

Fuel Cell Systems for Zero Emission Ships: Experience from Regular Line Operation

Sebastian Dirk,

Proton Motor Fuel Cell GmbH

s.dirk@proton-motor.de

+49 89 1276265-62

+49 172 1463134



Gefördert durch die EC / Financial Support given by the EC



Founded 1998
Development started 1994
50 employees



Holding, founded 2006
Listing in London 31.10.2006
100% owner of Proton Motor



We offer
Fuel Cell Hybrid Solutions
for „back to base“ commercial vehicles
and for stationary applications

- TryHyBus: Triple Hybrid Bus
 - Presented in 2009 in Prag
 - Since 2010 in normal line operation
 - Award for alternative propulsion systems (IHK Frankfurt)
 - Nomination for the Hermes Award 2010
- Light Duty Trucks in Cooperation with Smith Vehicles
 - Presentation at the Hannover Fair 2010
- Uninterrupted Power Supply (UPS)
 - Power Range 5kW – 20 kW
 - 19" rack
 - Produced by Deutsche Mechatronics
- Fuel Cell Systems for maritime applications
 - Zemship in Hamburg



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- Construction of the „FCS Alsterwasser“ at the shipyard in Oortkaten
 - Integration of the first fuel cell system
 - Initial commissioning of the hybrid System in the ship



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 - Drive past the Queen Mary 2



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- Ship baptism of the „FCS Alsterwasser“



- Since April 2009 FCS „Alsterwasser“ in normal line operation

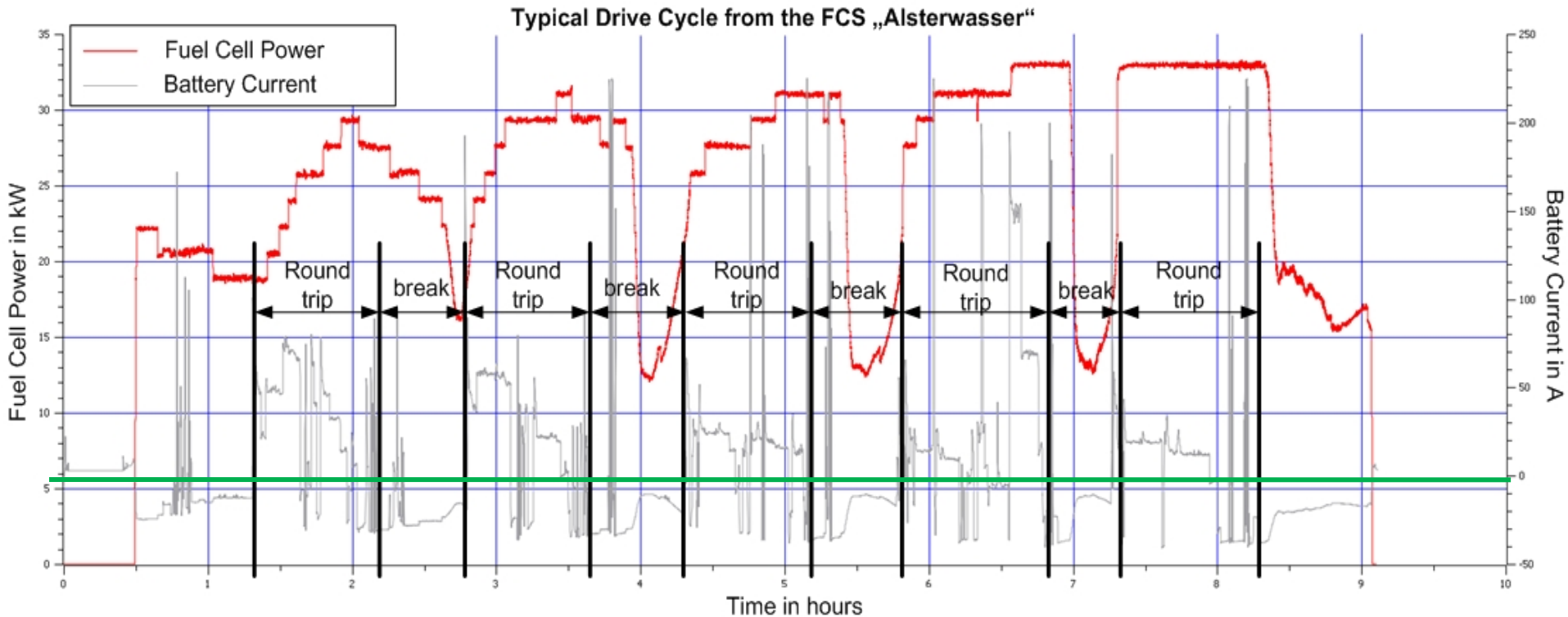
- Used for

- Alster Round Trips
- On Hamburgs Canals
- Charter Trips


**More than
14000 passengers
Until end Oct 2009!**

- Overall operating hours: 750h
- Since April 2009: 630h
- Often operations more than 8 hours a day
 - Normal drive cycle
 - About 5 Alster round trips a day





