Summer project 2026

NNRC

Nuclear propulsion at scale:

Fuel + infrastructure for 600 ships (2035–2050 ramp), segments + 3+ ports, with AI as part of the methodology

This summer study will examine what it would take, at a system and infrastructure level, to deploy and operate approximately 600 nuclear-propelled merchant ships, and how such a fleet could realistically be scaled between 2035 and 2050. The focus is on fuel supply, supporting infrastructure, and deployment feasibility, rather than on detailed reactor or ship design.

The primary objective is to develop a transparent, macro-level model that quantifies the fuel requirements and infrastructure needs associated with large-scale nuclear propulsion in shipping. Fuel-related outputs will include estimates of fresh fuel throughput, enrichment effort (SWU), refueling, and spent-fuel outflows. Infrastructure-related outputs will include order-of-magnitude requirements for enrichment and fuel fabrication capacity, transport and security cadence, port-based service hub capacity (inspection, maintenance, refueling, and offloading), and the growth of interim storage needs over time.

The study will consider a limited number of representative ship segments, typically two to three. These may include large container vessels as a baseline case, bulk carriers or tankers with high annual energy demand, and optionally a niche segment such as ice-class vessels or high-power shuttle tankers for sensitivity analysis. Each segment will be characterized using parameter ranges for propulsion power, annual operating days, hotel loads, thermal-to-shaft efficiency, availability, and a simplified “core-life band” (short, medium, or long) used solely to estimate refueling and offloading frequencies. No detailed reactor or fuel design is included.

A small set of major ports will be treated as service hubs, typically three or more, representing different regions and trade corridors. Examples include Rotterdam (Europe), Singapore (Asia), and Houston or the U.S. Gulf Coast (Americas), with optional inclusion of hubs such as Busan/Geoje or Dubai/Jebel Ali. For each hub, the study will define tentative fleet share, service capability level, throughput limits, and qualitative regulatory and security constraints, translated into capacity proxies suitable for macro-level modelling.

The deployment of the fleet will be modelled through scale-up scenarios from 2035 to 2050, reaching approximately 600 ships in operation. Several ramp-up pathways may be explored, such as linear growth, S-curve adoption, or constrained growth limited by fuel-cycle or port-hub capacity. These scenarios will be used to identify peak-year demands and potential bottlenecks.

An important part of the methodology is the use of AI-assisted analysis. A deterministic macro model will first be developed to link fleet size, ship characteristics, fuel demand, and infrastructure requirements. Based on this model, large numbers of scenarios will be generated by varying key assumptions. AI-based surrogate models and sensitivity analyses will then be used to accelerate scenario exploration, identify dominant drivers, and highlight bottlenecks in fuel supply or infrastructure, while maintaining full traceability of assumptions and results

Practical information:

Supervisors: Sunniva Siem, Ole Reistad, William Olsen

Student background: Physics and informatics. Understanding and interest in physics and programming is important. (2 students)

Preferred project period: Six-week duration beginning at any time between April 1st and September 15th, 2026

Expected deliverables: A report summarizing key results of simulations, and feasibility of for construction in due time (2035)