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HI-SEA (HYDROGEN INITIATIVE FOR SUSTAINABLE ENERGY APPLICATION): DEVELOPMENT OF A JOINT LABORATORY FOR PEM AND H2 MARINE APPLICATIONS

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The *HI-SEA Joint Laboratory* has been developed in the frame of a long time signed agreement between Fincantieri S.p.A. and the University of Genoa it integrates a Hybrid PEM power generator system with the research laboratory of the Thermochemical Power Group (TPG) of the University of Genova – Savona Campus.

The *HI-SEA Joint Laboratory* represents the first and largest effort to solve key challenges in the energy sector and to generate solutions for the low-emission ships and enhance the innovation capacity of a new business sector.

The goal of the laboratory is to define the best design for a modular FC system for ship application able to guarantee the maximum life span of FC stacks without omit performance.

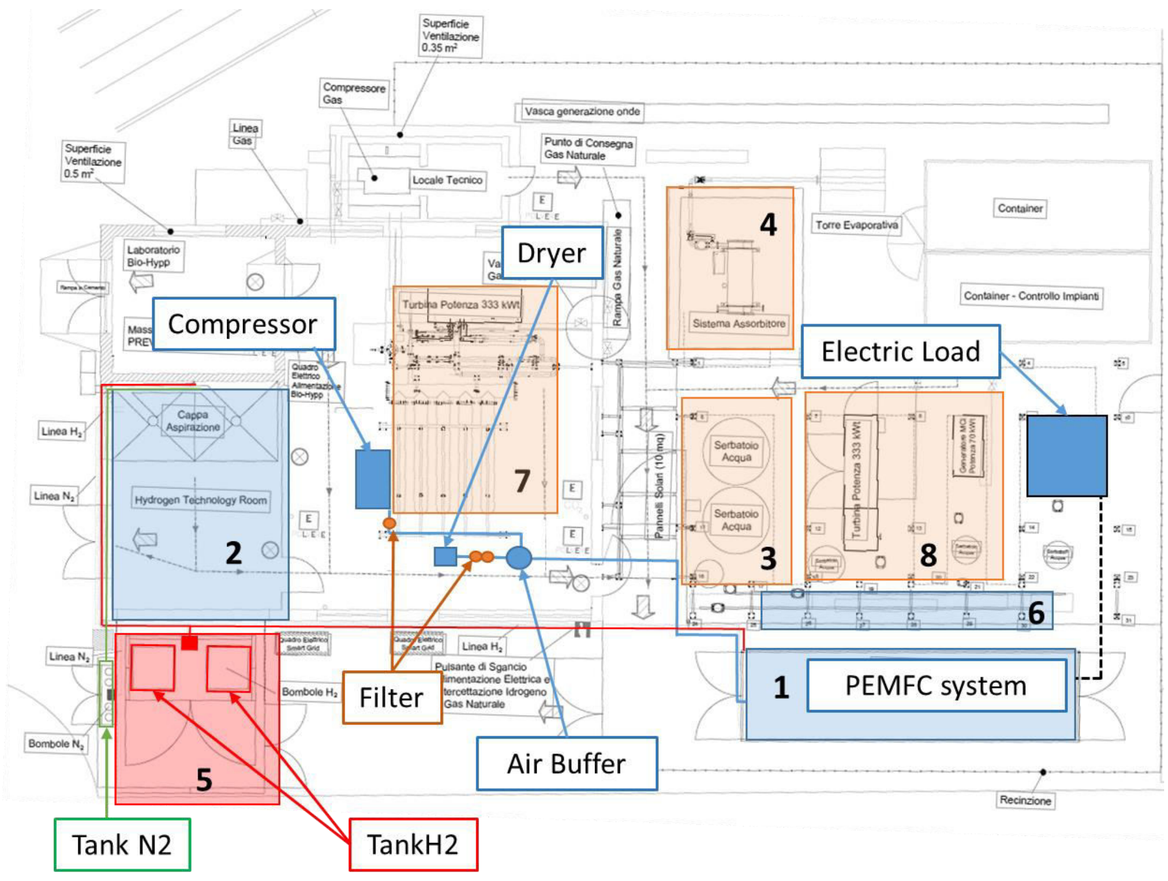

Figure 1. HI-SEA Laboratory plant

The laboratory presents a number of facilities that enable the study of various configurations of FC systems, hybrid systems with cogenerations or trigeneration as showed. The HI-SEA laboratory (light blue spaces and number from 1 to 6 in Figure 1) presents a unique presence of facilities that make it suitable for the study of ships power generator systems:

1. PEMFC power systems, with 260 kW total power;
2. Dedicated space for test and analysis of 30 kW staks and MH hydrogen storage tanks;
3. Large heat storage systems to test cogeneration;
4. Absorber chiller of 100 kWth to test trigeneration;
5. Hydrogen storage;
6. Water cooling system;
7. UTC laboratory of Rolls-Royce;
8. Lab scale E-Hub connected to a real smart grid.

