

duction in insulation spaces. The last one is related to the narrowing of the oil channels and therefore the increase in the electrical field constriction in them. The electric field thus becomes an important factor in the ageing of oil, the effects of which can manifest themselves in various forms.

The nature of the changes induced by an electric field can be of both a physical and chemical nature. The former include those that are ultimately characterized by a lack of effect, i.e. when an electric field is removed, the oil fully restores its original properties. In other conditions, under the influence of the field, irreversible transformations of hydrocarbon and other molecules of transformer oil take place, which can be considered as the result of chemical influences.

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ANALYSIS OF GENERATION BY PHOTOVOLTAIC PLANTS

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According to the International Renewable Energy Agency IRENA [1] (Fig.1), the rate of increase in the installed capacity of renewable energy sources, including non-guaranteed ones, has been noted. In the normative document SOU-N EE 40.1-00100227-101: 2014 "Standards of technological design of power systems and electrical networks of 35 kV and above" under the power plant of unguaranteed capacity means a power plant that uses unstable natural energy, resulting in a limited opportunity or completely is not able to adjust its capacity in accordance with the set daily schedule. The requirements for wind and solar power plants in their operation in parallel with the unified energy system of Ukraine state that wind farms and power plants are considered to be unsecured power plants under certain weather conditions (there is a possibility to stop issuing their active capacity to the network 3-5 m/s, and for solar power station with solar radiation $<200 \text{ W/m}^2$). Therefore, the task of studying the instability of photovoltaic power station generation depending on meteorological factors is relevant [2, 3].

For analyses power generation we used artificial neural networks (ANN). When forming the sample of training data, only those hourly data were taken into account when the station generates electricity (of 45002 datasets):

- Output: the hourly value of RES electricity generation;
- Inputs: $G_{b(i)}$: solar (direct) irradiation on an inclined plane (W/m^2); $G_{d(i)}$ – diffuse irradiation on an inclined plane (W/m^2); $G_{r(i)}$ – reflected radiation on an inclined

plane (W/m^2); H_{sun} – height of the sun (degrees); T_{2m} – air temperature at a height of 2 m (degrees Celsius); WS_{10m} – total wind speed 10 m (m/s).

