

Passenger Ship technology

Cruise ship industry shows steady European growth

European ferry owners need to engage with sanitation project

Low sulphur rules pose challenges for owners





Lorient Agglomération's 22m electric ferry Ar Vag Tredan is a world first

Commuter craft prototype creates no emissions

The supercapacitor power of new 22m catamaran, *Ar Vag Tredan*, is a world first for one French agglomeration and yard group STX Europe

WHEN the Lorient Agglomération in France was granted full operational control of the city's public transport system in 2008, one of its highest priorities was to modernise its ferry fleet. Its elected representatives specified that any new ferries must have zero emissions, so its transportation department set about finding a solution to this brief.

Following a tendering process involving 16 international yards, Lorient Agglomération chose the local Lorient branch of STX Europe to build a 22m catamaran powered by electrical supercapacitors – a world first. “We chose STX because it was the only proposal which met our specifications; we did not choose it because it is a local yard – that was just an added bonus,” commented Lorient Agglomération's transport director, André Douineau. “When we did a technical analysis considering the high workload of 28 return trips a day and the through life costs, it was clear that STX's proposal was the best.

“Even though the initial price of the ship was more expensive than some of the other proposals, these ones were relying on hybrid diesel or hydrogen power. Over the 30 years we want this ship to operate, fuel costs are likely to be much higher than electricity. Therefore this ferry is more economical.”

Mr Douineau praised the working relationship with the yard. “We have had great co-operation with STX. They worked with us to perfectly adapt the ship to our needs. They even consulted the crew and asked them for feedback on the design and equipment,” he added. “This is such a technologically advanced ship with no smoke and no vibration, so it is more comfortable for passengers too.”

STX developed the design with fellow French company, Stirling Design International. The yard group originally conceived the idea of using supercapacitors to power a vessel through its Ecorizon research and development programme, which aims to reduce the environmental impact of ships.

“Supercapacitors are a very safe and clean way to store power,” said Mathieu Lelievre, project manager at STX Lorient. “They discharge electricity on board that they receive from the shore grid.” A total of 128 supercapacitors have been installed on this new ferry, *Ar Vag Tredan* (the name means ‘the electrical

ship’ in the Breton language). Aluminium cathodes with nanometric pores store the electricity densely – a surface area of 3,000m² is contained within each gram of material.

The vessel will ply a 10-minute route between Lorient and Locmiquélic on the Blavet River in Brittany. The supercapacitors can only store enough charge for one trip and so have to recharge using a transformer at the terminal following every return trip. The two-pin industrial plug is at the “limit of human handling” according to Mr Lelievre. “We have also provided some mechanical assistance with a crane. For bigger ships we would develop a different system without plugs, either with contacts or ignition.”

The recharging process only takes four minutes, which allows the ferry to keep to its schedule of a sailing every quarter of an hour. It is particularly crucial for the vessel to be on time as water transport is integrated with the city's bus timetable. Buses arrive at and leave each terminal just after the vessel is due to dock. Lorient's six ferries are very busy – in 2011 they transported 770,000 passengers overall and more than 400,000 people on the Lorient to Locmiquélic route alone.

Mr Douineau commented, “It's important for us to have a quality service but we have a clause in the build contract to accept up to 14 days out of service, as this is a prototype

AR VAG TREDAN

Operator	Lorient Agglomération
Builder	STX Lorient
Designer	STX Lorient/Stirling Design International
Length	22.1m
Breadth	7.2m
Draught	1.5m
Propulsive power	2 x 75kW
Service speed	10 knots
Passengers	113 people including 3 people with reduced mobility and 10 bicycles
Classification	Bureau Veritas

ferry profile *Ar Vag Tredan*

design. If the ferry is offhire for longer than that, STX has to pay for each day it is unavailable."

STX Lorient's vice president of sales and marketing, Frédéric Deyrieux, believes the technology is reliable. "Supercapacitors are a proven solution within other types of transport such as trams and the technology has a recharge and discharge efficiency of about 98.5 per cent. As well as no gas emissions, there are no chemicals used, therefore maintenance is reduced. Each supercapacitor can last for up to 15 years, even with heavy usage.

"As the vessel only takes on enough power for one trip, this makes it lighter, so you require less power in the first place. Supercapacitors are an ideal solution for high frequency short ferry journeys."

Power to the onboard air conditioning will also be provided by the supercapacitors, through a heat pump. The heat pump has a coefficient performance factor of six, ie, using 1kW of electricity produces 6kW of heating or cooling.

The 400V recharging connection is on the bow of the ship. "We requested that the electrical connection was separated from where the passengers board," said Mr Douineau. Passengers embark using a folding ramp on the port side. "There probably would not have been a problem with situating the plug near the passenger areas, but we would rather be safe than sorry."

In case the supercapacitors fail, two 100 kVA Cummins Onan gensets are installed as back-up power. "If the electrical grid is not available then the ship can still be operated with two independent shaftlines," commented Mr Lelievre.

