ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 8, Issue 4 , April 2021

Computer Model of Combined Autonomous Power Source Based On Micro Hydroelectric Power Station and Photovoltaic Solar Power Plant

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ABSTRACT: Analyses of the development of renewable energy resources have shown that the use of only one type in the energy supply systems of autonomous consumers does not always allow for reliable and uninterrupted energy supply. To improve efficiency, a combination of different types of renewable energy is needed.

For uninterrupted power supply to remote consumers, it is advisable to use combined autonomous energy sources, in our case on the basis of a micro-hydroelectric power station and a photovoltaic solar power station, such an arrangement allows uninterrupted provision of electric energy to consumers, as well as significantly reducing its cost.

A computer model of a combined autonomous power source based on micro hydroelectric power plants and a photovoltaic solar power plant has been developed. The optimal scheme of electrical equipment of the combined independent electric power source based on micro hydroelectric power station and photovoltaic solar power plant and computer model in Matlab/Simulink program are proposed.

Studies of the developed model were carried out, which made it possible to draw a number of important conclusions on its practical application as a combined autonomous source of electric energy.

KEYWORDS: computer model, Matlab/Simulink, combined automatic power supplies, results of oscillogram study, efficiency.

I. INTRODUCTION

In many countries of the world the powerful systems of the renewables (R) are based, as we know, on use monowind-, the monosolar photo-electric or monosolar heat generating complexes [1-4].

Currently, the overwhelming number of renewable energy systems in the world are represented by mono complexes. These include wind farms, solar power stations, small hydropower plants, geothermal thermal power plants and POS, etc. The largest RES mono-complexes are used in the following countries: USA, China, Germany (wind farms, solar photovoltaic stations); France (Rance tidal power station), Japan, Yu. Korea (solar power plants); USA, Italy, Iceland (geothermal).Their characteristics are widely presented in literature, educational materials and electronic media. Among the largest monostances in terms of installed capacity - WES in the state of California (USA) - with an installed capacity of 1550 MW; Horns Rev 2 wind farm located in the North Sea, 30 km from the west coast of Jutland (Denmark), with a capacity of 210 MW; for photovoltaic power - PRC, installed capacity at the end of 2010 - 900 MW, by 2012 - already 2 GW, and the target of the PRC by 2015 - 15 GW of installed capacity; of the FEF under construction - in the USA (California, San Luis Obispo County), capacity ≈550 MW. At the same time, there are numerous examples of the simultaneous use of two or more types of RES [5-7]. In Canada, hybrid schemes are used to provide energy to remote villages - wind diesel and wind breeding. Hydrogen is used to produce electricity in internal combustion engines. The wind-breeding scheme is used in the Prince Edward Island Wind-Hydrogen Village project and in the city of Ramea. The power of the hydrogen generator is 250 kW. Annually, it saves 120 thousand liters of fuel, thereby preventing emissions to the atmosphere: CO_2 - 320 tons, NO_x - 6.8 tons, SO_2 - 0.6 tons.

World experience in the development of renewable energy resources shows that the use of only one type of renewable energy in the energy supply systems of autonomous consumers does not always allow for reliable and uninterrupted energy supply due to the physical characteristics of renewable energy sources themselves. As a rule, they try to provide energy supply to autonomous consumers at the expense of RES by combining different types of RES into

