

June 2017

MARANDA

Introduction

Marine applications must go green

Targeted regulations are in place in specific areas and **marine stakeholders have become increasingly eco-sensitive**

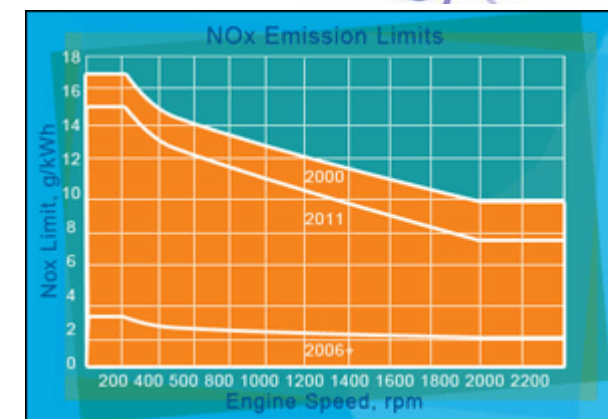


Marine Directive



In the EU, the Marine Directive aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020 and requires each Member State to develop a strategy for its marine waters.

At the international level, MARPOL (shortened Marine Pollution) is one of IMO's conventions that focus on preventing different forms of marine pollution including oil, noxious liquid substances, harmful substances, waste water, garbage and emissions of sulfur oxide and nitrogen oxide at sea. Mandatory limitations on NOx being released on the atmosphere are regulated under MARPOL Annex VI Regulation 13 and affect not only ships from signatory states but ships entering MARPOL signatory-members' waters.



MARANDA, a FCH JU funded project*, will accelerate the introduction of Fuel Cell and Hydrogen in the Marine sector

This project will contribute to meeting marine regulations and greening marine activities

MARANDA project aims to:

DEVELOP an
emissions-free
fuel cell hybrid
based marine
powertrain
system

ENSURE
suitability for a
broad spectrum
of marine
applications

PROVE the
technical
performance of
the system in a
target marine
vessel

DEMONSTRATE
the economic
feasibility of
hydrogen and fuel
cells in marine
sector

*This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735717.

This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and N.ERGHY

MARANDA Basic details

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<http://www.fch.europa.eu/project/marine-application-new-fuel-cell-powertrain-validated-demanding-arctic-conditions>

Time

- Start date: March 1, 2017
- End date: February 28, 2021
- Duration: 48 months

Coordinator

- Coordinator: Teknologian tutkimuskeskus VTT Oy, Finland (<http://www.vtt.fi/>)
- Contact: Jari Ihonen (jari.ihonen@vtt.fi)

Reference

- Project reference: 735717
- Topic: FCH-01-5-2016 Develop new complementary technologies for achieving competitive solutions for marine applications
- Contract type: RIA

€

- Project cost: 3,704,757.50 €
- Project funding: 2,939,457.50 €

Participating companies

POWERCELL SWEDEN AB (SE); ABB OY (FI), OMB SALERI SPA (IT); PERSEE (FR); SUOMEN YMPARISTOKESKUS (FI); The Finnish Environment Institute; SWISS HYDROGEN SA (CH)

MARANDA stated objectives

Technical and non-technical objectives of equal impact

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1

Develop improved, industrialisation –ready system components

Identify the components that have specific marine application requirements (e.g. lifetime and resistance to shock, corrosion, power range, SU/SD, etc...) and develop full system for high efficiency and low cost Balance-of-Plant (BoP)

2

Demonstrate and validate the system performance

Validate the system performance on a powertrain test bench and in a target marine vessel for a period of 6 months at least.

Demonstrate the CO₂ performance (through Life Cycle Analysis) of current powertrain solutions and demonstrate the specific emission saving

