Comparison between pumped storage hydroelectricity and hydrogen accumulation

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Operation at varying duty strongly reduces an overall performance of power station. Modern thermal power plants are complex systems of interconnected equipment, thus decrease in efficiency of one of the basic units leads to the general decrease of overall efficiency. This basic element in most cases is the turbine which efficiency strongly depends on operational regime, and for off-nominal regimes efficiency can be decreased on 1−12%.

Partially the problem of uniform load of power stations can be solved by uniform power supply system, which redistributes electricity between consumers, but long distance transfer of the electric power is connected with significant losses.

To cover non-uniformity of power production the power installations which accumulate the electricity at off-peak can be used. Such installations permit power station to work practically constantly at nominal mode and save fuel, thus reducing harmful influence to environment. Construction of high capacity power accumulation installations demands significant capital investments and thus arises a necessity of an optimal choice of the accumulation system for each case.

In present paper efficiencies of hydroelectric pumped storage power plants (PSP) and installations on the basis of hydrogen accumulation systems (HAS) for accumulation of electric power on plain-situated thermal power plants with nominal power up to 1200MW are compared.

In PSP accumulation of the electric power is due to pumping of water in water storages at off-peak and flow of this water through turbines at peak. In plains the area needed for such a system is several times greater than area covered by power plant itself.

Hydrogen accumulation is based on electrolysis of water at off-peak, storage of compressed hydrogen and oxygen and their combustion at peak. The produced steam can be used in autonomous high temperature steam turbine or in main steam turbines of power plant. We consider the second variant. Hydrogen has high energy density and needs small areas for the storage, not exceeding the area of the power plant that allows to integrate into it HAS without significant use of territory unlike PSP.

Comparison shows, that HAS has significantly lower payback period than PSP: 6 and 15 years accordingly. Due to installation of the accumulation equipment the efficiency of power plant will be constantly close to optimal, thus overall efficiency of power plant will be increased, that will cover capital investments into accumulation system, reduce environmental costs and lower specific fuel consumption.

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