Feasibility study of PEMFC and metal hydrides coupling for the Zero Emission Ultimate Ship (ZEUS)

The 6th Low Emission Advanced Power (LEAP) Workshop - Virtual

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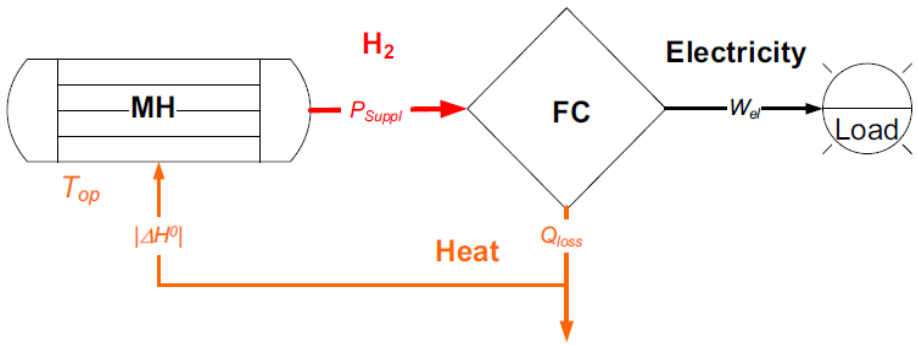
Introduction

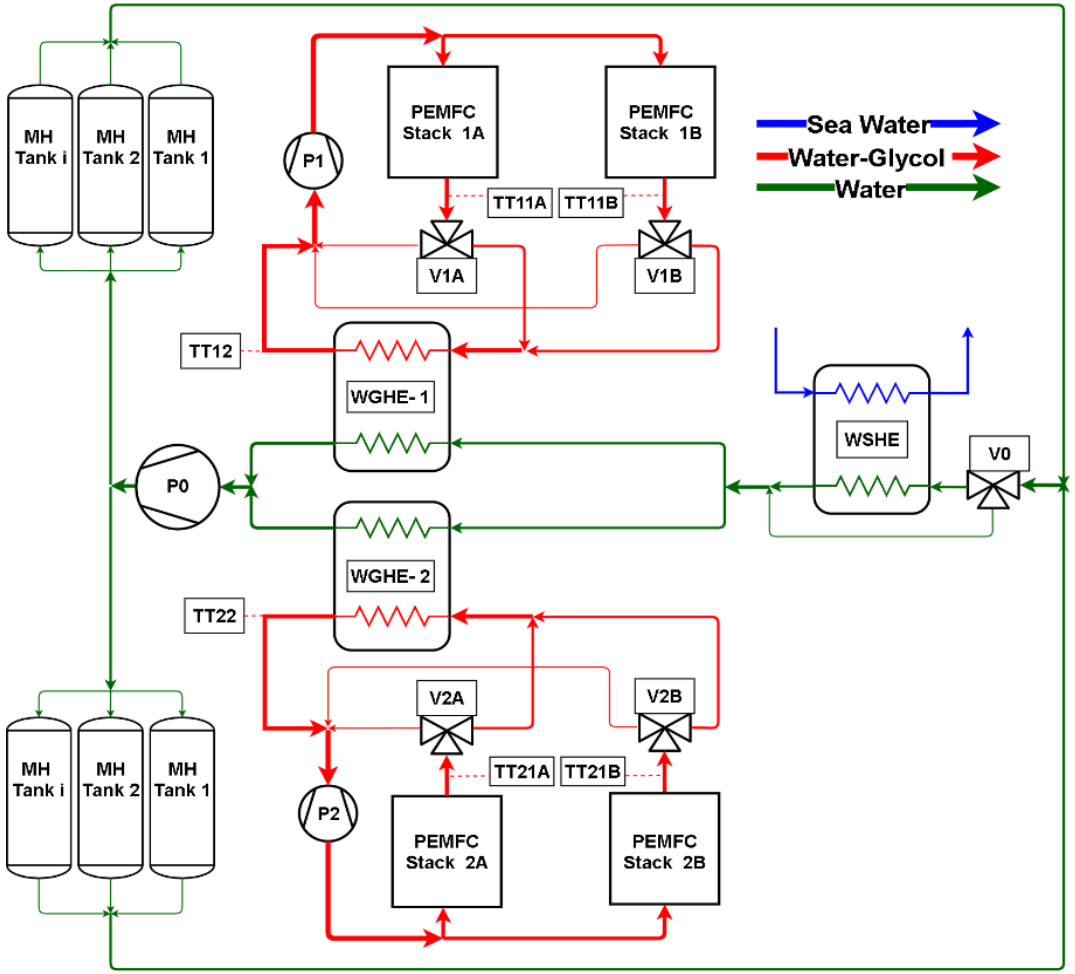
Aims and purposes

- This activity is part of the TecBia project, which aims to build Italy's first certified hydrogen powered ship, the ZEUS.
- A feasibility study of a metal hydride hydrogen storage system fed by heat dissipated from on-board stacks will be presented.
- One mission profile and some power ramps were investigated to understand the physical limits of the system and identify the best control strategy.