3

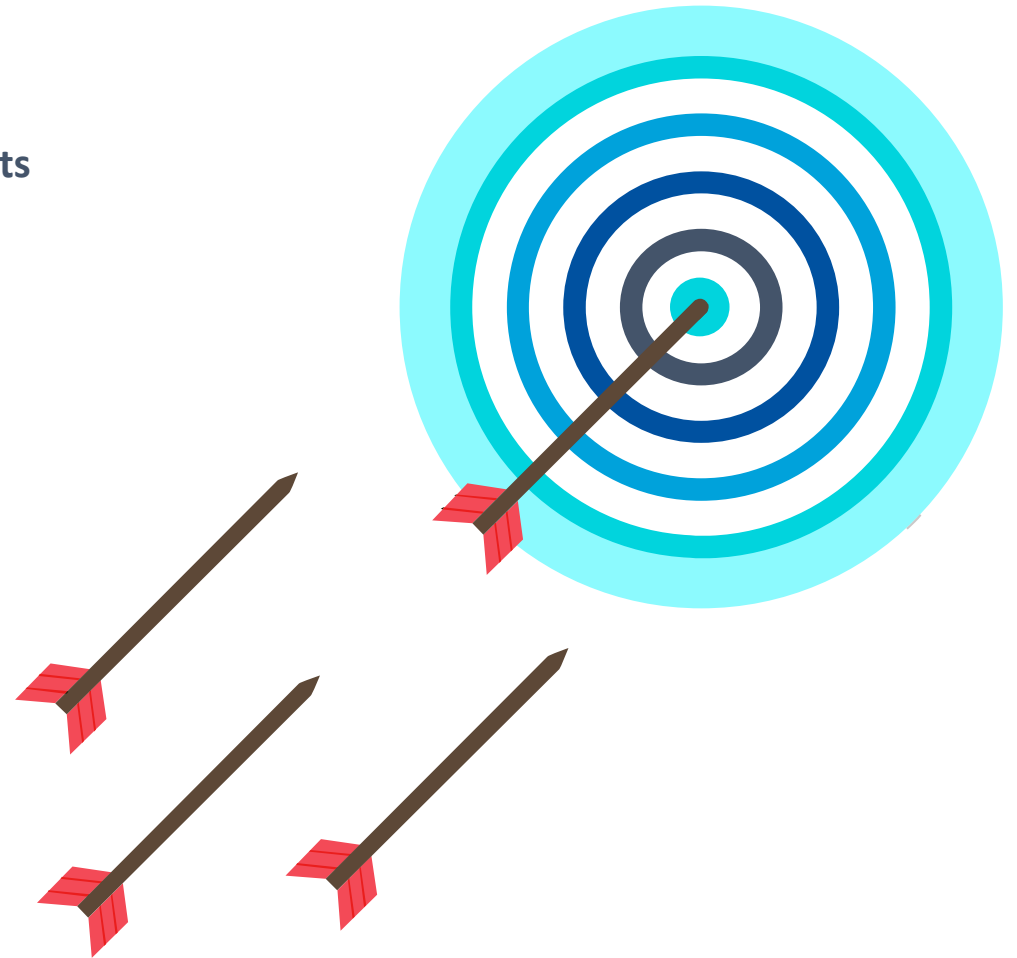
Outlay the return on investment for a prospective customer

Build a robust business case structure able to easily integrate customer specific criteria and proven by key marine stakeholders and offer custom diagnosis to prospective customers.

4

Formulate initial go-to-market strategy

Identify the specific needs and constraints of the various market segments to assess the best potential fit for fuel cell and hydrogen and define how best to address them.



Aranda, MARANDA's demonstration vessel

Aranda is a flagship Finnish research vessel, **operating in arctic conditions**

Owner/TC-Owner	SYKE (Finnish Environment Institute)
Call sign	OIRY
IMO	8802076
Built	1989 Helsinki, Wärtsilä Marine
Classification	FMA
Flag	Finnish
Crew	Finnish
GT / NT	1734 / 521
Lenght (LoA)	59,24 m
Breadth	13,80 m
Draught	5,0 m
Engine	1300 + 1700 kW (4 x Wärtsilä-Vasa 8R22 + W-V 12V22)

Well-equipped for challenging work

Aranda can conduct a wide range of biological, physical, chemical and geological research. The vessel's well-equipped laboratories and advanced computer system enable prompt onboard sample analysis and data processing.

Research facilities are mainly located in the central and aft part of the ship. Comfortable cabins and well-equipped common rooms make working aboard a pleasant experience, even on long expeditions. A floating floor has been installed in the research area to minimise vibrations and noise. The ship has special facilities for handling and storing samples, including a clean container, thermostatically adjustable acclimated rooms, cold storage, and freezer facilities housing a super freezer. Chemical research is facilitated by permanently fixed pipes between Aranda's bottled gas store and laboratories.