The vessel is propelled by two Masson Marine azimuth

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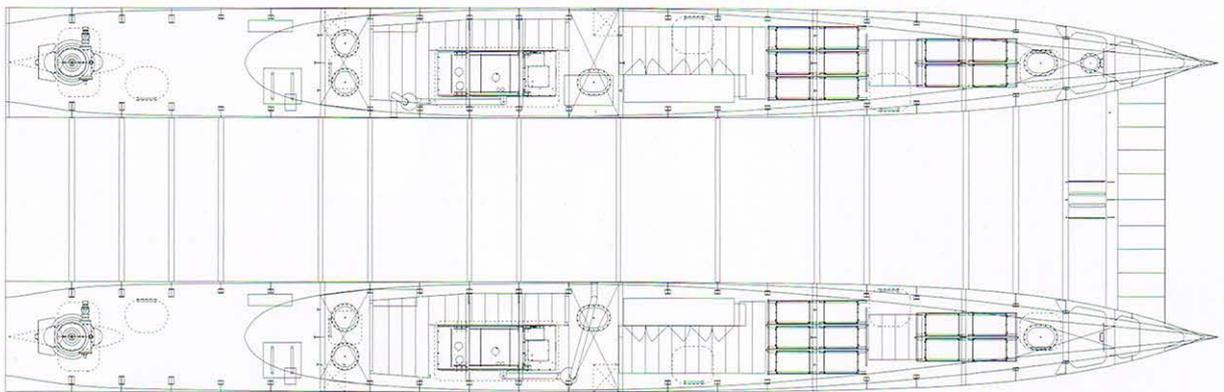
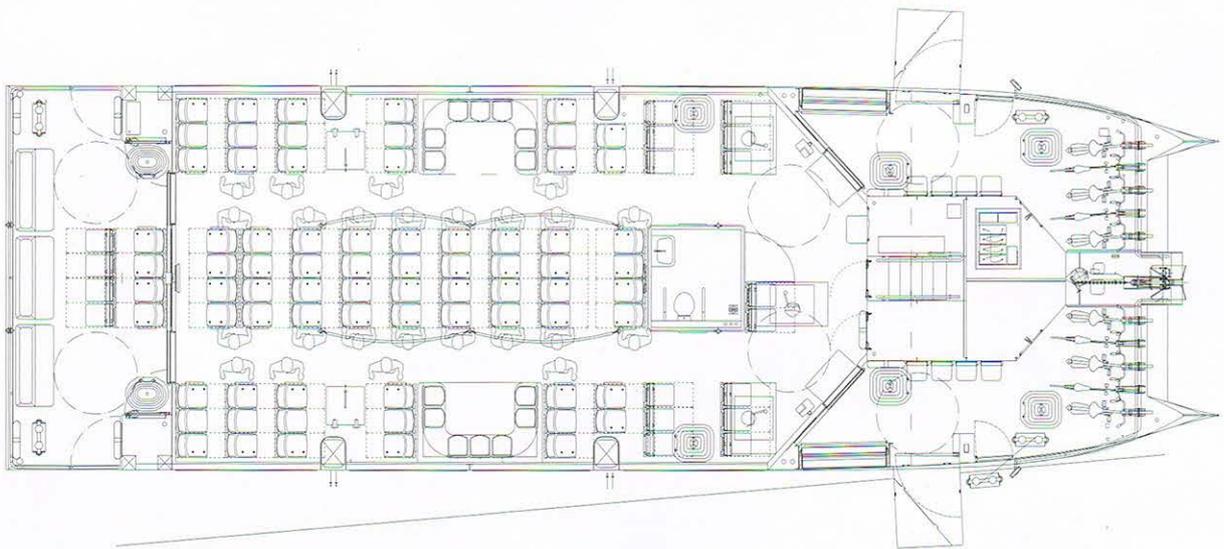
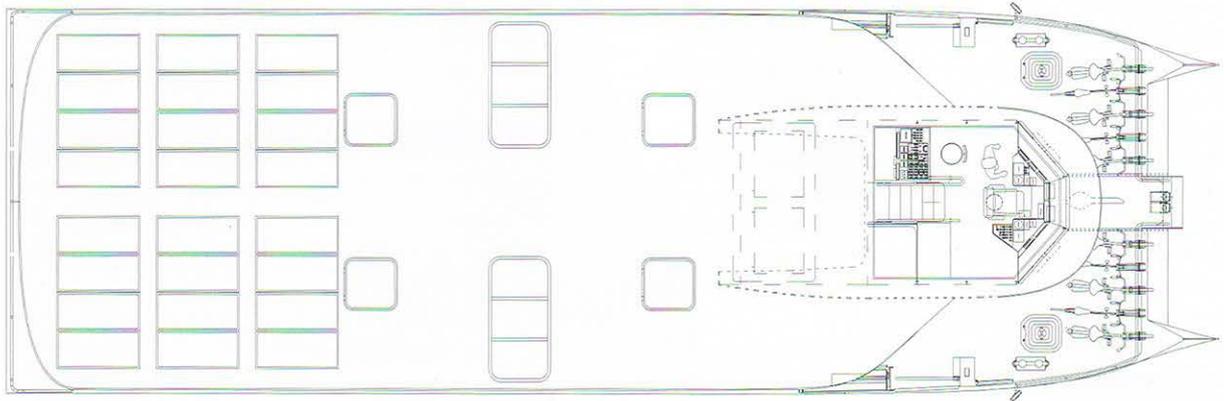
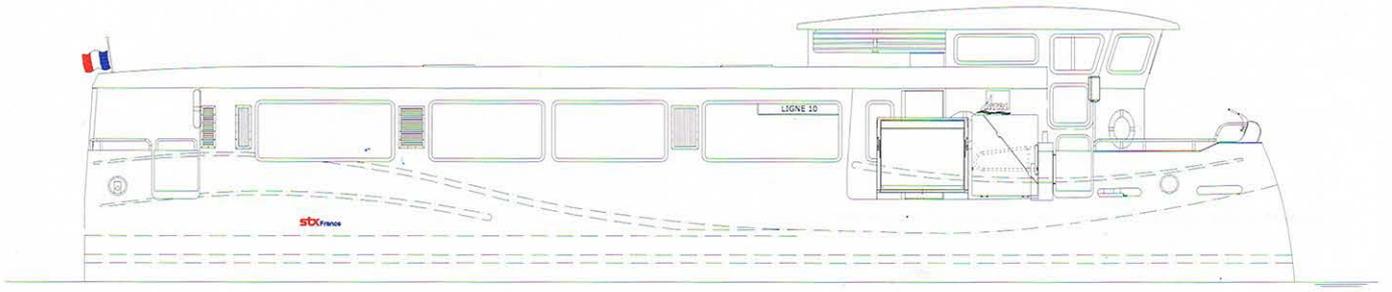
thrusters. This propeller pump propulsion utilises water flow driven by a nozzle with fixed blades. They can turn 360 degrees on either side of the ship and reverse the thrust, enabling good manoeuvrability in the narrow river passage. This is also why *Ar Vag Tredan* could be no longer than 22m, as otherwise it would not be able to turn.