- 8 hours typical drive cycle
- Five Alster Round Trips
- Between the trips the battery is charged by the fuel cell

- Energy demand from the FCS "Alsterwasser": 222 kWh
- Average Energy demand from 25 kW
- Hydrogen consumption calculated from the pressure difference
 - Start: 304 bar
 - End: 199 bar 14,4 kg
- Energy from the fuel cell: 218 kWh
- Efficiency at Fuel Cell output: 45 %

- Service concept included
 - Free service hotline
 - Accessibility: 7 days a week from 8am to 8pm
 - On Workdays: After notification within 24h on board

- No permanent service technician in Hamburg necessary

- In average two or three service units a month

- Most failures were fixed within 24h
 - Damaged air compressor
 - Errors on some sensors

- Remote data monitoring system installed

- One fuel cell system is sufficient for Alster trips

- With two implemented systems a service is not possible (very limited space)

- Use flexible tubes for the media supplies
 - Easy mounting and dismounting from the system

- Optimization of the battery management system
 - 24h monitoring of battery current
 - Measurement of all currents from the external battery chargers included

- Integrate improved fuel cell system to ensure normal line operation for the next two years

- Separation from fuel cell box and fuel cell periphery
 - Improve accessibility for service



- FC Peripherie
 - Air compressor
 - Cooling pumps
 - Main switches
 - Main controller

- Installation of flexible tubes
 - Easier and more reliable mounting and dismounting

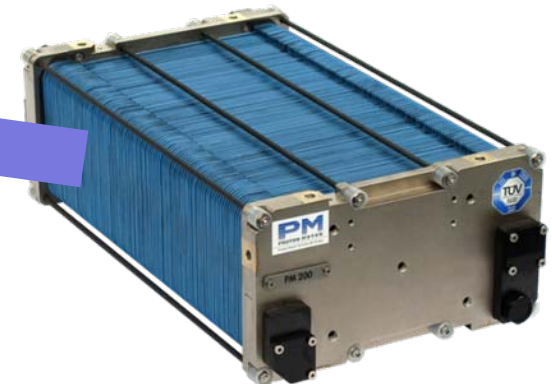


- Optimization of the battery management is implemented
 - Acoustic signal when the battery level falls under 60%
 - 24h monitoring of the battery current
- 50 kW fuel cell box is placed direct under the big hatch



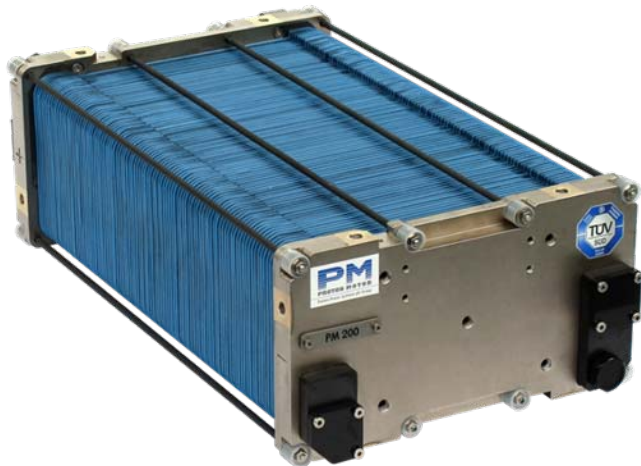
- Innovations

- Hydrogen recirculation pumps
- New Stack technology PM200



New stack technology designed for mass production and cost reduction:

- Manufacturing cost reduction in manual, semi automated and automated manufacturing processes -> easy ramp-up
- Service-friendly, cells can easily be replaced
- Better platinum and membrane recyclability



Certified by TÜV according to
EEC 62282 –2
-> now a standard
commercial component to be
used in fuel cell systems.

3 kW – 10 kW per Stack
Designed for use in fuel cell systems 3 kW – 50 kW

Next steps

- Test-drives on the Alster with the new system
- Optimization of the power management



Forecast

- Transfer the FCS "Alsterwasser" to the Baldeney lake in Essen
- Presentation it at the WHEC in Essen
- Two more Seasons in normal line operation

18 WHEC 2010

18th
World Hydrogen
Energy Conference
2010

May 16–21, 2010, Messe Essen

Thank you for your attention!

HANNOVER MESSE 2010
April 19 – 23, Hall 27, H 60

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