

Abstract

Optimization of wind farm power interaction based on the use of high-energy autonomous energy storage systems

Poland is one of the most promising wind energy markets in Europe. As of the end of 2020, the installed capacity of wind turbines and other renewable energy sources is 20.69% of the total installed capacity of the Polish power system. The growth of a part of wind farms in the Polish EPS makes it difficult to regulate the energy balance due to the random nature of wind energy. As demonstrated in the dissertation, one of the problematic issues is the growing need for regulating capacities that can compensate for an unexpected change in electricity generation at wind farms.

In the thesis, a mathematical model of a sufficient reserve capacity of an electrical network with wind power plants and a method for determining the reserve capacity for wind power plants are used. A method has been developed for determining the storage capacity for wind power plants, taking into account the forecasting of the generation schedule, as well as a method for coordinating the generation schedules for wind power plants and the load of electricity consumers. To use the proposed methods, a structural diagram of the WPP optimal control system and algorithms for their use for matching load and WPP generation schedules have been developed. The results of the calculations performed confirm the effectiveness of the developed methods and algorithms.

Keywords: wind farm, energy storage system, generation forecast, load schedule