Energy Efficiency

Reference: Marine

1. VerticalNavigation :

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Solar Sailor - Hong Kong Jockey Club (HKJC) ferries (Australia)

World first hybrid passenger ferries achieve 50% fuel and CO2 savings

12 month scheduled maintenance agreement>1,280 tonnes per year of CO2 emmissions saved; zero emissions at wharf when in electric mode>8-17% fuel savings
Fuel savings approx HK$2.5 million per year
Replace ageing fleet; 12 month schedule maintenance contract; redundant propulsion system
Redundant propulsion system to assist boats comply with naval High Speed Code

I. CUSTOMER ENVIRONMENT / PROJECT CONTEXT

Customer profile:

Solar Sailor is an Australian technology company that supplies its patented 'solarsail' technology to harness a combination of renewable solar and wind energy in a hybrid marine power (HMP) system. Providing redundancy in propulsion, fuel efficiency, passenger comfort and zero emission/ stealth mode, Solar Sailor's technology can be utilised in a wide variety of marine applications; from small unmanned vessels to large tankers, ferries, tourist cruisers and private yachts.

One such application is the Hong Kong Jockey Club's Kau Sai Chau public golf course (KSC) ferry link; a high duty service providing 40 runs per ferry per day. With four ferries available, at least 2 ferries will be operating at any one time. Having a 20 minute turnaround time, each 6 kilometre trip features varying speed zones, challenging weather conditions and frequent berthing and manoeuvring. Ferries have a capacity of 100 passengers and 60 golf bags.

Customer objective and constraints:

Faced with increasing costs due to rising crude oil prices and an ageing fleet of boats, the Hong Kong Jockey Club (HKJC) approached Solar Sailor to determine whether HMP catamarans would provide a viable economic alternative to traditional diesel powered ferry boats. HKJC's ambition for sustainability and environmental leadership meant the organisation was keen to find an energy and cost efficient solution for its KSC ferry service. The new ferries needed to reduce fuel consumption and carbon dioxide emissions whilst helping to keep the city's air and water cleaner, all without hampering passenger comfort. Although the green credentials of the ferry solution were important to HKJC, it was also imperative that the solution delivered lower operating costs and improved reliability. In a world first, Solar Sailor was commissioned to supply four state-of-theart parallel hybrid marine power (HMP) catamarans to HKJC over a period of 2 years; with the first boat delivered in 18 months.

The first three boats utilise the solar sail HMP technology in a standard catamaran design; whilst the fourth boat also incorporates an advanced, patented 'Solarsail' to take advantage of the strong winds along the ferry route. With state-of-the-art solar sail technology on each of the ferries and special low-wash hulls, Solar Sailor required automation that would be able to control the HMP system, with an easy to use interface for the ferry pilots.

To achieve HKJC's goals, Solar Sailor decided to design the ferries in Sydney and then build the catamarans in China with extensive testing in Hong Kong. With a very tight delivery schedule, Solar Sailor required a global partner who could provide local engineering support for electrical distribution and automation in all three locations.

II. SOLUTION IMPLEMENTATION

Implementation methodology (main phases):

Schneider Electric was selected by Solar Sailor to supply and engineer the automation control and electrical distribution system for the HKJC project. As the global energy management specialist with over 35 years experience in industrial process control in Australia, Schneider Electric had both the experience and project delivery teams necessary to successfully deliver the electrical distribution and automation systems and the subsequent local support required for the Solar Sailor ferries.

As part of the first parallel hybrid ferry service in the world, each catamaran has two 190/25kW Solar Sailor HMP systems; consisting of two 250 horsepower diesel engines (giving a service speed of 16 knots fully loaded), plus two 25kW (33.5 hp) electric motors for speeds of 6 knots or less while manoeuvring and berthing. The ferries also have 7.5kW of solar panels on the roof and a 32kW generator.

Working in close partnership with Solar Sailor, the control and electrical distribution system was engineered, project managed and installed by Schneider Electric's Professional Services team working in Sydney, Hong Kong and China. Schneider Electric's global presence

minimised some of the challenges usually experienced in a multinational project.

"*Originally we were going to install all of the power and control systems ourselves. However once we got started I realised it would be easier if we got Schneider to do it*" says Solar Sailor CEO Dr Robert Dane "*they have the experience and the quality of people both in Sydney and Hong Kong, plus they can provide a global warranty. It made sense for us to get them involved as we had already worked successfully with Schneider*."

