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ZEMShip

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Abstract

On August 29th, 2008, the first commercially used fuel cell passenger ship has been put into service on the Alster lake in Hamburg. From now on up to 100 passengers will be able to enjoy their ride on the inner city lake and its connected canals-without generating any local emissions.

1 Introduction

Zemships (Zero Emission Ships) is a joint project carried out by nine partners and headed by the Ministry of Urban Affairs and Environment of the Free and Hanseatic City of Hamburg. The budget of Project Zemships, which has been started in 2006, amounts to 5.5 million Euros. 2.4 million Euros of the overall budget have been co-financed by the European Union. The other part of the Zemships budget is contributed by its partners. This poster session will describe the technology behind the ZEMShips project.

The hybrid fuel cell propulsion system of Zemships comes from Proton Motor. Its key components are:

- 48 kW (peak) fuel cell system *PM Basic A50* using the proprietary fuel cell stacks by Proton Motor
- Hydrogen tanks at 350 bar for three days of operation (typical)
- Batteries as energy storage for buffering and peak load „shaving“
- Energy management system and fuel cell controls for optimally efficient operation

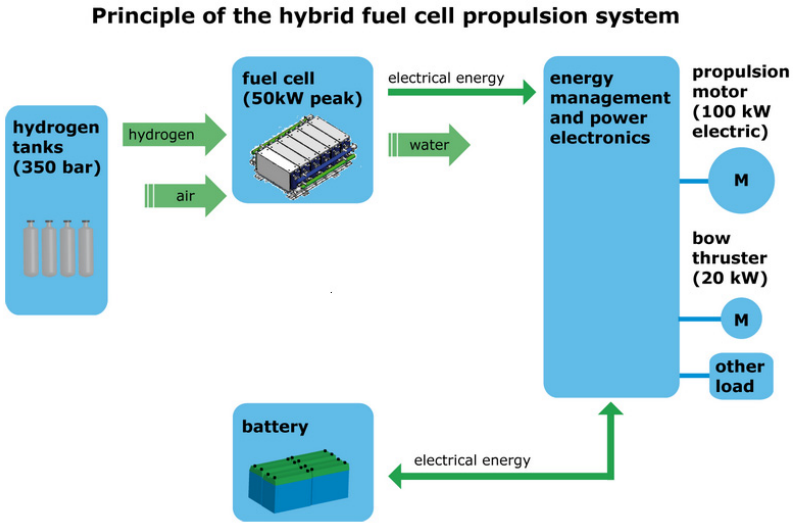

Figure 1: Principle of the hybrid fuel cell propulsion system.

2 Clean and Energy Saving

From the innovative drive system, because the vessel produces no exhaust gases and is very quiet in operation.

The drive system is projected to run almost twice as efficient as a conventional diesel powered ship on the typical routes in Hamburg.

3 Fuel Cells

Fuel cell systems combine efficient fuel utilization and, due to the use of hydrogen as the energy source, environmentally friendly operation. Additional characteristics of the systems are a high level of efficiency coupled with advantageous partial-load and load-change behavior. These electro-chemical energy converters generate absolutely no emissions - the product of the electrochemical conversion process in the fuel cells is simply pure water. Zemships is powered by a PM Basic A 50 fuel cell system by Proton Motor with 48 kW peak.

Proton Motor has developed the fuel cell system *PM Basic A 50* and its fuel cell stacks dedicated for the use in commercial vehicles. The liquid-cooled PEM fuel cell systems (PEM = Proton Exchange Membrane) feature a particularly simple, sturdy and modular construction. This enables them to cover a wide range of applications. Another core component is an integrated, low-energy water management system. Thus, external humidification is not required.

4 Hybrid System

The integrated battery package takes surplus energy from the fuel cells, for example when the ship is stopped at an interim port and requires less power. When the ship needs maximum power for example during casting-off and coming aside maneuvers the batteries supply the energy back to the engine. An intelligent energy management system controls the division of work between fuel cells and battery. Thus the hybrid system ensures maximum efficiency of operation and lifetime with minimized cost.

5 Hydrogen Storage System

The hydrogen is stored on board in 350 bar pressure tanks. The 50 kg of hydrogen stored provide enough energy so that the ship only needs to be refueled about once every three days

6 Experience

With over 10,000 passengers carried over the past few years, the ZEMship has collected over a thousand hours of experience in real world, daily operation. The ZEM ship is planned to be run another 2 years, while collecting valuable information for the next generation systems.

Figure 2