

HySeas III

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Consortium Partners



Introduction

The HySeas III project kicked off in July 2018 and aims to demonstrate that fuel cells may be successfully integrated with a proven marine hybrid electric system (electric propulsion, control gear, batteries, etc), along with the associated hydrogen storage and bunkering arrangements. The project will do this by developing, constructing, testing and validating a full-sized drive train on land, currently scheduled for end 2019.

Should this test be successful, Scottish Transport have agreed to fund the building of a roll-on roll-off passenger ferry which will integrate the entire hydrogen/electric drive train and which will be subject to extensive monitoring and testing.

The fuel cell units to be employed are currently in service, delivering proven and reliable zero-emissions road transport for over ten years - in an expanding fleet of over a hundred fuel cell buses in Europe and beyond. The PEM fuel cell modules to be employed in HySeas III have in some cases reached over 30,000 operating hours.

The route chosen to be the recipient of this innovative vessel will be Kirkwall to Shapinsay, in the Orkney Islands, located to the north of Scotland. Orkney benefits from significant renewable energy resources, which are exploited through wind and tidal turbines.

Excess renewable energy is used to produce hydrogen via electrolysis of water, which is then stored under pressure. This means that both production of the fuel and use of the fuel has no harmful emissions – GHG, SO_x, NO_x, or particulate matter.

Project Updates

In the past year, the project held 3 consortium meetings, as well as a number of workshops and technical meetings. One of the first visits was to Orkney, to familiarise the consortium with the renewable energy and hydrogen infrastructure being used and to take a trip on the existing Shapinsay ferry.

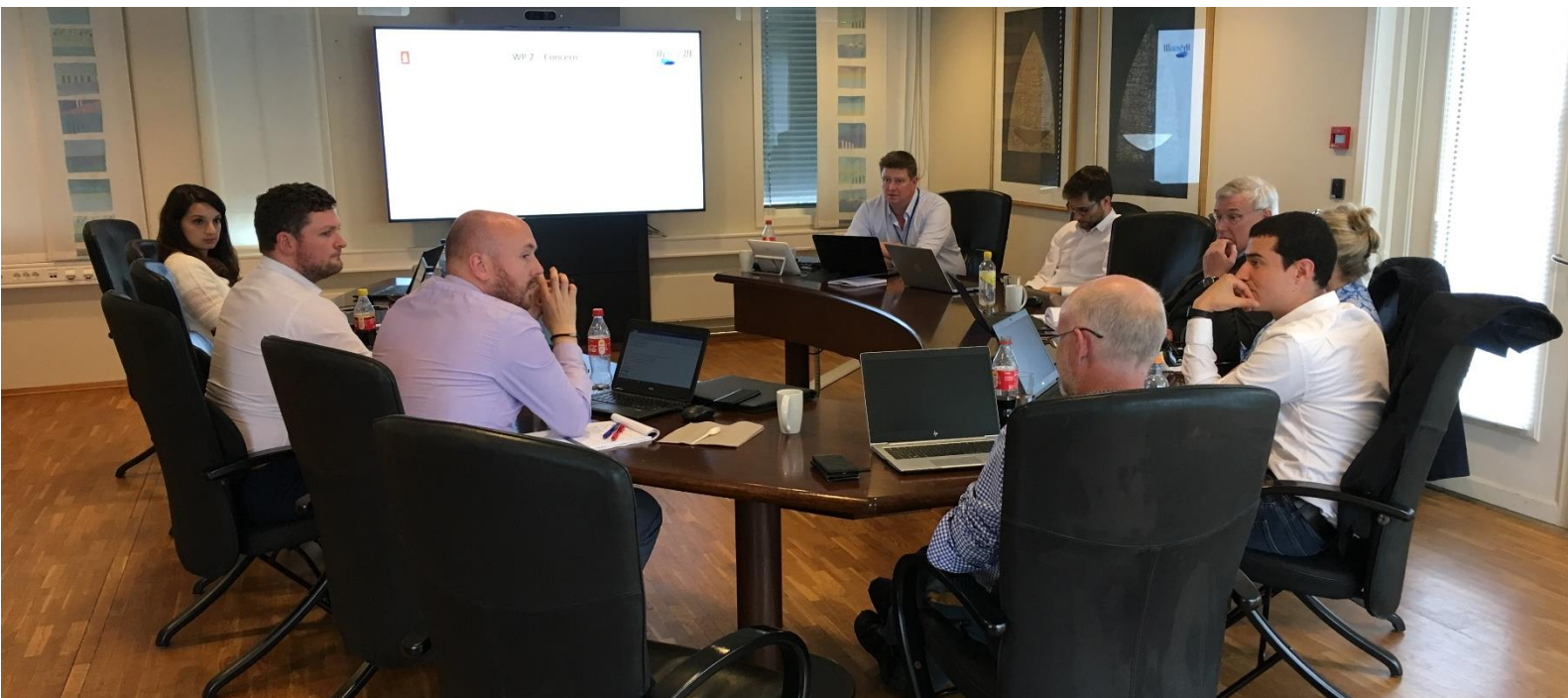
Thereafter work commenced on defining the operating profile of the new ferry in order to estimate the peak and normal operating power requirements of the drive train, battery capacity as well as the required storage capacity of compressed hydrogen. In parallel, the vessel specification and concept design were developed as per conventional ship design practice. With these completed, the specification of the drive train was also prepared.

