

# **FC**wave<sup>™</sup>

Hydrogen fuel cells for zero-emission shipping

Kristina Fløche Juelsgaard Director of Market Development Ballard Power Systems Europe

#### Our Heritage **BALLARD**



\*compiled from 2015

# We continuously invest in our technology**BALLARD**and product development



Unit cell components

MEA, bipolar plates



Fuel cell stacks 14th generation



Fuel cell modules 8th generation



Fuel cell vehicle integration application engineering/ after sales service



Humidified and pressurized system



Freeze-start from -30°C



**IP** protection



>30,000 hours life time

### Changes are happening in the marine industry

### **BALLARD**



Global Energy Ventures ping Solutions for the Energy Transition

4

to a mealw vessel, owned and operated by

offshare vessel to run on ann

powered fuel cell, January 23, 2020.

#### **BALLARD**<sup>®</sup>

On a global scale, the shipping industry contributes a significant share of GHG emissions



# 2.2%

 $CO_2$  per year

# 15%

 $NO_x$  per year

# 13%

 $SO_x$  per year

#### **BALLARD**<sup>®</sup>



#### Availability Marine-certified FC products have not yet been available

# Challenges



#### Costs

Life cycle cost not yet validated in marine applications over long term operation Marine-certified production volumes have yet to benefit from economies of scale

- for Hydrogen Fuel Cell Adoption in the Marine Sector



#### Reliability

Reliability under the rigors of the marine environment has not yet been proven in long term operation

Why are hydrogen fuel cells not already long-commercialized in the maritime sector?



#### Integration

Up until now Ex-Zone issues, air locks, certification..., have challenged integrators



#### Codes and Standards

IMO IGF Codes and therefore Flag requirements are categorically different compared to road, stationary, railway and aircraft requirements, and still under development



# Introducing



### The world's first marine fuel cell module to receive DNV Type Approval



Marine Fuel Cell

- The DNV Type Approval certifies that FCwave<sup>™</sup> meets all the stringent global requirements for marine applications
- A long-awaited breakthrough demonstrating the industry's confidence in fuel cells for ships



**Features BALLARD**<sup>®</sup>

**Rated Power Design life between major overhaul** 35000 Hrs. **Operating Voltage Rated Current System Cooling Outlet temperature** H2 inlet pressure (max) **Environmental protection IP44** (Class req. for engine room installation) Weight **Dimensions (L W H) Safety Barrier principle** (Class approved)

200 kW 350-720 VDC 2 x 300 - 1 x 550 65°C 6.5 Barg

#### 1050 kg

1200 x 738 x 2200 mm

Redundant surveillance of totally encapsulated H2 compartment



# **Benefits**

Fuel cells will play a key role in helping the marine industry address GHG emissions on the water and in ports.



#### Longer Range

Fuel cell powered vessels can run longer and travel farther before refueling than vessels relying solely on batteries



#### Multiple usability of fuel

The Hydrogen fuel also provide a surplus of heat from the process which can be utilized for HVAC, heated tap water, heating freshwater generators



#### Scalability & Modularity

Deployed in parallel, dispatchable configurations to meet variable power requirements. Flexible configurations adapt to vessel space constraints.



#### Stable, Reliable Power

Require very little maintenance, have low maintenance costs and an extremely long service life

# **BALLARD** Modular installation







Water out

### Ballard's Marine Center of Excellence

Europe's leading fuel cell company

Hobro, Denmark R&D & Production Service center Motive & Stationary

#### **Strong Local Presence:**

- European HQ, Ballard Power Systems Europe A/S located in Hobro, Denmark
- Location of Ballard's Marine Center of Excellence and Critical Communication Infrastructure Center of Excellence
- Manufacturing capacity of 60 MW/year

#### **Strong Market Focus**

Local manufacturing of Ballard's fuel cell product's for marine industry (FCwave<sup>™</sup>) and critical communication infrastructure (FCgen<sup>®</sup>-H2PM)

#### **Strong Support**

- 150+ employees in Europe dedicated to sales, market development, engineering, manufacturing, service, support and training
- 160+ heavy duty vehicles in operation powered by Ballard
- 8 marine vessels in preparation
- 380 power backup systems in service











### We support our customers through their journey



# Zero emission should also be sustainableSALLARDFuel cells have a lower impact on the environment



At Ballard we:

- Design our product to minimize carbon footprint
- Refurbish fuel cell stacks at the end of life
- Re-use graphite bipolar plates
- Reclaim 95% of the platinum
- We are committed to be carbon neutral by 2030

### Ships powered by Ballard

Project, Ship Name	Partners/Customers (Sponsors)	Application, FC Power
HYSEAS III	Caledonian Maritime Assets Ltd, Kongsberg Maritime, DLR, Interferry, Orkney Ferries, U. St. Andrews, (EC Horizon 2020)	Ferry, 600 kW
ELEKTRA II	BEHALA, TU Berlin, EBMS, Anleg, EST-Floattech, Schiffahrt Hermann Bethel, SER, HGK Shipping, (NOW, BMVI)	Inland Push Boat, 300 kW
FLAGSHIPS, Zulu 06	Compagnie Fluvial de Transport, ABB, LMG Marin, (EC FCH-JU)	Inland Cargo Vessel, 400 kW
FLAGSHIPS, FPS Waal	Future Proof Shipping, VTT, Seam (Westcon), LMG Marin, Persee, NCE Maritime CleanTech (EC FCH-JU)	Inland Cargo Vessel, 1200 kW
HJELMELAND, Hydra	Norled, Westcon, LMG Marin, Linde Engineering (Norwegian Public Roads Administration)	Ferry, 400 kW









# Here for life

# Thank you

Kristina Fløche Juelsgaard +45 5158 0749 kfj@ballardeurope.com

ballard.com