



BY MARIJAN JOZIC,
MANAGING DIRECTOR, JOZIC ENGINEERING

NUCLEAR-POWERED SHIPPING: SMRs COULD TRANSFORM THE MARITIME INDUSTRY

I came across a report describing a large marine diesel engine engineered with such a high level of optimization that it achieves significantly lower fuel consumption while delivering approximately 35% more power output. From an engineering standpoint, this represents a major step forward in thermodynamic efficiency and combustion control. However, the broader response often remains underwhelming: incremental improvements, no matter how advanced, are no longer seen as sufficient. A similar pattern can be observed with innovations such as wind-assisted propulsion systems, including advanced sail concepts capable of reducing fuel consumption by up to 20%. While technically sound, these solutions are still perceived by some stakeholders, particularly environmental groups, as insufficiently transformative.

The maritime sector requires a step change rather than incremental optimization. A fundamentally new propulsion paradigm is needed to drastically reduce or eliminate greenhouse gas emissions. In exploring potential solutions, I encountered a development program in which multiple industrial and research partners are collaborating on small modular reactors (SMRs), specifically Generation IV nuclear reactor concepts, for marine propulsion.

Regulatory pressure is increasing. The International Maritime Organization (IMO) of the United Nations has tightened its decarbonization targets. The maritime sector currently accounts for about 3% of global CO₂ emissions, driven by the widespread use of heavy fuel oil and other fossil fuels. Nuclear energy offers an alternative due to its extremely high energy density, near-zero operational emissions and ability to provide continuous baseload power. In addition to onboard propulsion, modular nuclear units could be deployed at strategic port locations to supply shore power, thereby reducing emissions from vessels at berth.

The Dutch offshore engineering company Allseas has announced a strategic initiative to deploy nuclear propulsion across its fleet. Allseas specializes in offshore pipeline installation for oil and gas transport. It is the first major maritime contractor to publicly commit to nuclear energy as a primary decarbonization pathway, explicitly favoring it over alternatives such as hydrogen, methanol,

or ammonia. At present, most large ocean-going vessels rely on residual fuels, which are among the most carbon-intensive and polluting energy sources in widespread use.

According to the company's five-year strategic plan, published in 2025, the first vessels equipped with SMRs could become operational within five years. Allseas aims to achieve full operational carbon neutrality by 2050. Projections indicate that by that time, up to 700 SMR units with an electrical output of approximately 25 MW each could be deployed, potentially reducing CO₂ emissions by as much as 55 megatons annually. The initiative is being developed in collaboration with Dutch research institutions, including TNO, TU Delft, NRG PALLAS, and the Royal Association of Netherlands Shipowners (KNVR).

From a technical perspective, the proposed SMR design is based on high-temperature gas-cooled reactor (HTGR) technology. Reactor safety is inherently enhanced through the use of TRI-structural ISOTropic (TRISO) fuel particles. Each TRISO particle consists of a uranium dioxide (UO₂) kernel encapsulated in multiple concentric layers of pyrolytic carbon and silicon carbide, forming a robust containment system capable of retaining fission products even under extreme conditions. These particles, typically about one millimeter in diameter, are embedded in a graphite matrix to form spherical fuel elements, commonly referred to as "pebbles", about the size of a tennis ball.


In a pebble-bed reactor configuration, thousands of these fuel spheres are continuously or semi-continuously loaded into a cylindrical reactor core. The reactor operates with a helium gas coolant, which is chemically inert and does not become radioactive under neutron irradiation. The helium is circulated through the core, where it is heated to high temperatures (in the range of 700–900°C). The thermal energy is then transferred via a heat exchanger to a secondary water/steam cycle, producing steam that drives a turbine-generator set. The expected electrical output of a single module is on the order of 25 MW. A key advantage of this approach is modularity. Reactor units can be factory-fabricated, transported and installed either on board vessels or at fixed onshore locations, reducing construction complexity and improving quality control.