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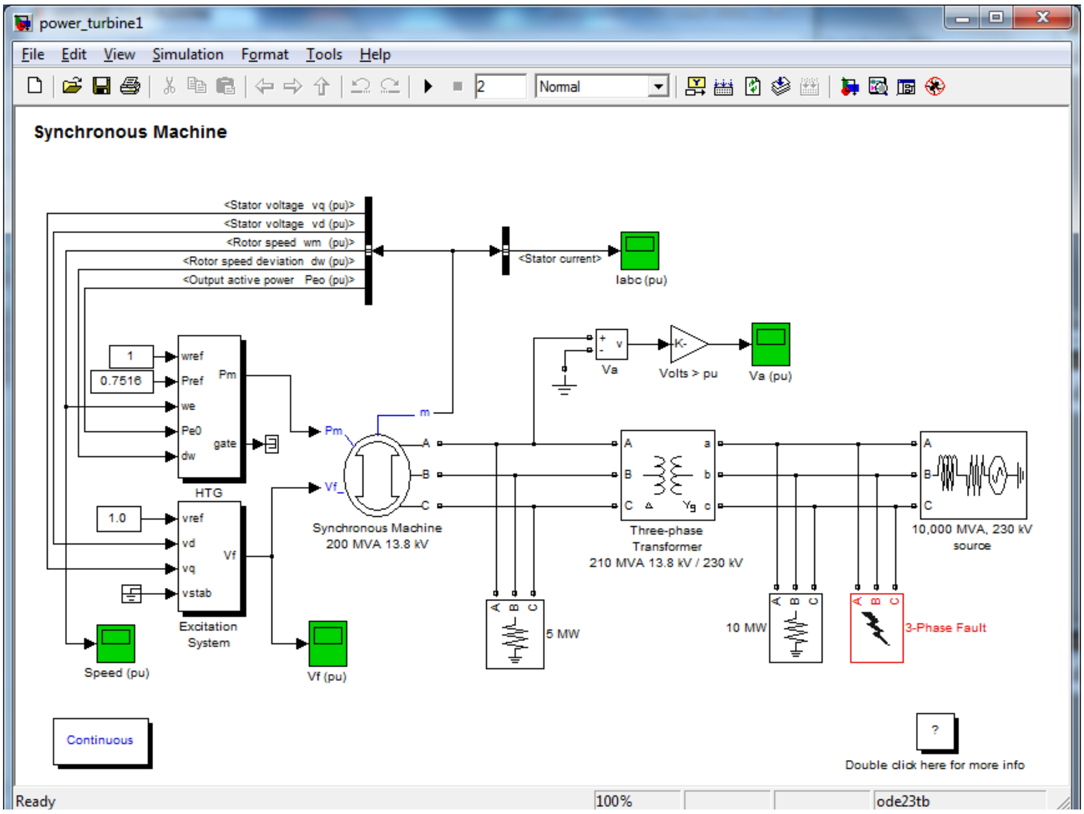
the so-called energy complexes. They usually include renewable energy plants, diesel (gasoline) power plants (DEU), as well as various types of energy storage systems [8-9].

For the remote territories of the Republic of Uzbekistan, which are not economically profitable to connect to a single power system for the electricity supply of industrial and agricultural consumers, the use of renewable energy sources using, for example, the potential of the sun and water is relevant [10-15].

The main goals and objectives in this work are: - the development of a computer model of a micro hydroelectric power station; - the study of the characteristics of a micro hydroelectric power station, - the development of a computer model of a combined autonomous power source based on a micro hydroelectric power station and a photovoltaic solar power station

MICRO HPP COMPUTER MODEL.

The computer model of micro HPP is presented in Fig. 1. The developed model contains the following elements: synchronous generator, three-phase transformer, output and input filters



The figures 2,3 show oscillograms of parameters of micro hydroelectric power plants.

The results of the analysis of the characteristics in these figures confirm the conclusion that the computer model of micro-HPP reflects a reliable influence on the output voltage of various loads in. terms of magnitude and nature and can be further used to create a computer model of a combined autonomous energy source based on micro-HPP and a photovoltaic solar power plant.

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COMPUTER MODEL OF A COMBINED AUTONOMOUS ENERGY SOURCE BASED ON MICRO HYDROELECTRIC POWER PLANTS AND A PHOTOVOLTAIC SOLAR POWER PLANT.

For uninterrupted power supply to remote consumers, it is advisable to use combined autonomous energy sources, in our case on the basis of micro hydroelectric power plants and photovoltaic solar power plants. The computer model developed below is a computer model of a combined autonomous energy source based on a micro-hydroelectric power station and a photovoltaic solar power station (Fig. 4). This arrangement allows uninterrupted supply of electric energy to consumers, as well as significantly reducing its cost. A computer model of a photovoltaic solar power plant should be developed in order to create a combined independent power source based on a micro-hydroelectric power station and a photovoltaic solar power station.
The input and output voltage of the DC-DC converter is shown in Figure 5.

Figure 6 shows oscillograms of an inverter of an autonomous power source based on micro hydroelectric power plants and photovoltaic solar power plants.

