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**Virtual Power Lines**

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The ever-increasing share of wind and solar photovoltaic electricity in modern state power systems dictates requirements for improving the quality of effective management of this resource, and in some cases the modernization of the current or the construction of new infrastructure in the distribution electric networks serves to prevent overloads.

In a number of countries, pilot projects of “wireless” alternatives or so–called virtual power lines (VPL) are emerging as an alternative to the expensive modernization of infrastructure necessary for the full integration of variable renewable energy sources (solar photovoltaic and wind energy). VPL reduce the load on the live parts of the line, while increasing the performance and reliability of the power system. In a general sense, VPL include rechargeable batteries connected at least in two places of the network: one battery complex is installed on the side of electricity generation next to a renewable generation source. In this part of the virtual transmission line (in the battery), the excess of produced electricity is stored, which, due to the overload of the transmission line, cannot be transferred to the consumer [1].

It is worth noting that in some countries, the contract for the purchase and sale of electricity from renewable generation is concluded for a certain period of time in advance. However, there are risks for both parties to the contract due to the volatility of renewable energy production and the difficulty of forecasting it both with excess and insufficient production. An

additional factor complicating the process of full-fledged operation of renewable generation as part of modern power systems is the limited capacity.

So, in case of an overabundance of the generated capacity, a part outside the contract cannot be sold by the supplier, in fact reducing the overall utilization rate of installed capacity and, as a result, reducing profitability. In turn, the system cannot purchase cheaper energy from renewable sources, incurring losses to some extent.

The second battery pack is located on the consumption side: it will be charged in the absence of overload in the power line and low demand on the consumption side. The battery storage used as VPL offers a technical alternative to increasing the capacity of power grids, as well as improving the reliability and security of the system. The purpose of using VPL is to provide additional electrical capacity much faster and, in some cases, at a lower cost than with the usual strengthening or expansion of infrastructure [1].

VPL are a particularly cost-effective solution in cases where network congestion occurs during certain rare events of different times, among which abnormally high temperatures in summer are distinguished. In addition, virtual power line battery complexes can provide services to maintain an optimal voltage level. Ultimately, VPL are an add–on that helps manage congestion without upsetting the balance between supply and demand.

References:

1. Virtual Power Lines: Innovation Landscape Brief [Electronic resource]. – Mode of access: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jul/IRENA_Virtual_power_lines_2020.pdf. – Date of access: 13.03.2022.