Twenty-four solar panels on top of the ship can deliver a maximum of 130W each, in total around 5 per cent of the vessel's power. This will feed the low-voltage equipment on board such as the navigation equipment. Lorient Agglomération specified two radars instead of the usual one, and these were supplied by Furuno.

The vessel also meets French division 190 regulations for



The freshly painted vessel was ready for sea trials in August



ferry profile *Ar Vag Tredan*

disabled and reduced mobility passengers. The boarding ramp can adapt to the angle of the quay using its three hinged sections to enable wheelchairs or children's buggies to pass over it.

Aluminium was selected for the hull due to its light weight. "We made the lightest structure possible depending on the rules we had to build to and the use of the ship," said Mr Lelievre. "We also selected only light components for insulation and piping material – in fact every time we had to choose equipment, we considered the weight as an important characteristic." For instance, all the onboard pumps are constructed from copper and nickel.

The whole design of the ship was realised using computer-aided design/computer-aided manufacturing (CAD/CAM) software. Model tank tests of the hull's hydrodynamics were performed at the HSVA towing tank in Germany. "The hull has a low resistance and we worked on supplying the thrusters with good vanes," said Mr Lelievre. "In order to have good efficiency for the thrusters we had to remove volume in the aft and forward [areas]. The supercapacitor installation brought the centre of gravity forward, as each module is quite heavy."

Both hull compartments have reasonable volume at 3m high and 2m wide. As the draught is 1.5m, each compartment is actually half below the waterline. "This means the vessel is not too sensitive to the wind, in comparison to monohulls," Mr Lelievre commented. The hull has been coated with International Paint silicone antifouling.

Safety equipment specified includes two 100-person liferafts and fire extinguishers. Also installed is 3M's Novec fire protection fluid in the fire suppression system. This fluoroketone

works as a gas but is liquid at room temperature. It has zero ozone depletion potential and can dissipate in five days.

Just two crew members will be employed on board the ship. On deck, forward, there are 10 bicycle racks. Ninety-eight passenger seats are provided in the passenger lounge.

Upon delivery in September, *Ar Vag Tredan* will replace *Sainte Catherine*, which was built back in 1962. Another of the old ferries, *Curseau*, will be taken out of service as it does not have two independent shaftlines, as required in IMO regulations, but will remain available in case of emergencies. Therefore the new vessel will run alongside four elderly ferries.

There is an option in the contract for another vessel, but Mr Douineau commented, "It depends on the performance of this one. A sistership would be slightly different from this design though, as it will incorporate all the modifications we recommend resulting from the experience of operating *Ar Vag Tredan*. A decision will not be made for a few years at least." **PST**

EQUIPMENT/OUTFIT

Supercapacitor supplier	Batscap
Gensets	Cummins Onan, 2 x 100 KVA
Rudders/azimuth thrusters	Masson Marine
Antifouling	International Paint
Liferafts	Survitec Zodiac, 2 x 100 people
Sanitary installations	STX
Navigation equipment	Furuno



Volume was removed from the aft of the hulls to balance out the weight of the supercapacitors