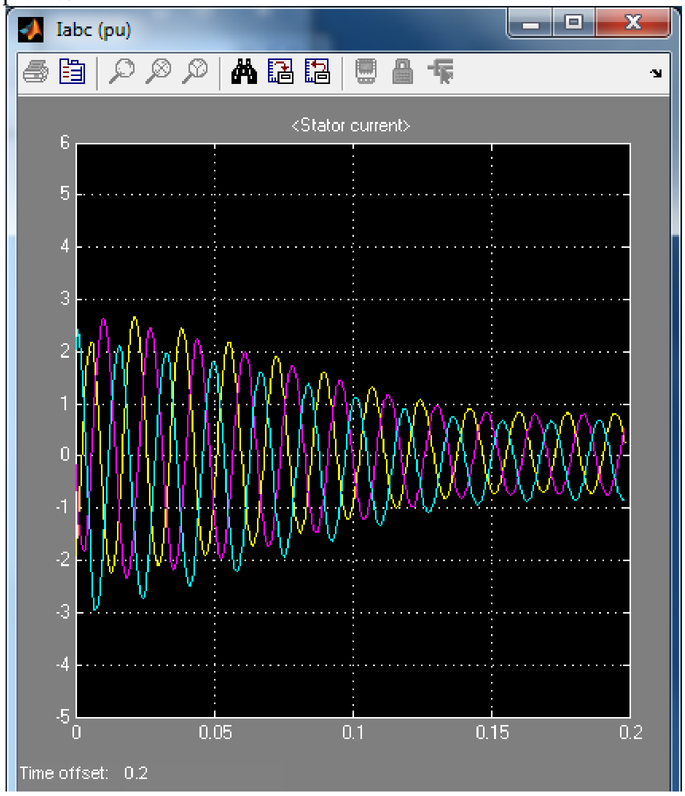

Fig. 2**. Oscillograms of stator current change**

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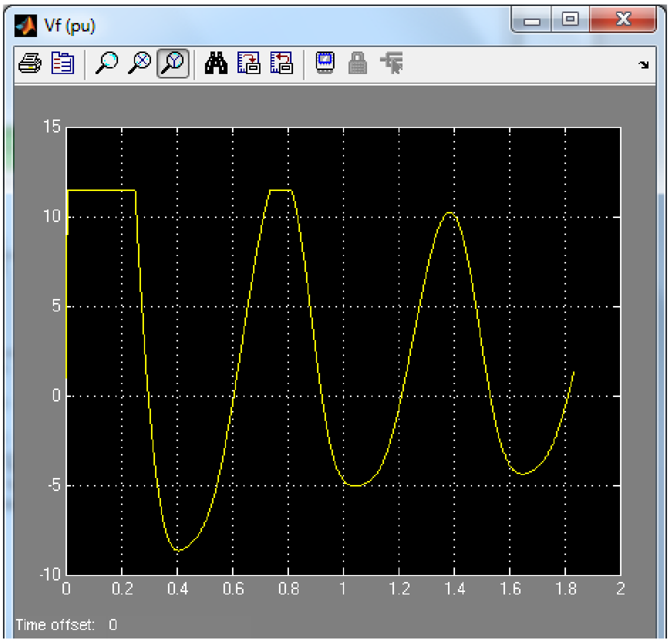

Fig. 3. **Oscillograms of generator excitation voltage change in relative units**

