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GRAVITY ENERGY STORAGE DEVICES

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Gravitational electric power storage devices are one of the types of stable mechanical-type electric power storage devices that, when there is an excess of electricity, store potential energy by lifting the working fluid to a certain height. And then, when additional electricity is required, this working fluid is fallen, releasing potential energy, converting it into kinetic energy, which in turn drives a turbine that generates electricity. They can use either heavy materials or water in their work.

In practice, this principle is implemented in pumped-storage power plants (PSPP). At low peaks of electricity consumption, water is pumped from a lower reservoir into an upper storage pool and then released at maximum peaks of consumption. Under the influence of gravity, it flows into the lower reservoir, rotating the hydroelectric turbine and generating electricity, which enters the power grid. Fast start-up and operational readiness allows the use of PSPP in various modes with multiple starts and stops during the day. At the same time, the efficiency of PSPP reaches an average of 66% [1].

The main functions of PSPP are:

1) Coverage of daytime consumption peaks;
2) Closing the power consumption gap at night;
3) Energy storage;
4) Reactive power compensation in the power system;
5) Maintaining a constant current frequency [1].

Gravity storage devices that work with blocks are also used in practice, where a heavy block acts as a working body instead of water. The Swiss company Energy Vault has built a system based on this principle outside of Shanghai in Rudong, Jiangsu Province, China. Energy Vault installations, using up stored electricity, lift a massive composite block, thereby storing potential energy. And when the electricity needs to be extracted, the block falls down, and the kinetic energy from the fall starts

the generator motor. According to the data provided by the company, such system allows to accumulate 100 MWh of energy, which it can produce with a capacity of 25 MW. It is the world's first commercial-scale model. It stands next to a wind farm to which it provides the necessary storage capacity for the electricity generated. The crane is equipped with six booms and is able to lift 30-ton blocks composed of local waste materials. At the same time, the claimed efficiency of this system is 75% [2].

Among the advantages of the EVx^{TM} design built in China are the following:

- modularity of construction,
- resistance to harsh operating conditions,
- long service life,
- no decrease in productivity over time,
- fire safety, since the structure is a composite material structure.

According to research by the International Institute for Applied Systems Analysis (IIASA), gravity storage devices can be built on the basis of abandoned mines.

Only instead of blocks, they will be based on trolleys. Unlike horizontal lifting and lowering of the block from top to bottom, trolleys roll down the mountain during peak loads, and the engines with which they were lifted work as a generator, generating electricity. According to statements, this system has a global potential of energy capacity from 7 to 70 TWh.

Summing up, we can say that gravity storage devices are in an active stage of development and represent a promising direction in the field of energy storage, being environmentally friendly, flexible in operation and necessary in the context of the transition to more sustainable and renewable energy sources.

References

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