Introduction of existing hydrogen projects in Europe

London – 08/11/2019
Marine applications must go green
Even more so, after 2020. With 30 year ship ownership actions towards reducing CO₂ emissions should start now!

**CO₂**
- **Regional level**: Reduction of the total annual GHG emissions by at least 70% in 2050 compared to 2008
- **International level**: Reduction of the total annual GHG emissions by at least 50% in 2050 compared to 2008

**SOx**
- Extravascular emission
- ECA
- EU in ports

**NOx**
- NOx emission trend (relative to IMO Tier II)

**ECAs**
- Applies to new keels
- Applies to the ‘entire fleet’
Existing technologies, even combined, are not sufficient

LNG has proved efficient to address particulate emissions, but fails significantly contributing to CO2 reductions.

IMO targets are not achievable with current technologies, converting the entire fleet to LNG will not be sufficient. Urgent need to regulate H\textsubscript{2} for ships.

Until there are rules for H\textsubscript{2} as a marine fuel, H\textsubscript{2} ships must follow the “Alternative design process”, which is:

- Lengthy
- Costly
- Unpredictable
- Subjective to individual interpretation

Perennial requests from the sector

- Regulation
- International cooperation

The alternative design is the process by which it must be demonstrated that safety, reliability and dependability of the systems is equivalent to that achieved with new and comparable conventional oil-fuelled main and auxiliary machinery.
Anticipated role of hydrogen in the maritime sector

Increasing social pressure on the sector together with multiplying hydrogen related studies
Anticipated role of hydrogen in the maritime sector

Different scenarios illustrate how H₂-based fuels will represent between 25% to 80% of maritime fuels by 2050.

This decade will be characterised by prototypes of ZEVs and deployment in niche areas. The decade 2020 – 2030 is the most significant decade in terms of research and development with the following decades based on scaling and commercialisation. Therefore this stresses the urgency for action now.
FCH vessels are accelerating

with respect to LNG development
One size will not fit all

Preliminary results, analysis done by Hydrogen Europe
IMO role, what is the support needed to make it happen

Institutional support for convergence of actions

Context
• Experience is built from the industry and demo projects to support an establishment of rules
• FCH ships are multiplying and approval processes are taking place in an ad hoc and isolated manner
• Some guidelines from the IGF code lead to unsafe designs when applied to hydrogen (e.g. double-wall piping)

What needs to come next?
• Capitalise on the experience gathered through the various designs and approval processes
• Enable a better convergence between class agencies, for example on risk-based design methodology
• Highlight the IGF related guidelines which do not apply to hydrogen
• Establish specific must-have safety assessments and guidelines

What is the support needed to make it happen?
• A coordinated process, superseding the individual interests from the different project/stakeholders
• A forum to exploit experience and exchange safety assessments, regular meetings, etc.
• Pre-normative research focusing on must-have safety assessments

Would IMO be willing to take over the coordinator role this would help drive progress at the international level
And now, more details on...
Two hydrogen flagships deployed in this project illustrate the business viability and promote social acceptability of zero-emission shipping based on hydrogen and fuel cells.

A push-boat operating as a utility vessel on one of the most demanding rivers, the Rhône.

A passenger and car ferry operating as part of the local public transport network.

FERRY
STAVANGER
NORWAY

PUSH BOAT
LYON
FRANCE

OVERARCHING
TEAM STAVANGER
TEAM LYON

Persee
BALLARD
VTT
NORLED
WESTCON
LMG MARIN

NCE Maritime CleanTech
CFT
SOGESTRA
DE TRANSPORT
ABB
LMG MARIN

Joining Soon
POWER & AUTOMATION
Project overview

**AMBITION:** Illustrate the business viability and promote social acceptability of zero-emission shipping based on hydrogen and fuel cells

**FEATURES**
- Total Budget: 6.8 MEUR
- Duration: 4 years, 2019-2023
- A total of 1 MW installed on-board fuel cell power
- On-site hydrogen production with electrolysis powered by renewable electricity

Specification
- Design
- Build
- Test & approval

**2019-2020**

**2021-2022**

Operation in commercial service
Hydrogen vessels

Passenger & car ferry
- Stavanger area Norway
- 600 kW FC power

Pusher
- Lyon, France
- 400 kW FC power
Stavanger case data

- Route: Judaberg-Helgøy with 6 stops (route changes through the day)
- Daily operation: 140 nm (260 km), 19 hours (6 a.m. – 1 a.m.)
- H₂ fuel consumption: 460 kg / day (to be confirmed)
  - Comparable to ca. 1900 litres / day of (bio)diesel
- H₂ storage: 250 bar gaseous with 600 kg total capacity (TBC)
- Bunkering: every night, from shore to ship
- Power system
  - 3 x 200 kW PEM fuel cell modules
  - Battery capacity planned 0-500 kWh (need for batteries is under consideration)
  - Biodiesel generator back-up power
- Class and flag: approval by DNV-GL, under Norwegian flag (NMA)
Lyon case data

- Route: Port area for local work + Port of Lyon – Docks of Fulchiron
- $\text{H}_2$ fuel consumption (180 kg / week)
- $\text{H}_2$ storage (250 – 350 bars / 300 – 350 kg $\text{H}_2$)
- Refuelling by swapping $\text{H}_2$ storage rack.
- Power system
  - 2x PEM FC modules
  - Batteries
  - 2x diesel generators for back up power
- Class and flag: approval by Bureau Veritas, by French national authorities
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