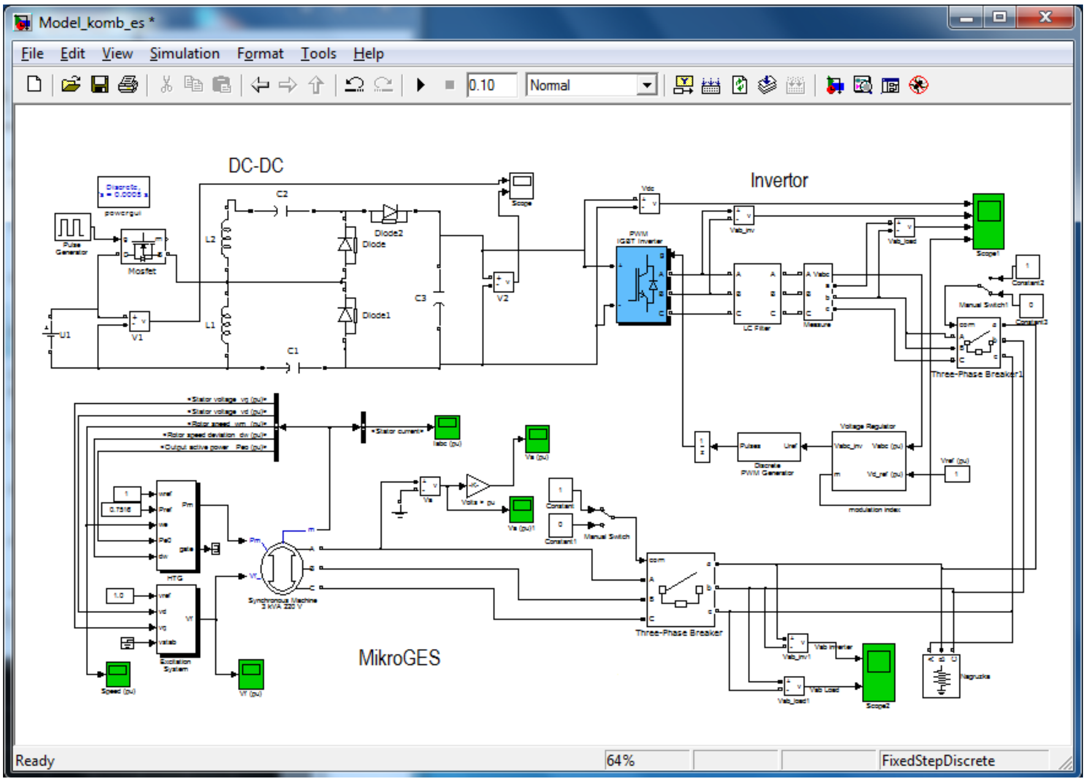

Fig. 4. **Computer model of combined independent power source based on micro hydroelectric power plant and photovoltaic solar power plant**

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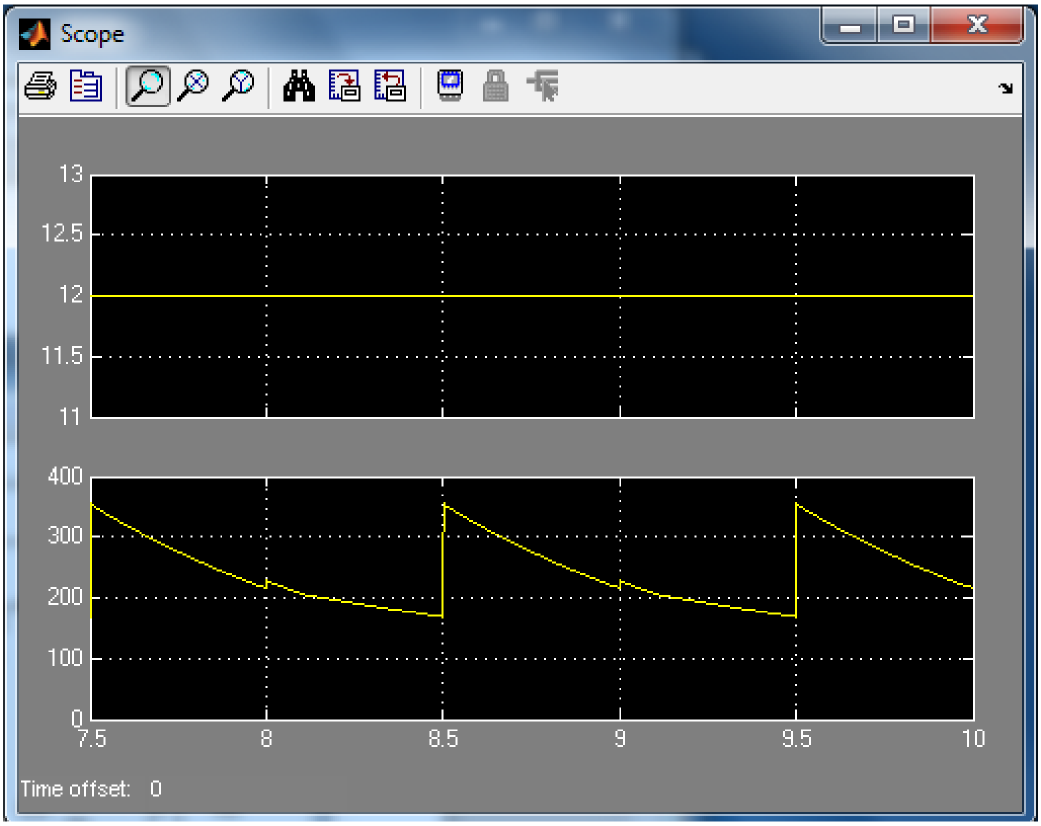