Initial deployment is expected to occur in land-based installations, allowing regulatory frameworks and operational experience to mature before offshore implementation. Subsequent integration into Allseas' fleet and potentially the wider maritime industry would follow. This phased approach aligns with the company's sustainability targets, a 30% reduction in emissions by 2030 and full carbon neutrality by 2050, as stated by Stephanie Heerema, project manager for nuclear developments at Allseas.

Although nuclear propulsion in maritime applications is often perceived as novel, it has historical precedents. The first nuclear-powered submarine, USS Nautilus, was launched in 1954, demonstrating the feasibility of compact naval reactors. In the civilian domain, the NS Savannah, launched in 1959 under the U.S. "Atoms for Peace" program, was the first nuclear-powered merchant vessel. It utilized a pressurized water reactor (PWR) with a thermal power of approximately 74 MW, translating to around 20 MW of shaft power. While technically successful and exceptionally clean in operation, Savannah was not economically competitive due to high capital costs, complex regulatory requirements, and limited cargo capacity resulting from reactor shielding and safety systems.

Similarly, the Soviet Union developed the nuclear-powered icebreaker Lenin, commissioned in 1959. Unlike Savannah, Lenin proved operationally viable in the harsh Arctic environment, where its ability to operate for extended periods without refueling provided a decisive advantage. It was initially equipped with three OK-150 reactors, later replaced by two more advanced OK-900 units. The vessel demonstrated the strategic and operational benefits of nuclear propulsion, in remote regions where fuel logistics are challenging.

However, both relied on early-generation reactor technologies with low fuel efficiency, higher operational complexity and less advanced safety systems. Generation IV SMRs incorporate passive safety features, improved fuel integrity and simplified system architectures, making them more suitable for commercial deployment.

As a result, shipping companies are increasingly evaluating nuclear propulsion as a long-term solution for deep-sea shipping decarbonization. 



JOIN OUR LINKEDIN GROUP PAGE AT [LINKEDIN.COM/COMPANY/TSIMAG](https://www.linkedin.com/company/tsi-mag)



24,900
 READERS ACROSS OUR PRINT AND DIGITAL MAGAZINE FROM **151** COUNTRIES WORLDWIDE

PTEASIA
 PASSENGER TERMINAL EXPO
 September 23-24, 2026,
 Sands Expo & Convention Centre, Singapore
 See us at PTE Asia 2026!

PT World magazine will be distributed at every entrance and throughout PTE Asia 2026

- ### Sample Subscribers
- Airport Security and Access Control Head **Los Angeles International Airport** United States
 - Airport Security and Passenger Facilitation Director **Singapore Changi Airport** Singapore
 - senior International Border Security Liaison Officer **Sydney Kingsford Smith Airport** Australia
 - Senior Immigration Officer **Hong Kong International Airport** Hong Kong
 - Senior Immigration Policy Advisor **Narita International Airport** Japan
 - Senior Cargo Security Coordinator **Heathrow Airport** United Kingdom
 - Head of Passenger and Cargo Screening **Charles de Gaulle Airport** France
 - Head of Passenger and Cargo Security **Singapore Changi Airport** Singapore
 - Director of Security and Emergency Management **Frankfurt Airport** Germany
 - Director of Security Operations **Munich Airport** Germany

IN THE Q3 SEPTEMBER ISSUE...

- Special feature on Biometric Border Control
- Special feature on Port Cyber security and the Supply Chain
- Special feature on CBT training

ADVERTISING DEADLINE: 11th September 2026
 PUBLISHING DATE: 18th September 2026

TO BE INVOLVED, CONTACT OUR SALES TEAM
 Daniel Goodwin, sales director
 Email: dgoodwin@tsi-mag.com
 Website: tsi-mag.com/advertise/enquiry-form/

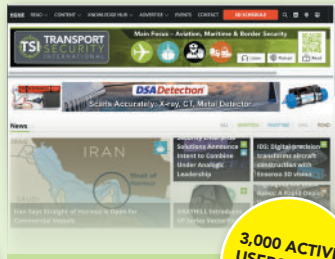
MORE THAN JUST A MAGAZINE
 YOU CAN REACH THE READERS OF TRANSPORT SECURITY INTERNATIONAL THROUGH SEVERAL CHANNELS AND PLATFORMS



WEEKLY NEWSLETTER

Sent every Monday, the TSI weekly newsletter contains the latest industry news.

