

## **ANALYSIS OF THE USE OF EFFICIENT RADIAL AND AXIAL FLOW ELECTRIC GENERATORS IN LOW SPEED ENERGY FLOWS**

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**Abstract:** This scientific work analyzes the theoretical and practical aspects of the use of radial and axial flow electric generators that operate efficiently in low-speed energy flows. Within the framework of the research, the specific features of the process of generating electricity at low rotational speeds, the electromagnetic structure of generators, design solutions and energy conversion efficiency are studied. The operating principles, load characteristics, torque generation capabilities and energy losses of radial and axial flow generators are compared and analyzed. Also, their prospects for use in wind, hydro and other low-speed alternative energy sources, technical and economic efficiency and operational advantages are evaluated. The results of the research serve to develop scientific and practical recommendations for the selection and design of high-efficiency electric generators in low-speed energy sources.

**Keywords:** Low-speed energy flows, radial flow generator, axial flow generator, electric generators, electromagnetic system, torque, energy conversion, alternative energy sources, efficiency, electric energy production.

**Introduction.** The modern demand for the development of electric power generation in the world is to increase the reliability of uninterrupted supply of electric power to consumers, to maintain the balance of electric power in the system, in the development of the electric power generation sector, special importance is attached to generators that produce electric power. In the production of electric power from low-potential water and wind currents, the use of electric generators with improved technical characteristics is of particular importance.

As a result of the decrease in the need for reducers, gears and gears used to increase the speed of water and air circulation in the world, reducing the cost and increasing the reliability of the system is considered one of the urgent tasks. Scientific research is being conducted on the production of electricity by effectively using its energy, in particular, on improving the value of the mechanical power produced by turbines, increasing the starting torque, increasing the efficiency of electricity generation by generators at low rotational speeds, and using generators of various designs with axial and radial flow in the system. In these research works, the improvement of an electric generator with a low nominal speed for generating electricity in low-pressure and low-speed water and wind flows through an electric generator is considered a priority. At the same time, the high nominal speed of generators in the production of electricity from water and wind flows, the requirement of constant current for the excitation winding, and the control of the excitation winding according to the load, pose problems for the effective operation of the system [1].

Use of low-potential water flows. The use of energy from hydropower systems has been studied for several centuries. Although most of the world's large-capacity water flows have been developed to date, there is great potential for the use of small and micro-power water flows. The

hydropower potential of Uzbekistan is estimated at 27.5 billion kW/h per year, and 27% of this figure is currently being used [2].

It has been observed that the use of low-current water energy, along with increasing the share of energy use, also reduces the damage caused to nature. In an experiment conducted using an underwater generator operating at 0.3 m/s-1 m/s, more than 300 fish species survived, 96% of which showed the advantages of using these generators [3]. The table below compares the technical characteristics of generators used to obtain energy from low-current wind and water alternative sources.

Table 1. Technical characteristics of axial and radial flow generators.

Values	Axial	Radial [4]
Power	3 kW	3 kW
Nominal voltage	220 V	220V
Speed	1200 rpm	1150 rpm
Frequency	60 Hz	60 Hz
Current	8.75 A	12.6 A
Motor mass	27 kg [4]	41 kg
Efficiency	90 %	83%
Power density	111.1 W/kg[5]	72.8W/kg [5]
Estimated cost of materials	609.8 €	535.65 €
Production cost factor (K)	1.5	2
Total costs	914.7 €	1071.3 €

#### Axial flow generators

The use of axial flow generators without the use of a reducer in wind turbines has led to an increase in the wind energy utilization coefficient, energy density and a decrease in generator weight [6]. When comparing axial (SGPM-5-150A) and tangential (SGPM-5-150T) current generators, the efficiency of the axial flow generator was 2.1% higher, the use of the commutator was 2.2 times less, and many other advantages were found [7]. The voltage of the two-rotor axial generator was 79 V-150 V at 50 Hz when operating at 219-402 rpm, and the frequency was 333 rpm [8]. The energy density of the axial flow two-stator and three-rotor generators, and the energy density of the two-rotor and single-stator axial flow generators was 283.6 W/kg and 195.3 W/kg, respectively. However, the large number of magnets required to manufacture these types of generators increases the cost of the generator [9].

Radial flow generators. Radial flow generators are currently used in many large-scale hydroelectric power plants. The generator used in these hydroelectric power plants is multi-pole, has a low rotational speed. The difference in voltage between each phase of a radial flow generator with a power of 10 kW and a rotational speed of 214.3 rpm was observed to be 0.3%-1.3%, and the difference between practical and theoretical experiments was 5% [10]. Other research studies have shown that the use of radial flow generators for wind flows with low potential energy efficiency gives good results. When the flow speed is 3 m / s-5 m / s, the generator speed can reach 100 rpm-500 rpm [11]

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