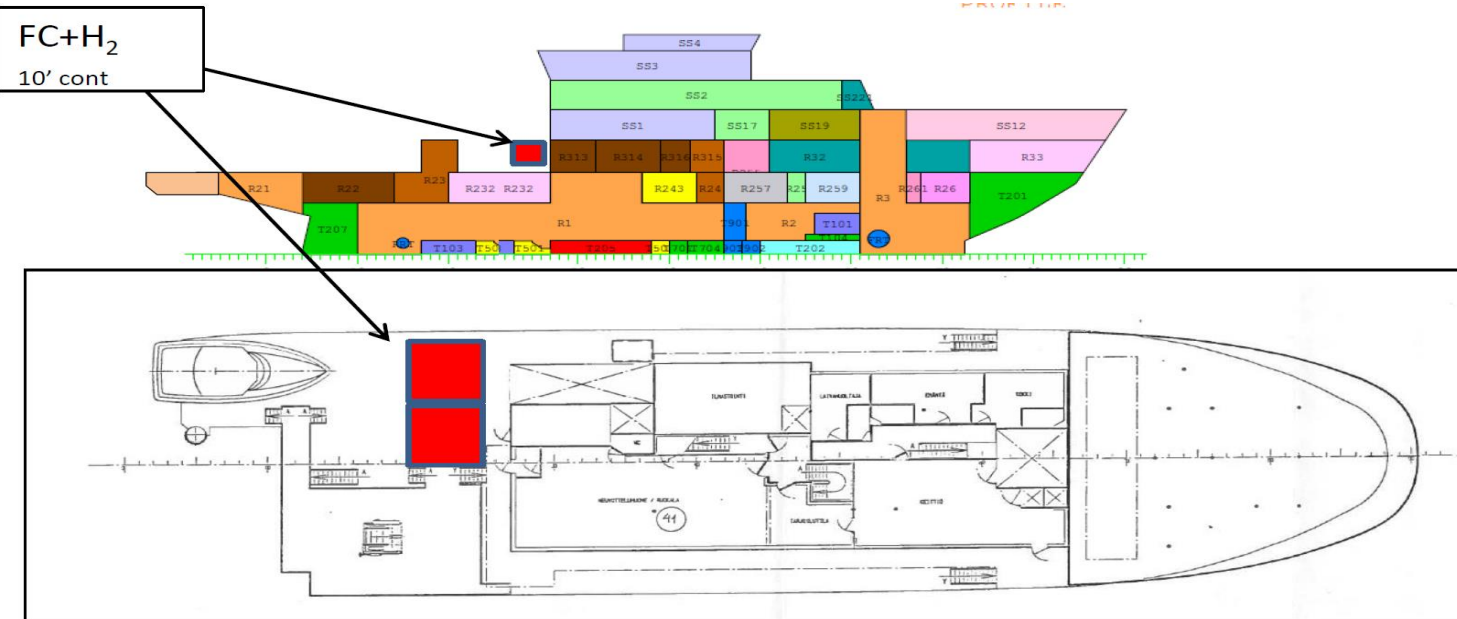


Planned fuel cell and hydrogen installation in Aranda

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A 165 kW (2 x 82.5 kW AC) fuel cell powertrain (hybridized with a battery) will provide power to the vessel's electrical equipment as well as the dynamic positioning during measurements, free from vibration, noise and air pollution.

Special emphasis is placed on air filtration and development of hydrogen ejector solutions, for both efficiency and durability reasons.



A mobile hydrogen storage container, refillable in any 350 bar hydrogen refueling station will be developed in this project. Liquid hydrogen, more suited to larger fuel cells, will be taken into consideration in the business cases and go-to-market strategy.

MARANDA KPIs

Both technical and economical



Fuel to electric
efficiency
50%



freeze start
capabilities
from -35°C



operating
temperature
[-32°;+50°]