Fig. 5**. DC-DC converter input and output voltage**

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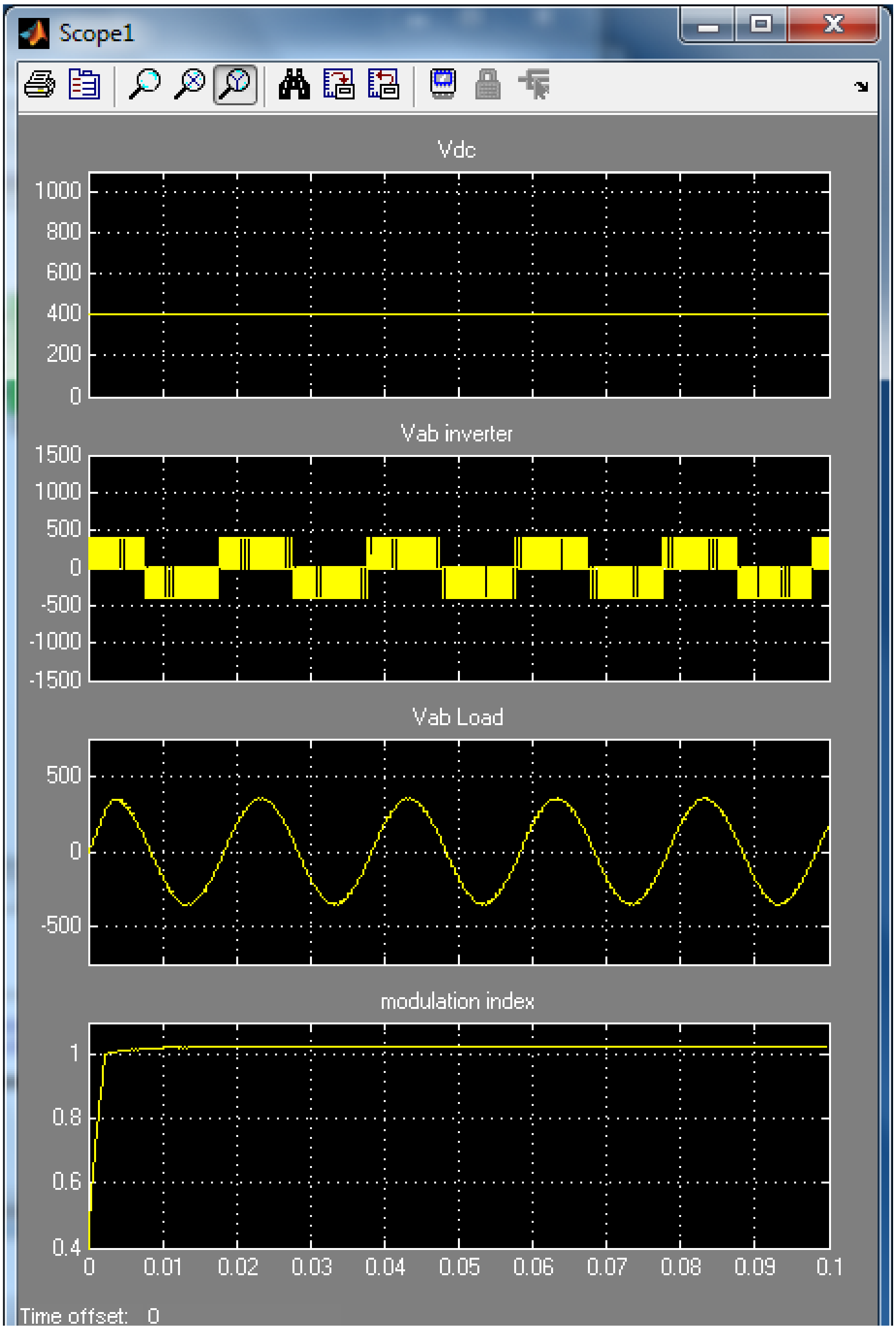

Fig. 6. **Inverter oscillograms**

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II. CONCLUSION

Computer models of a combined autonomous energy source based on micro hydroelectric power plants and a photovoltaic solar power plant have been developed. The computer model is developed in the MATLAB Simulink software environment.

The computer model will allow you to investigate the influence of the magnitude and nature of the load on the magnitude of the output voltage of the combined autonomous energy source.

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ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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