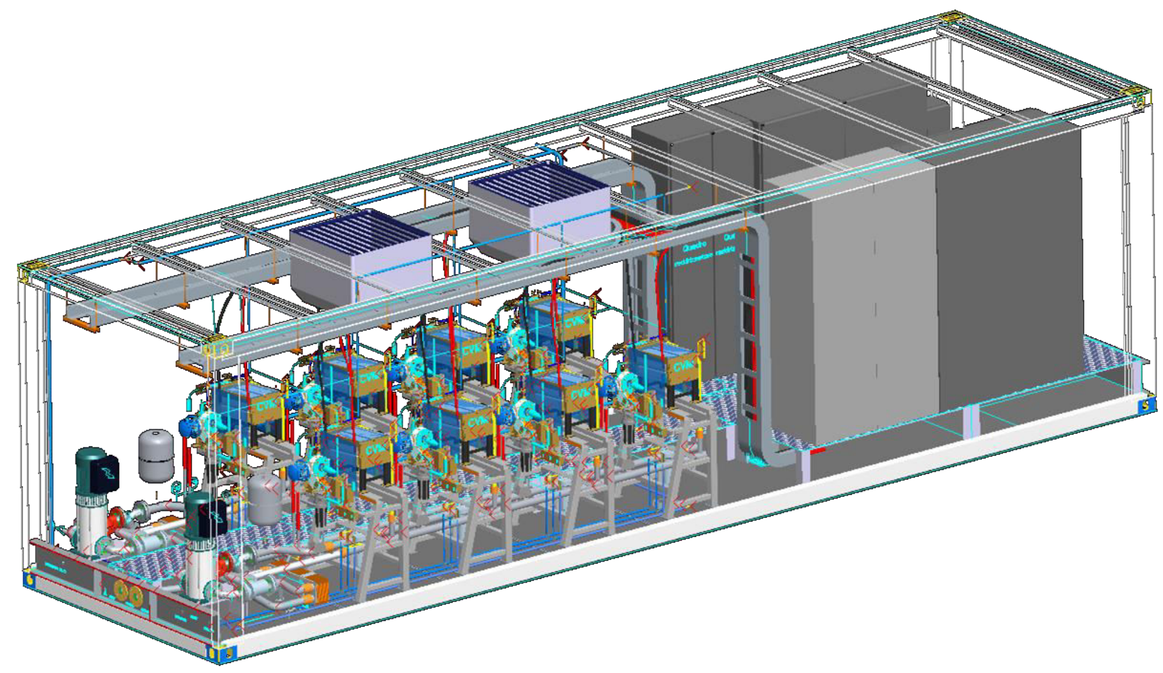

Figure 2. External view of the PEMFC power system

The PEMFC facility enables to connect 3 or 4 stacks in series for each of the two branch, with or without DC/DC to control the output tension. Moreover, the 60 kW AC/DC rectifier together with the controllable electric load will permit the simulation of any kind of battery packs, enabling the assessment of the optimum balance between FC and battery dimension as a function of the Operational Profile and the best integration of PEMFC in a DC grid. Different operational profile will be tested to investigate the possibility to use PEMFC system to power only auxiliaries or propulsion too.
The presence of water storage systems with temperatures and flows measurement will enable to assess the potentiality of the PEMFC system for cogeneration. Moreover, the absorber chiller comply with the thermal output of the PEMFC and will permit to test at a real system size the coupling of the systems, an important achievement for the reduction of onboard energy consumption.

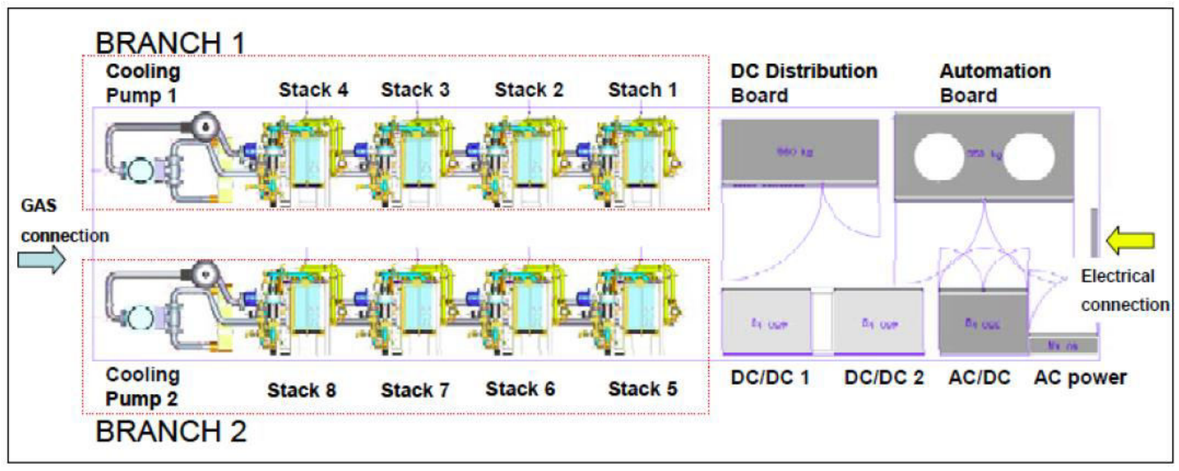

Figure 3. Schematic view of the fuel cell system.

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