Hydrogen handling in an emergency back-up system

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An innovative emergency back-up system is designed to supply 5 kW electrical power during 5 hours. Hydrogen produced by water electrolysis under pressure is stored in a metal hydride tank and supplied to a proton exchange membrane fuel cell (PEMFC), upon power interruption. It is composed of a water electrolyser, a small hydrogen buffer tank, a metal hydride storage tank, an oxygen storage tank for higher "round-trip" efficiency, a PEMFC and a central control unit for automatic operation.

The water electrolyser operates under 15 bar pressure keeping the oxygen storage tank volume low. The electrolytic hydrogen is purified before entering the metal hydride tank. The hydrogen storage section has been optimised from the point of view of energetic efficiency. It is composed of a conventional tank, storing 1 Nm^3 H_2 at 15 bar, and 4 metal hydride storage units of 5 Nm^3 H_2 capacity each. The metal hydride storage can supply hydrogen to the fuel cell at the rate of 4.2 Nm^3/h, even at ambient temperatures that are below freezing, using only the heat from the secondary circuit of the fuel cell cooling system (40-50ºC).

The design and engineering of the system components and their integration into the complete system, has been studied and optimised during the past two years and is presented together with the first results from the system's operation. The energetic efficiency and optimised integration of the hydrogen production and storage sections will be discussed.

Keywords: Hydrogen, Metal hydride, H_2 storage, Water Electrolysis

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