ENSURING SUSTAINABILITY OF ELECTRIC POWER SYSTEM WITH RENEWABLE ENERGY SOURCES

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Introduction. The statistical service of the European Union (Eurostat) estimates that Ukraine is potentially capable of producing at least 74% of the country's energy from renewable sources, while now this level is about 10% (as of October 2021). Renewable energy over the next 10 years will occupy up to 30% of the country's electricity generation market. However, due to volatile nature of electricity generation, it is necessary to provide for electric power regulators.

Presentation of the main research. In the second quarter of 2019, renewable energy facilities with a total capacity of 656 MW were put into operation in Ukraine. This is 6 times higher compared to the same period of the previous year (109.6 MW was introduced in the second quarter of 2018). Thus, at the end of the second quarter of 2019, the capacity of the Renewable energy sector (RES) in Ukraine reached above 3,600 MW. In general, in the first half of 2019, RES facilities with a total capacity of 1,517.1 MW were launched in Ukraine. Of these, 1,252.1 MW – solar power plants (SPP), 243.7 MW – wind farms (WF), 20.4 MW - biogas plants and 0.9 MW - small hydropower plants (SAEE, 2021).

According to the National Commission for Regulation of Energy and Utilities (NCREP, 2021), in the third quarter of 2019, the structure of electricity generation in Ukraine is as follows [2]: nuclear power plants (NPP) – 53.7%, thermal power plants (TPP) – 30.8%, combined heat and power plants (CHPP) – 6.8%, hydro power plants (HPP) and power storage power plants (PSPP) – 4.9%, RES -3.7%. In turn, among RES, wind farms and solar power plants accounted for about 90% of electricity generation, respectively 30% and 60%. The remaining 10% was produced by small hydropower plants (5%) and biogas / biomass generation (5%). Electricity generating systems based on RES are being implemented in Ukraine at a very high rate

and occupy an increasing share of the market. Among them solar power plants dominate.

Significant daily and weekly uneven electricity consumption has a negative impact on the performance of the interconnected power system (IPS) that shows up in: 1) decrease duration of the installed capacity use; 2) increase in specific fuel consumption due to uneven mode of operation of the equipment; 3) acceleration of equipment wear4 4) reduction of district heating system efficiency due to direct reduction of superheated steam; 5) deterioration of electricity and heat supplied to consumers quality.

To increase the economic efficiency of the energy sector, the configuration of electrical load schedules is deliberately changed. This change (lowering the maximum and increasing the minimum load) is called adjustment (alignment) of load schedules. The most common method is use of electrical energy storage systems.

These systems include hydro-, pneumo-, electricity and hydrogen energy accumulating systems. They perform two functions: 1) they are involved in regulating workload schedules; 2) as generation sources, they cover load peaks.

Such systems are considered as a buffer between the mains and RES and are designed not only for long-term energy storage, but also for smoothing significant ripples associated with the unstable nature of RES.

Data on a day, a week and a month period power generation and consumption show that are time intervals at which over generation is observed. These time intervals can be used for storage of power, which later is used to cover consumption in time of peak intervals. There are two pumping storage plants (PSP) in Ukraine that are turned on, and they operate in the mode of energy storage – consumers. In addition, when the share of RES falls and consumption increases, they go into the mode of generation. It is necessary to have controlled shunting generation to balance the grid, which can produce about 13 GW power in less than in three hours of consumption growth.

In addition, every year the amount of the needed stored power increases. Experts noted that that in Ukraine, instead of over-stimulating the development of one type of generation, it is necessary to comply with the requirements of the National Action Plan for RES 2020 - to develop WF and SPP in a balanced way with the construction of shunting PSPs.

The existing structure of generating sources at the beginning of 2019 allows to integrate wind farms and power plants up to 4 GW in total without deterioration the balance reliability of the interconnected IPS system of Ukraine. At the same time, building further capacity of wind and solar power plants requires a change in the structure of generating sources limiting the capacity of base power plants.

The real situation on a Sundays in Autumn 2019 was that the difference between curves of power consumption and scheduled generation of "traditional" energy falls on the generation of RES. To balance the power system, the dispatchers took an unprecedented step launching the PSP in the afternoon for injection. And the situation is not standing still and according to the NCRECP by the end of 2021 is expected to significantly increase the generation of RES. That is, the curve of "traditional" generation is guaranteed to move even lower in the daytime next years.

Conclusions. Thus, the Ukrainian power system has a feature. During a flood, hydropower plants are operating at full capacity and can hardly manoeuvre. With such a regime and a high NPP base, there is not enough shunting generation left in the energy balance, which can provide the necessary reserves and effectively close the sharp evening increase in consumption (Ukrenergo, 2021). To overcome this situation, it is necessary to develop different types of generating capacities, taking into account increase in the share of generation from RES to 25%, as envisaged in the Development plan until 2035. Ukraine`s energy system needs to implement a storage systems based on energy accumulation. One of the effective ways for future development of power accumulating capacities is research and development hydrogen producing, accumulating, and generating complexes.

References

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