A scaled down version of the drive train was developed for simulation, testing, validation and fault finding at Kongsberg. This 'mini' drive train was then built to help develop the final drive train and power management system.

As there are barely any rules governing the carriage and use of hydrogen as a fuel in fuel cells in a marine environment, risk based design is used and the consortium conducted a HAZID workshop together with regulatory partners Lloyd's Register and the Maritime and Coastguard Agency.

A specification for landside bunkering and storage infrastructure has been developed and extensive work has also gone into an analysis into the potential size of the market for hydrogen ferries to lay the groundwork for later analysis into potential new business models to hasten the adoption of hydrogen amongst ferries.

Suppliers to the project include Leclanche for the batteries, and UMOE for the hydrogen storage tanks.



Award Winning

We are pleased to announce that the world's largest sustainability awards, Greentech Festival's 2019 Green Awards, awarded the HySeas III project, the accolade of 'Innovation of the Year'. The prize was received on behalf of the consortium by Ferguson Marine.

The Greentech Festival was created following the merger of the Greentech Awards and the British Green Awards with past winners including Sir David Attenborough. This year, the judges were looking for the "most impressive (most current, auspicious, astonishing) innovations in green tech" and the project's leading work with a marine application for hydrogen fuel cells gave our nomination a significant edge over the highly respected international competition.

Fellow consortium member Kongsberg Maritime also picked up an award for the pioneering work they are doing on the autonomous ship Yara Birkeland.

Shane Hand and Andrew Herdman from Ferguson Marine also picked up awards from the Scottish Renewables 2019 Young Professionals Green Energy Awards.



Systems Testing

A Ballard MD30 containerised fuel cell module was shipped from Denmark to Kongsberg's test lab in March, where it was combined with a hydrogen supply and battery and then connected to the Kongsberg Energy Lab which will simulate a range of dynamic loads.

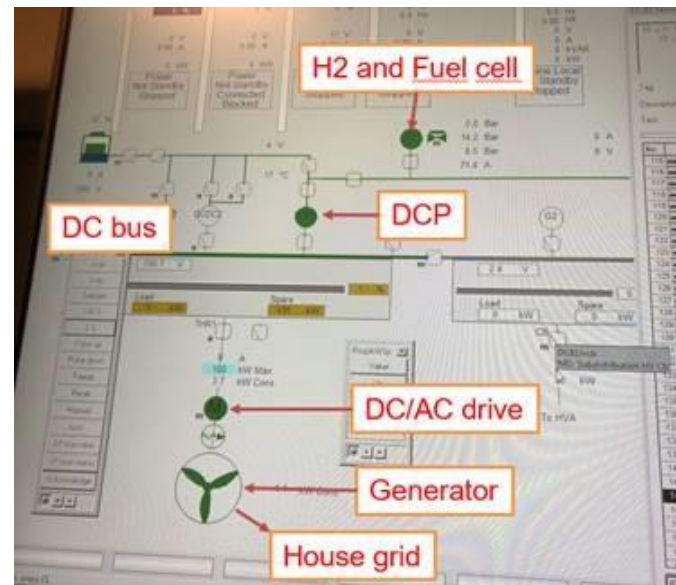
Engineers from Kongsberg and Ballard worked together to commission the fuel cells and Kongsberg were able to start and control the fuel cell centrally from the control laboratory, as well as to add load.

In the current setup, energy from the fuel cell goes through the DCP converter, DC bus, thruster drive and then feeds the local grid. Linked to the DC bus are two battery packages that can be controlled through the energy management system which enables tests to be performed to understand dynamics, behaviour, energy management and the control system including a combination of fuel cell and battery.



The Ballard MD-30 fuel cell has a rated net power of 30kW in dimensions (l x w x h) of 900 x 480 x 375 mm weighing 125 kg. Full specs are here. The fuel cells that will be used in the full-scale drive train are the HD100 with a 100 kW rated net power, with dimensions of 1200 x 869 x 506, weighing 285 kg. Full specifications are here.

The fuel cells have previously been tested by a consortium in Japan (Yanmar, NMRI, JSTRA, supported by MLIT) in 2018 on a 16.5 m boat powered by 2 MD-30 fuel cells and a 60kWh lithium ion battery.



Where to find us

Members of the consortium will be present or speaking at the following events:

1 September 2019	9 th International Conference on Life Cycle Management	Poznan, Poland
3 September 2019	Maritime Hydrogen and Fuel Cells	Bergen, Norway
5 September 2019	Orkney International Science Festival	Orkney, UK
10 September 2019	Greening Inland Shipping Conference*	London, UK
11 September 2019	International Chamber of Shipping Conference*	London, UK
17 September 2019	Okobilanzwekstatt	Stuttgart, Germany
18 September 2019	Maritime Hydrogen & Marine Energy	Florø, Norway
02 October 2019	Scottish Hydrogen & Fuel Cell Association Conference	Aberdeen, UK
07 October 2019	INTERFERRY Annual Conference	London, UK
21 November 2019	FCH JU Stakeholder Forum	Brussels, Belgium
03 December 2019	International Conference on Ship Emission Control	Hamburg, Germany
December 2019	HySeas III Full Scale Drive Train Test	TBC, UK

* Part of London International Shipping Week