Introduction

ZEUS thermal coupling of PEMFC and MH systems





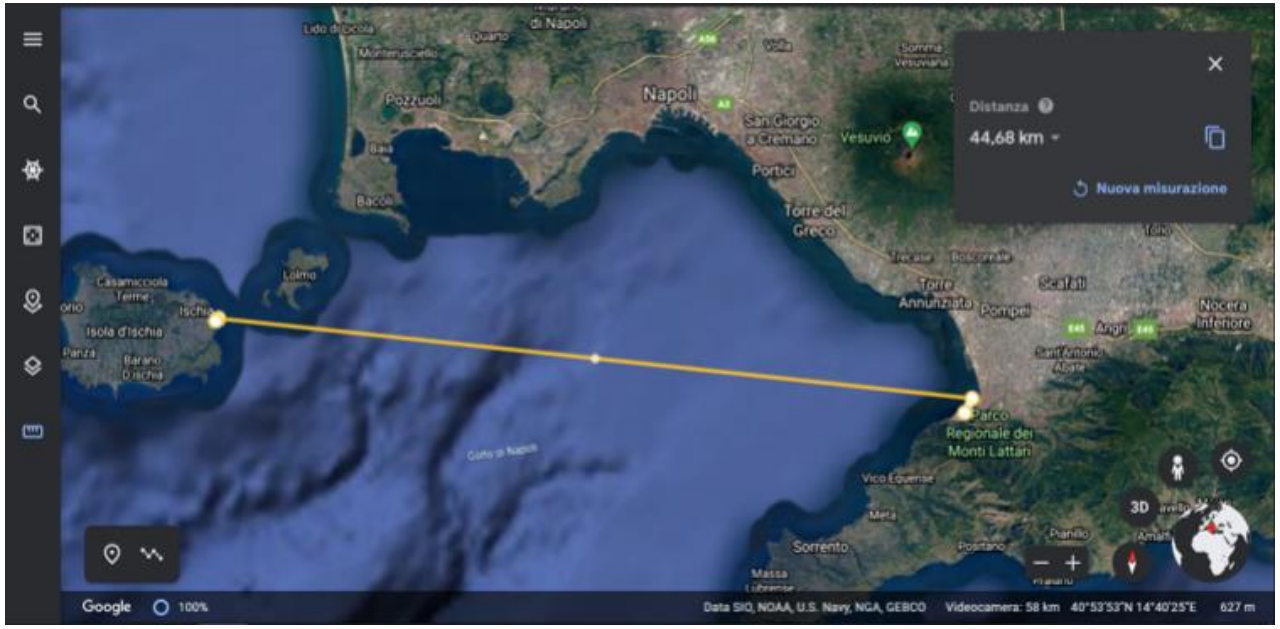
Dynamic Model: Description

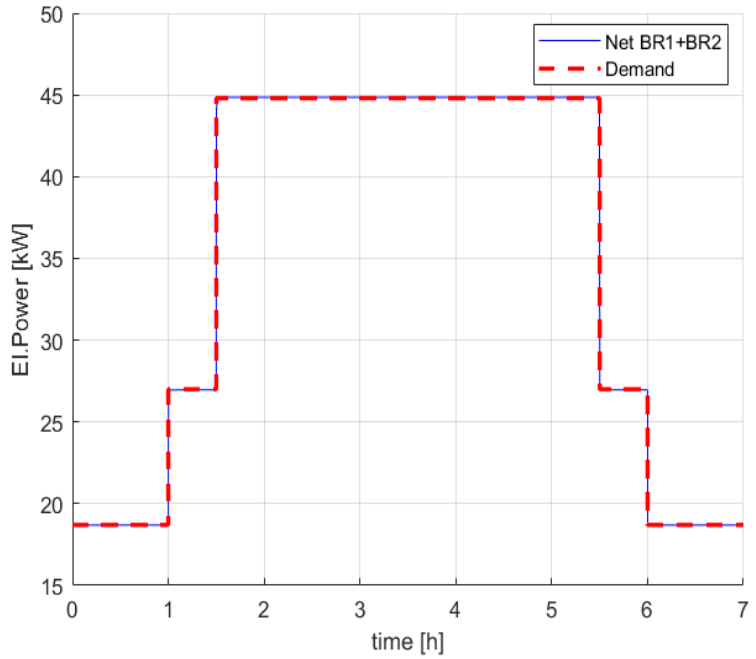
Matlab Simulink Model

- All the models are 0D representations of real components.
- All components are adiabatic towards the ambient
- The representation of the thermal control circuit of the FC modules and the one related to the MH heating is not comprehensive of the fluid dynamics delays

