Integrated Wind-Hydrogen Systems

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SUMMARY

Hydrogen is presented as a product from wind parks, complementary to electricity. An innovative wind-hydrogen system has been designed and constructed at the wind park of the Centre for Renewable Energy Sources (CRES), near Athens, Greece. A 500 kW gearless, synchronous, multipole Enercon E40 wind turbine supplies power to a water electrolyser of 25 kW, a hydrogen compressor of 7.5 kW, metal hydride tanks and other electrical utilities. The start-up of the wind hydrogen plant is foreseen in summer 2005 and the results from the early trials will be presented together with the design of the plant.

FULL DESCRIPTION

The simultaneous production of an environmentally clean fuel and electrical energy is an interesting challenge for wind park developers. Wind-hydrogen systems may be optimised for different situations such as off-shore wind parks, where produced hydrogen may be transported to the user site by sea, and weak electricity grids or stand-alone systems, where hydrogen as chemical or energy carrier may be fed to the market through the road network.

An innovative wind-hydrogen system has been developed at the wind park of the Centre for Renewable Energy Sources (CRES), near Athens, Greece in the context of the RES2H2 project that is co-funded by the EC under the 5th Framework Programme. The hydrogen plant is connected to a 500 kW gearless, synchronous, multipole Enercon E40 wind turbine. It is composed of a water electrolysis unit of 25 kW with a nominal capacity of 0.45 kg/h hydrogen, metal hydride tanks for long term storage at high efficiency and a hydrogen compressor for filling high pressure hydrogen cylinders.

The advanced water electrolyser operates under 20 bar pressure and can withstand rapid variations of input power (15-100% of nominal capacity in 1 second). The hydrogen compressor has only one stage to compress hydrogen up to 220 bar. A small conventional tank acts as hydrogen buffer to smooth the pressure and flow variations at the compressor inlet. The metal hydride tanks contain a LaNi5-type alloy and have a nominal storage capacity of 3.6 kg hydrogen. The system also comprises an air compressor and drier to supply instrument air to the pneumatic valves, a water boiler to supply hot water to the metal hydride tanks for hydrogen desorption and a closed circuit for cooling water with water chiller, in order to reduce water consumption. The whole system is centrally controlled through a Programmable Logic Controller (PLC) and connected to a data monitoring and acquisition unit.

The construction works are almost completed and the commissioning of the wind-hydrogen plant is expected during summer 2005. The presentation will cover the design of the plant and a review of the technical challenges involved in its realisation. The results from the first trials, mainly regarding the performance of the electrolyser under variable input, will also be presented. The presentation will conclude with a study regarding the efficiency of the electrical integration of a wind-turbine with an electrolyser.