system cost
< 1000€/kW*



Fuel cell stack life
15 000h

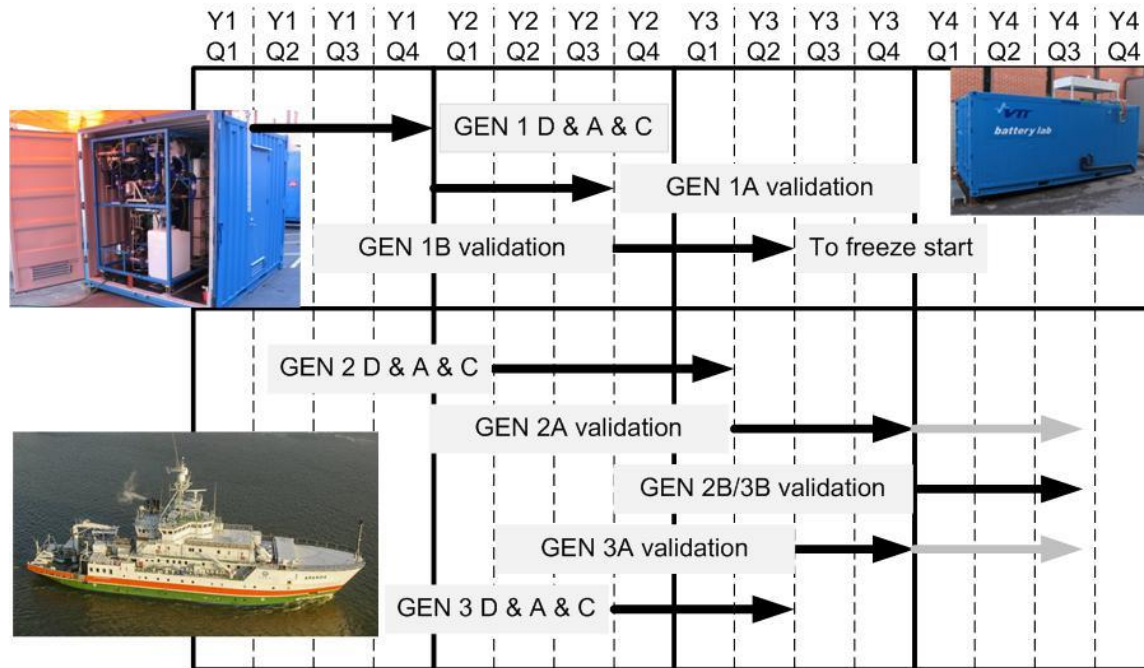


Fuel cell systems
conditions
able to withstand the
shocks, vibrations,
saline environment
and ship motions

