated technical element. A change in fuel type can alter the entire supply chain and operating philosophy of a maritime nuclear asset. It may affect what enrichment levels are required, how fuel is transported, where refuelling can occur, how waste is managed and what kinds of security and safeguards obligations apply.

The session will also examine the growing interest in HALEU fuel. Higher enrichment levels can support longer operating cycles and more compact reactor designs, both of which are attractive for maritime applications. However, HALEU supply chains remain relatively immature, particularly outside government-backed programmes. This creates additional commercial and strategic considerations for developers and operators.

Importantly, the discussion around fuel will extend beyond front-end supply. Participants will also explore spent fuel management, cooling requirements, storage pathways and long-term lifecycle responsibility. For maritime nuclear to achieve broad acceptance, credible plans for waste handling and end-of-life management will remain essential.

Why maritime integration changes the design basis

One of the strongest themes running through the session is that maritime nuclear cannot simply import land-based reactor assumptions without modification.

Marine environments create operational conditions that differ fundamentally from terrestrial plants. Ships and floating platforms experience continuous motion, vibration and changing orientation. Collision, allision, grounding, flooding and severe weather create accident sequences that could interact directly with nuclear safety systems.

The session will examine how these realities influence engineering decisions. Systems that rely on gravity, liquid levels or natural circulation must demonstrate acceptable performance under marine motion and flooding conditions. Shielding, containment, maintenance access and emergency response arrangements must fit within a marine platform rather than a fixed terrestrial site.

The session will also introduce the role of CONOPS, or Concept of Operations, within system development. CONOPS provides the bridge between business need and engineering architecture. It defines how the asset is expected to operate, what constraints apply and how operators, regulators and customers define success.

From there, developers can begin translating operational requirements into functional systems and ultimately into physical layouts and design solutions. Participants will hear how this process helps developers avoid treating reactor selection as a standalone technical exercise disconnected from real operational needs.

Looking ahead

By the end of Session #2, participants should have a stronger framework for evaluating maritime nuclear technology pathways and understanding the trade-offs that shape them.

The session does not aim to provide definitive answers about which reactor or fuel technology will dominate future maritime deployment.

The sector is still developing, with significant work still ahead around regulation, supply chains, licensing and commercial adoption. Instead, the objective is to help participants understand the logic behind different approaches and the constraints that influence them.

The broader CONVOY programme will continue building on these themes in later sessions. Future discussions will not only examine each of the two sub-sectors in more detail, but move further into licensing and regulation, and economics and insurance. Session #2 therefore serves as a technical foundation session. It introduces some of the operational language that underpins many of the strategic decisions the sector will face over the coming years.

Participants are encouraged to approach the session with a systems mindset. Reactor technology, fuel cycle, operations, regulation and commercial deployment are deeply interconnected. Understanding those connections will become increasingly important as maritime nuclear transitions from theoretical possibility toward practical implementation.