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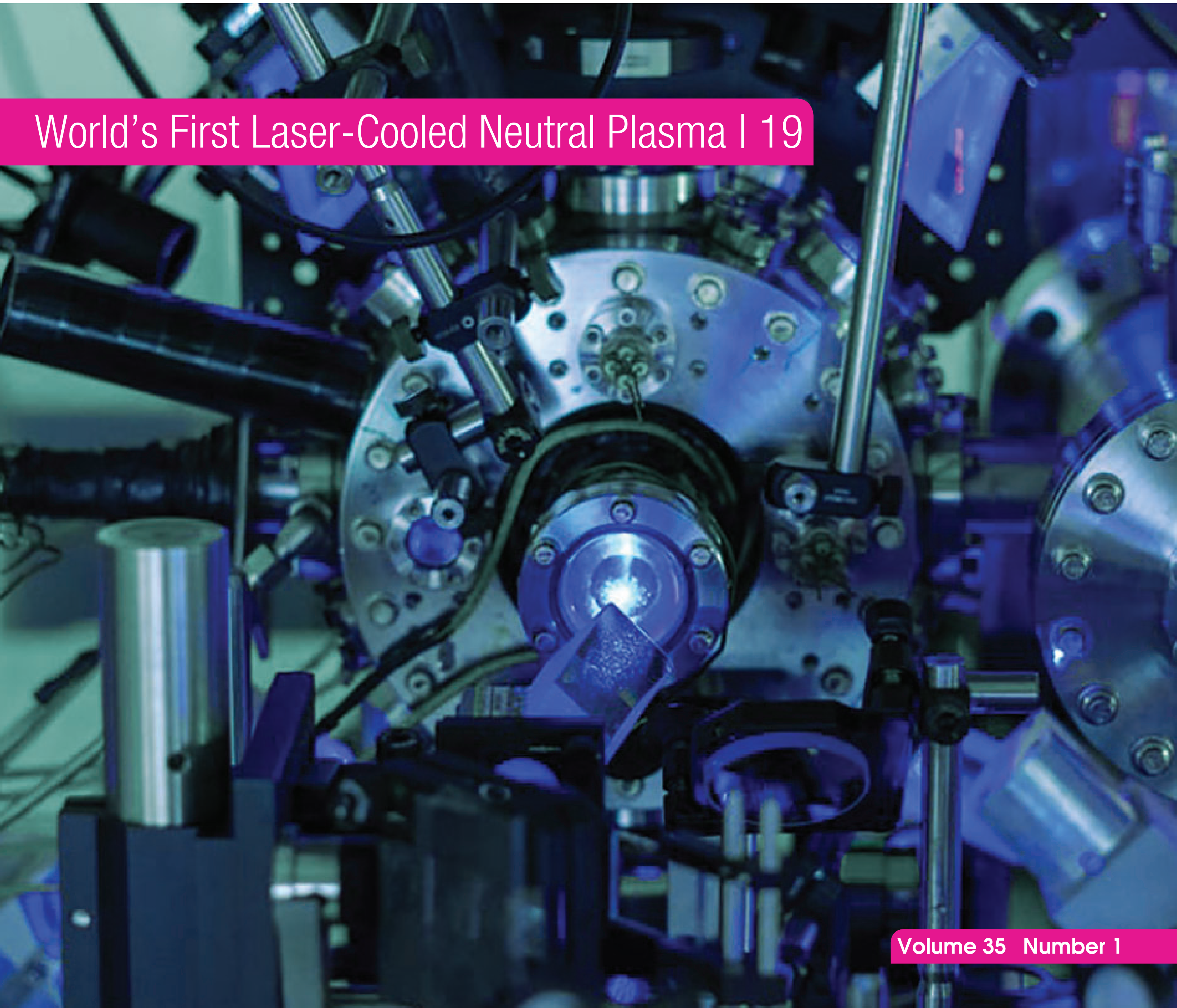

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GTT's Membrane Technologies Provide Solution For LNG-Fueled Ships

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LNG shipping began in the 1960s with the launch of PYTHAGORE, a vessel featuring the integrated GTT Tank Mark I membrane. This initial GTT version was followed a few years later, when the METHANE POLAR (POLAR ALASKA, 1969) included the first form of the integrated GTT Tank NO-82 membrane.

GTT products focused on membrane technology were thus commercialized and in service, with subsequent decades providing advances within the thermal and mechanical performance of both technologies. Such developments better fit with the behavior of LNG carriers while the LNG shipping industry raced to improve economies of scale: vessel capacity increased fivefold in 10 years and tenfold in 40 years!

Panel inspection of GTT's Mark III membrane containment system. *Image: GTT/Roland Mouron*

This tremendous growth in capacity also brought major challenges to tank technologies, prompting engineers to innovate by reducing both construction costs and the boiloff rate (reduced tenfold from 0.7% to 0.07% of the volume per day) while increasing the tank fatigue resistance in rough seas of vessels of up to 266,000 m^3—very challenging, since LNG is under low pressure and at -163°C, -261.4°F.

In recent years, global warming has also generated new challenges. The International Maritime Organization implemented stringent regulations to limit the emission of harmful effluents by the shipping industry (SOx, NOx and CO_2). LNG emerged as the fuel of choice, enabling compliance with these regulations. As a natural consequence, GTT proposed adapting its well-known technologies to the overall maritime industry.

However, the functional specifications for the tanks of an LNG carrier (LNGC) are very different from those of a container ship. GTT overcame these challenges while adapting its technology:

- Whereas LNGCs carried LNG as a cargo, container vessels carry it as a fuel. In this case, boiloff rates don't need to be minimized but rather precisely tailored to suit specific vessel requirements.

- LNG carriers operate either full or empty in ballast conditions while the LNG fuel tanks within container ships are always partially loaded, significantly increasing the potential for sloshing loads.

- LNG carriers are designed around the LNG cargo tanks as the main part of the ship, while the LNG fuel tank of a container vessel is designed to fit the hull with minimum impact on the cargo space.

In 2017, for example, the CMA CGM company ordered production of nine ultralarge container vessels of 22,000 TEU, leading to GTT's design of an 18,600 m^3 LNG fuel tank that will be 52 m in width and can function at any filling level. In order to sustain these significant local sloshing loads, the technology carefully distributes high- and low-density polyurethane foam using 210 kg/m^3 that was specifically developed for these applications, while 130kg/m^3 is usually used in LNGCs. GTT's Mark III technology is fitted with 270 mm of insulation, to withstand cryogenic conditions, releasing about 400 kg/h of natural gas to match the power demand of a vessel propelled by a WinGD X92DF two-stroke engine with an output of 63,840 kW at 80 rpm. GTT also designed the tank to fit the hull just below the accommodation block, therein limiting the impact on the cargo area.

This adaptation of GTT membrane technology in a merchant vessel is groundbreaking within the shipping industry, not only showcasing LNG as a marine fuel used on large scale onboard ultralarge container vessels but also heralding a new era that's advancing very low emissions.**www.gtt.fr/en** ■