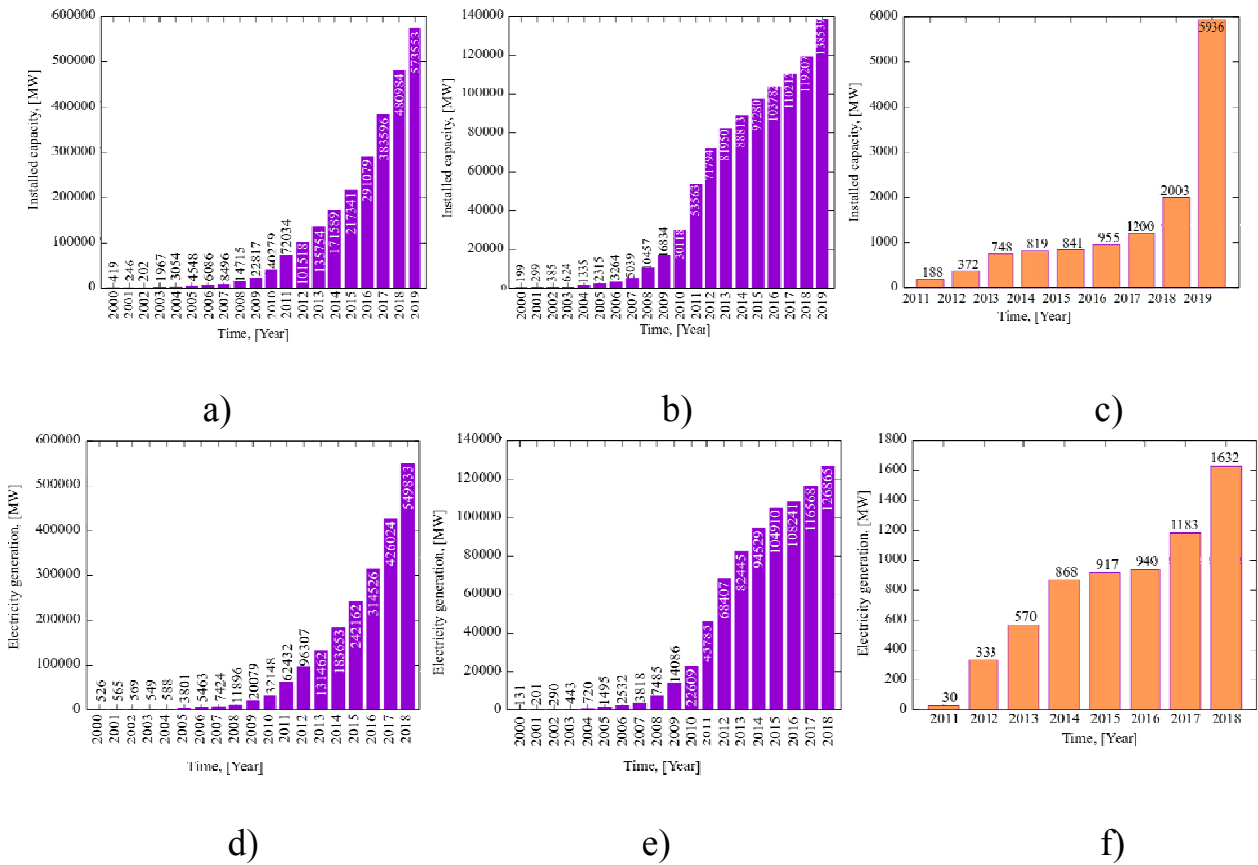
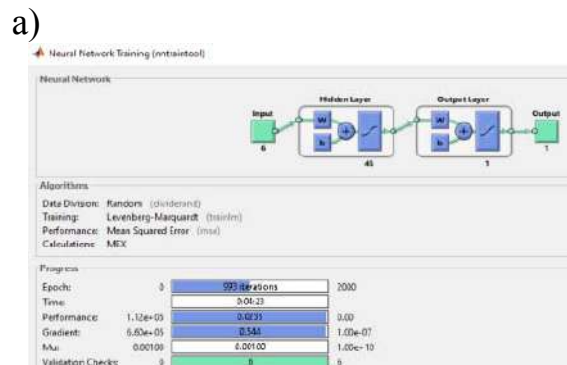
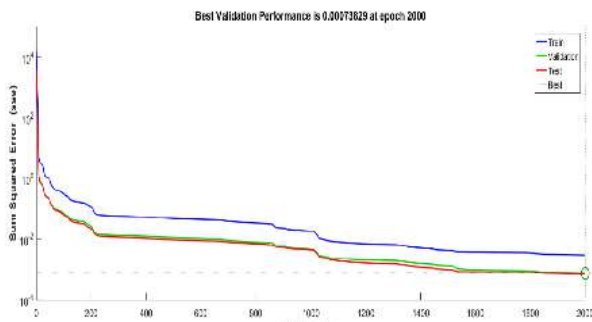
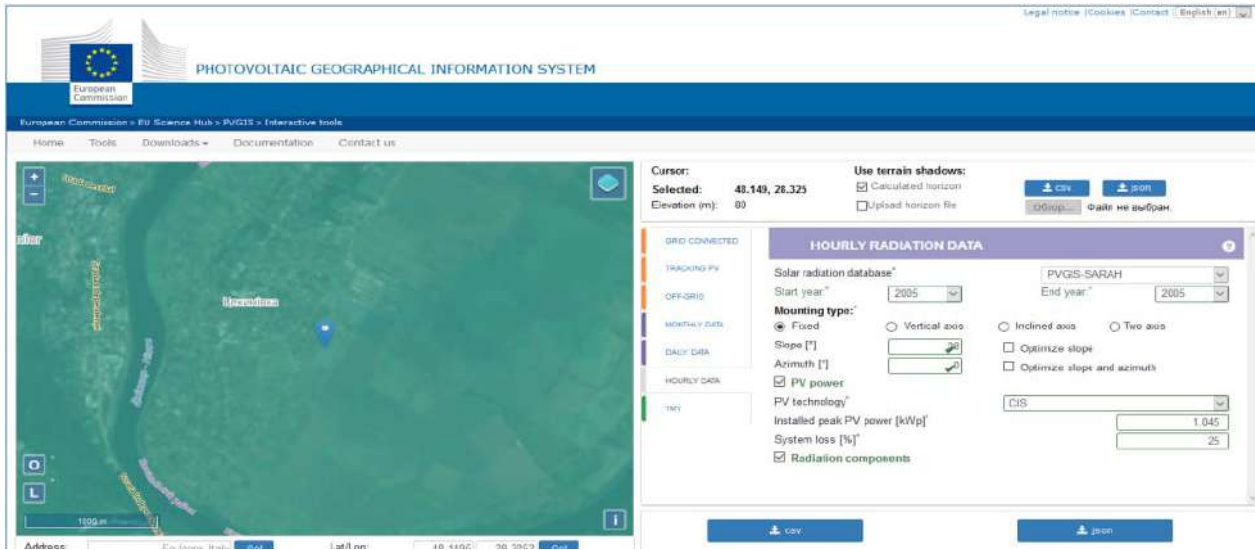


Figure 1 – Installed capacity solar power plants in World a); Europe b); Ukraine c); and electricity generation by solar power plants in in World d); Europe e); Ukraine f).

We took data from European Commission Photovoltaic Geographical Information System (Fig. 2 a)). After analyzing the data for the 2013-2015 years PVPS (photovoltaic power station) "Tsekinivska-2" 4-5 queues, a training set was formed to create an ANN. For this purpose, the MATLAB is used, namely the module for the creation of ANN - Neural Networks Toolbox. The package includes more than 160 different functions that allow you to create, train and explore neural networks. The results is shown Fig. 2 b) and c).



b)

c)

Figure 2 – Hourly meteorological data from European Commission Photovoltaic Geographical Information System for PVPS "Tsekinivska-2" 4-5 a); Results learning ANN for determination power generation depend on meteorological factors b) and c).

Conclusions. The created artificial neural network allows to determine the generation of RES depending on the change of meteorological factors and can be usage for predict power generation.

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