Dynamic Model: Description

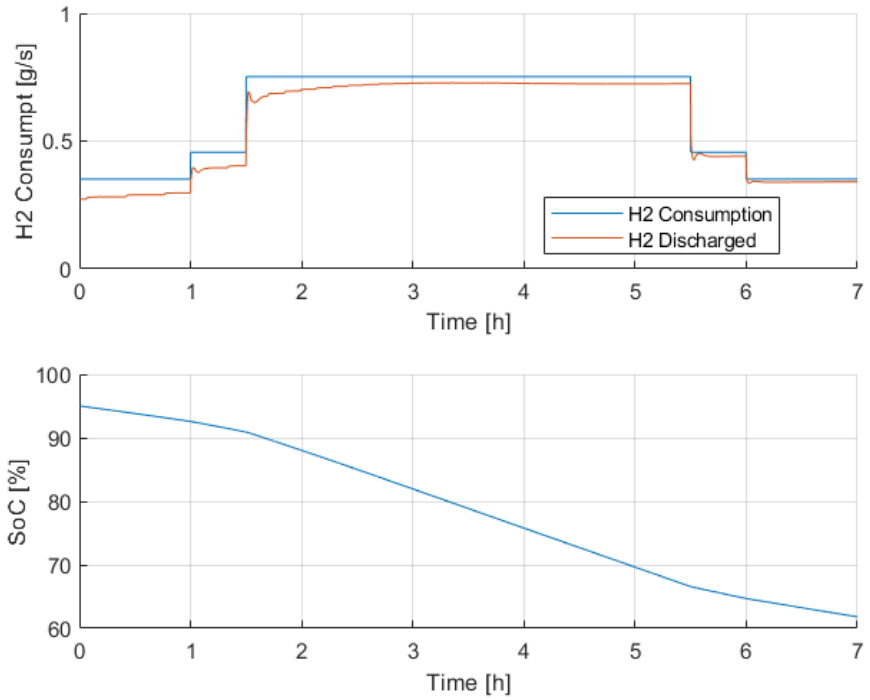
Ramp and typical load profile

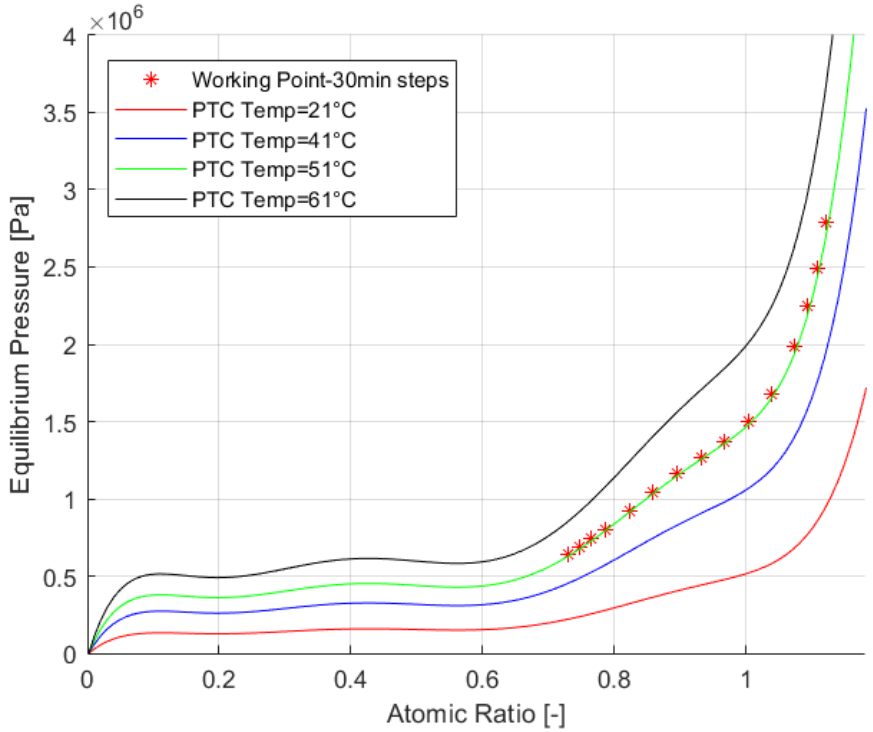




Dynamic Model: Results

Model results for a typical load profile



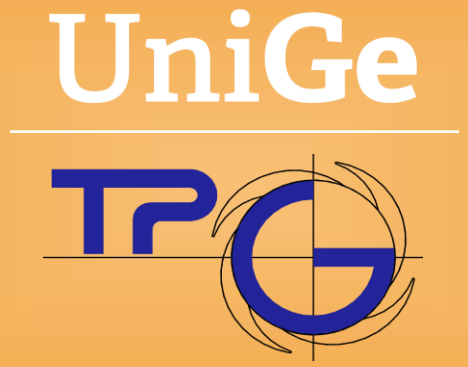


Conclusions

- This model confirm the feasibility for the thermal coupling of MH and PEMFC systems.
- The control strategy can sustain the system during the operating conditions and power ramps.
- The best performances have been obtained using two branches.

In the future we aim to:

- Perform the Simulink model: validation using ZEUS data, implement different control methodes (MPC etc).
- Include others components: batteries, MCI diesel etc.
- Investigate the start-up phase.



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