In order to achieve optimal performance of all four boats, the first boat was built and performance tested. This allowed improvements to be made to the design of the other three boats, prior to their production, thereby saving time and money. One such improvement was an enhanced electrical design that considerably reduced the amount of wiring required.

Duration:

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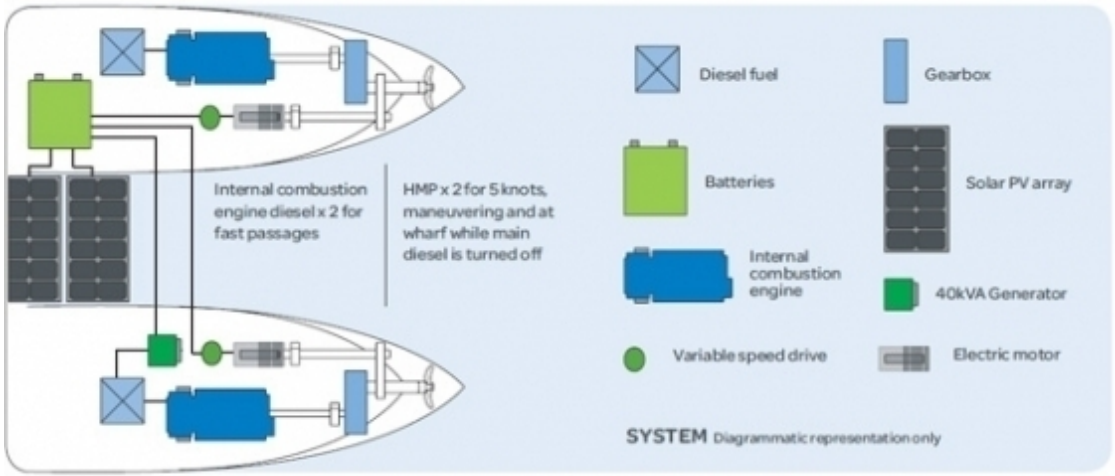
Solution overview (services, products, systems, architectures...):



The ferries' control system utilises various products, including Magelis HMI, Altivar drives and Modicon M340 PLCs configured to Schneider Electric's proven PlantStruxure architectures. Schneider Electric also supplied the electrical distribution system including power meters, circuit breakers and transformers in non-corrosive polycarbonate cabinets to minimise weight.

Even though top speed is only 16 knots, due to the boats' high power to weight ratio, the ferries must also comply with the strict safety rules of the naval High Speed Code. One of the safety features of the HKJC ferry design is complete redundancy of the propulsion system. The solution engineered by Schneider Electric ensures that there is an instantaneous alternative should one of the propeller drive systems fail, or need to be taken offline for any reason. For example, should the diesel engines fail then the electric motors could still operate and manoeveur and power the boat back to the wharf.

The automation system is designed to optimise energy usage. The system controls the airfoil wings automatically while Schneider Electric's best-in-class Altivar 71 variable speed drives (VSDs) are utilised to maximise efficiencies during motor start-up and manoeuvring. This ensures the ferries benefit from the improved acceleration, superior emergency stopping and easier handling of modern high-torque direct-

drive motors.

To further improve energy efficiencies, the Altivar 71 drives have been specially commissioned by Schneider Electric to charge the batteries for the electric propulsion system whenever the diesel engine is in operation.

The patented solar wing technology employed on boat four will utilise both solar and wind energy, and depending on weather conditions, these two sources can be used together or independently. The wings track the sun for optimal solar collection and the wind for optimal wind power. This is controlled manually or via the Magelis HMI. The technology is self-optimising to accommodate various loads and frequent stopping, which means that Solar Sailor HMP system can maximise fuel savings.

Schneider Electric's solution also included installation supervision and technical assistance during HMP system tests in Hong Kong, training of operation and maintenance personnel and detailed operation and maintenance manuals. The solution also includes a 12-month planned maintenance schedule, warranty and on-site support by Schneider Electric in Hong Kong to ensure optimal performance and maximum operational time.

How did we estimate the energy savings (methodology, tools, ...)

