Hydrogen as an Alternative Product for Wind Park Developers

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A wind-hydrogen system was developed at the wind park of the Center for Renewable Energy Sources (CRES), near Athens, Greece in the context of the EC funded RES2H2 project. The aim of the installation is to study the performance of hydrogen production and storage technologies under variable power input, as that produced by a wind turbine. Such solutions could well be used in the medium term for storing excess energy from wind parks connected to stand-alone weak electricity grids in the form of hydrogen. However, even for the case of wind parks connected to the mainland grid, there are cases where the electricity transmission lines are too weak and thus a developer could consider producing hydrogen and using roads or pipeline infrastructure to export this alternative product to electricity, given a hydrogen energy market.

System components

- 500 kW gearless, synchronous, multipole Enercon E40 wind turbine
- 25 kW electrolysis unit producing 5Nm^3H_2/hr at 20 bar, developed with special cells to be able to withstand rapid changes of input power (15-100% capacity in 1 sec). The electrolyser will operate in various modes (percentage of wind turbine production, "peak-shaving", etc.), with excess energy from the wind turbine being fed to the grid.
- 40 Nm^3 H_2 storage in novel metal hydride tanks
- 1-stage 15-220 bar compressor at variable flow rate (3-7 Nm^3H_2/hr)
- cylinder filling station
- central control unit
- peripherals (water chiller, water heater, air compressor)

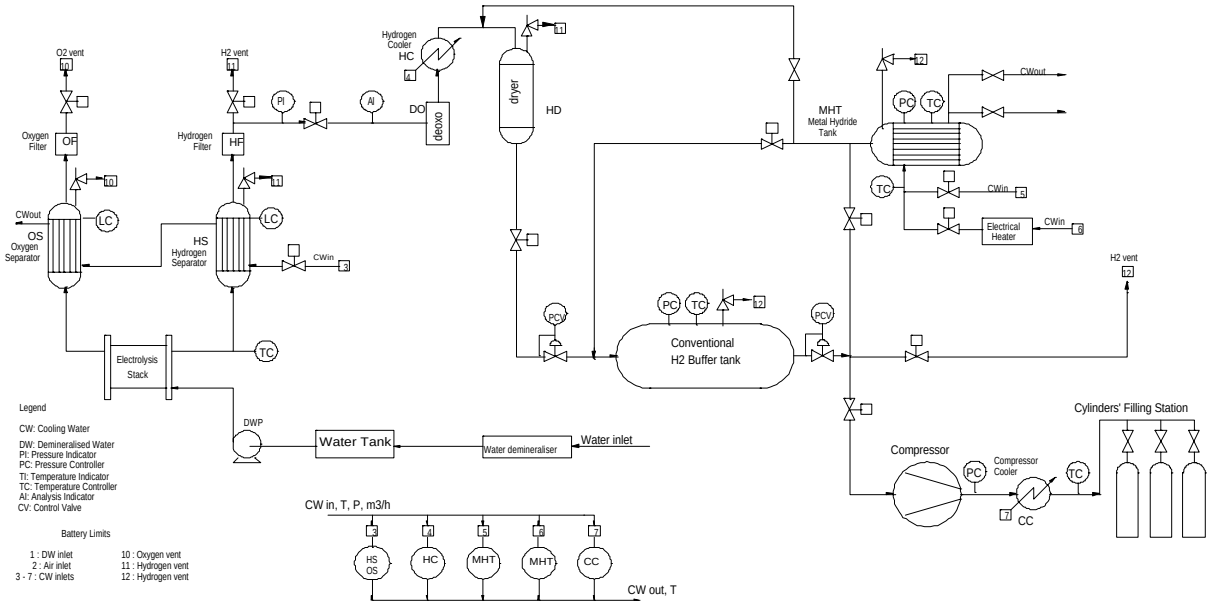

Fig. 1 Process flow sheet of hydrogen production, storage and compression system

Fig. 2 Overall view of the wind – hydrogen installation

Progress

All system components have been installed, including the electrolyser, compressor, metal hydride tanks, cooling unit, control cabinets. The metal hydride tanks have been activated and the compressor has been primed with Nitrogen. System start-up was performed in October 2005. Still pending is the installation of a thunder-strike protection system.

Conclusions

- besides meeting technical and cost targets and addressing safety issues, the design of a hydrogen energy system must be done in relation to what is market ready – no point to optimise a system specifying units whose capacity is not available or that are still at an early development phase
- the transportation and installation of hardware is something to be considered for such installations that are in many cases remote and with poor access. The capacities of the systems involved in the present site were on the limit of conventional trucks and lifting equipment in terms of size and weight in combination with the poor access road quality
- the interfacing of the various units is key, in relation to static and dynamic hydrogen flow, electricity and information flow and control. In the present system:
  - parameters such as the flow rate, pressure and temperature of hydrogen were used for the hydrogen interfacing of the hardware at the low pressure (20 bar) part of the system
  - the use of a buffer tank is vital for the matching of the electrolyser and the compressor, specially under variable (wind turbine) operation
  - dynamic effects are of the order of 1 Hz. An analogue input was specified on the electrolyser in order to specify the current, based on the output of the wind turbine and the control strategy
  - a PLC based control system was preferred to a PC based one for reasons of safety, resulting however to reduced flexibility in implementing changes in situ
- special attention must be paid to peripheral units, vital for the safe operation of the system, including cooling water, instrument air, Nitrogen inertisation. A closed cooling water system was preferred since in such remote locations water availability is limited
- the fact that the installation is remote and exposed means that provisions must be taken in protecting the hardware from nature’s elements, from theft and even from wild animals