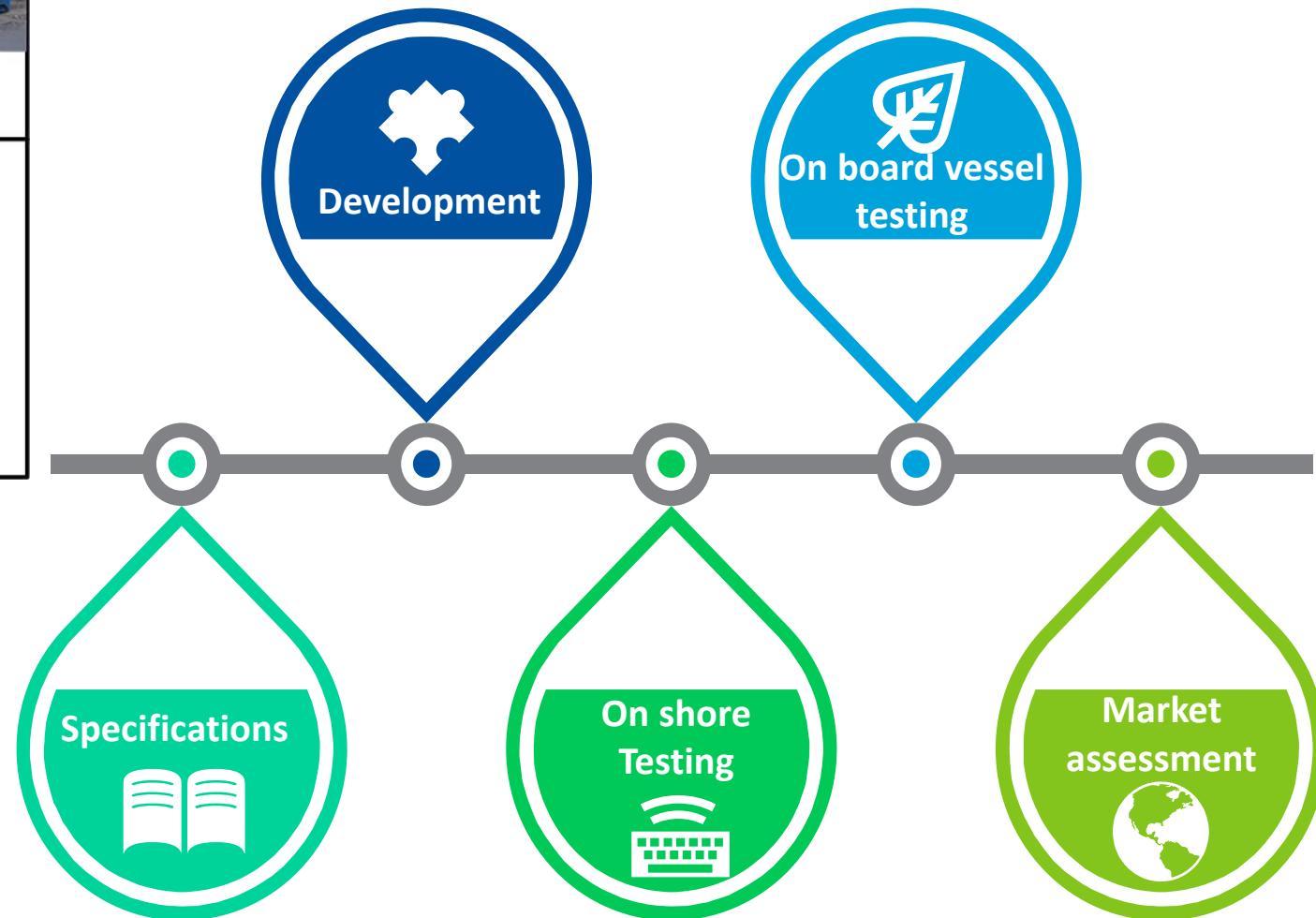
*For 100 units / year

MARANDA timeline

A four year project including onshore and on board vessel validations



The fuel cell system will be tested in conditions similar to arctic marine conditions before implementation to the target vessel. In addition, long-term durability testing (6 months, 4380 operating hours) of the system will be conducted at an industrial site.



Join us in this flagship project

And contribute to the future of the marine sector



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VESSEL OWNERS

Plan the adoption of hydrogen in your new vessel project or vessel overhaul with our online tool FOR FREE during the course of the project

<https://pers-ee.com/en/mobhy/adoption>

MARINE STAKEHOLDERS

Help us shape this flagship project and advance Hydrogen & Fuel cells in marine activities by joining MARANDA Advisory board:

1st Meeting taking place tomorrow at 1pm



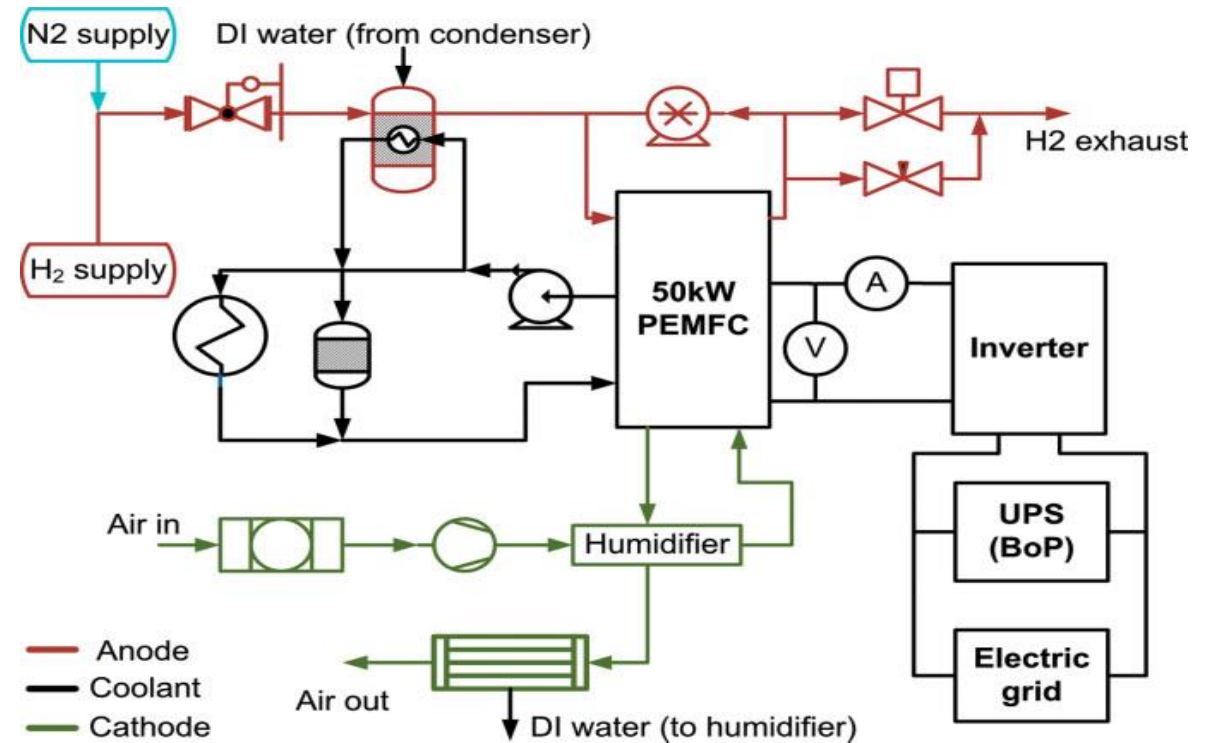
Contact us at maranda@pers-ee.com

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The durability testing site at Kemira factory



VTT has operated 50 kW system at the Kemira site 4400 hours during 2013-2015 in national DuraDemo project. In picture The VTT 50 kW scale PEMFC pilot plant (left) installed in durability test site. The schematic flow chart of the plant (right).