Independent trials of the first vessel were undertaken to benchmark the HMP system against conventional diesel engines. During the 9 day trial, conducted in foggy conditions and light winds, the boat was tested by measuring fuel usage via flow meters. The boat was run conventionally with the HMP system turned off and then the tests repeated with the HMP system in operation i.e. electric motors used for low speeds and docking. The trials demonstrated an 8% saving on the route where the boat runs at maximum speed. On the second route where the boat is restricted to slower speeds, as it passes a fish farm, the savings were estimated at 17%.

Says Robert Dane "*The initial fuel savings were significant and will improve with skipper familiarisation. The fourth boat will have our patented Solarsails, so the results should be even better as the route has good reliable wind patterns*."

Figure 1: Solar Sailor's patented 'solarsail' technology harnesses renewable solar and wind energies to create energy efficient ferries

Figure 2: Easy to use interface on the Magelis HMI allows the ferry pilot real-time access to the propulsion system

III. RESULTS / ACHIEVEMENT

Customer benefits:

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The HKJC say these new boats are delivering 50% fuel savings compared to the existing diesel ferries. The ferries will also save 1,280 tonnes of CO2 per year. In comparison to the previous conventional boats, the reduced fuel consumption represents fuel savings of about HK$2.5 million per year.

HKJC also receives the peace of mind of a global Schneider Electric warranty and 12 months scheduled maintenance. Passenger comfort was also noticeably improved due to reduced noise levels, fewer vibrations, and marked reduction in diesel fumes.

Customer testimonies (Verbatim):

"*We estimate the solar ferry and solar golf carts at Kau Sai Chau will bring fuel savings of around 50% and reduce CO2 emissions by 1,280 tonnes per year compared to the old boats*" says Kau Sai Chau General Manager Cameron Halliday, "*we hope others follow our lead to make the world cleaner, greener and healthier for future generations to enjoy*".

"*The Hong Kong Jockey Club demonstrated their commitment to environmental leadership when they decided on commissioning the world's first fleet of parallel hybrid ferries for commercial use*" says Solar Sailor CEO Robert Dane, "*and the impressive fuel savings realised in the trials justifies their vision. We believe that with the additional features of boat four and the ongoing partnership with Schneider will ensure even greater savings in the future. The fuel savings and zero emission mode near the wharf has huge implications for urban ferries globally.*"

Schneider Electric is continuing its global partnership with Solar Sailor to design, build and commission hi-tech energy efficient vessels. "*Now that Hong Kong Jockey Club has proven this technology is viable, not only environmentally but economically, we have been receiving many requests to build new boats, yachts, tourism vessels and urban ferries in other parts of the world. With the global presence and support of Schneider Electric, we are sure that we will be able to continue our success in providing hi-tech hybrid vessels for commercial applications*" says Robert Dane. "*Customers will benefit from Solar Sailor's patented technology and IP, installed, engineered and maintained by the 'guys down the road' at Schneider.*"

Schneider Electric differentiating values VS competitors:

Solar Sailor needed a development partner who could provide engineering and project management experience to deliver the ferries' control system. Schneider Electric was selected by Solar Sailor, to supply and engineer the automation control and electrical distribution system for the HKJC project, because of their local expertise and global network of qualified engineers and maintenance technicians.

As the global energy management specialist with over 35 years experience in industrial process control in Australia, Schneider Electric had both the experience and project delivery teams necessary to successfully deliver the electrical distribution and automation systems and the subsequent local support required for the Solar Sailor ferries.

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IV. ADDITIONAL INFORMATION

Other information

About Hybrid Marine Power (HMP)

Solar Sailor's award winning hybrid marine power (HMP) system combines the efficiency of electrical drive systems with the power of conventional diesel drives. As with hybrid cars, the system is controlled and optimised by computers.

The HMP system utilises complex algorithms to ensure optimal performance. For example to achieve optimum efficiency when sailing at high speed, the hybrid runs the internal combustion engine. On average a hybrid urban ferry produces less emissions than a traditional boat, zero emissions at the wharf and zero water pollution under all conditions.

HMP ferries utilise a parallel hybrid configuration, meaning that both the internal combustion engines and the electric motors can drive the propeller. To ensure noise and emissions are kept to a minimum, the new HMP catamarans use only the electrical engines when passengers are embarking or disembarking or whilst approaching the piers.

In addition to its ability to use alternative fuels like biofuels or gaseous fuels, the HMP system can also harness renewable energy sources, such as wind and solar, via its ‘solar wing' system.

The breakthrough HMP technology reduces fuel, maintenance and downtime costs, resulting in reduced total lifcecycle costs.