SENT TO OVER 18,000 SUBSCRIBERS



DEDICATED WEBSITE

Helping you reach over 3,000 active users every month.

3,000 ACTIVE USERS EVERY MONTH

SCREENING CARGO AT PORTS AND BORDERS IS SMART. SCREENING CARGO ANYWHERE IS SMARTER.

leidos

New Rail Security Screening System

leidos is proud to support border security across the globe with our advanced screening technologies. Our X-ray, metal and Personnel (PTM) are now deployed at the 1 Janco Rail Port of entry in Janco. This scanning 100 percent of all trains passing through the port.

[READ PRESS RELEASE](#)

Advanced X-ray Solutions

Chemicals and insider threats are constantly evolving ways to conceal contraband, weapons, narcotics and other threats. To ensure that users can act quickly and effectively to detect and mitigate threats, leidos solutions deliver innovative screening technologies, including X-ray, common interface and AEM.

[READ ARTICLE](#)

FEATURED PRODUCTS

E-SHOTS

A dedicated branded email sent on your behalf to our database of over 18,000 highly engaged security professionals. The perfect platform to make your brand or product stand out and drive results.

DSA Detection

Scan Accurately. X-ray, CT, Metal Detector.

Border Security Revolution

No More Guessing. How to Detect Hidden Threats with X-ray Diffraction.

What if hidden drugs, explosives and other illicit materials could be detected even when they are carefully concealed within legitimate goods? Standard X-ray imaging shows only the shape and density of objects. X-ray diffraction (XRD) technology is changing the way border professionals can see things. XRD technology is now being used in an innovative way to detect contraband at border checkpoints and ports, offering a powerful enhancement to traditional scanning methods.

The technology is highly effective because it can distinguish between materials that appear similar on regular X-ray scans, reducing false positives and increasing detection rates. Its non-invasive nature also allows for rapid screening of cargo and luggage without the need for manual inspections, making it both efficient and valuable for border security operations. Join us in this webinar to learn more about XRD, how it works and how it can help identify specific substances with high precision.

Joachim Peiry

Joachim leads the diffraction centre of excellence with customer facing functions. In the last 30 years he experienced the journey from diffraction prototype to a commercial product and is keen to bring the technology in the field, making the world a safer place.

WEBINARS

Partnering on a webinar with Transport Security International magazine provides:

- Wide-ranging brand exposure
- In-depth thought leadership
- High-volume lead generation

Subscribe at tsi-mag.com/subscribe



Secure Terminals at Super Terminal Expo

Connect with 6,000+ aviation decision-makers at Super Terminal Expo 2026. Bring your brand to the event where safety and security concepts turn from aspiration into active terminal operations.

SUPER TERMINAL EXPO
3 - 5 Nov 2026
AsiaWorld-Expo | Hong Kong

WHY SUPER TERMINAL EXPO?

01 Co-Exhibit with Industry Leaders

Stand with industry giants - anchor your brand alongside leading partners like **Nuctech** and **Guangtai** to protect tomorrow's passengers, cargo, and infrastructure.



02 Exclusive Hong Kong International Airport Security Tour

Network with elite airport delegations on a restricted-access tour highlighting Patrol Cars and Smart Security Screening Systems in action.

03 Dedicated Safety & Security Forum

Showcase your solutions directly to regulators, airport operators, and key decision-makers driving terminal standards.

LET'S BUILD YOUR 2026 SUCCESS TOGETHER

Enjoy a **10% early-bird discount** — book before **30 June 2026**

Scan the QR code for more information about exhibiting.

CONTACT US

INTERNATIONAL SALES

Cero Deng
E: Cero.Deng@informa.com

CHINA SALES

Renee Wu
M: +86 185 2084 1017
E: renee.wu@informa.com

Organiser:



Principal Partner:



Strategic Partner:

