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Design of a water pump-solar source system for drinking water supply

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Abstract. Proper organization of the drinking water systems provided to the population, monitoring and management of their activity with the help of modern technologies is an effective way to save drinking water. In this article, the energy saving and continuous supply can be achieved by designing an energy-efficient, modern and solar-powered GRUNDFOS SP 17-8 pump instead of the old submersible pump designed to provide drinking water to individuals in Khavos district of Syrdarya region. issues are covered.

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1 Introduction

In some regions of our republic, insufficient use of groundwater is observed in some cities and other settlements as a result of the unsatisfactory condition of the underground water supply network systems, the intensive rise of the groundwater level, as well as the lack of scheduled hydrogeological monitoring. In some regions of our country where there is a shortage of quality drinking water, groundwater pumps and devices are not used enough, measures aimed at supporting their production have not been implemented in our republic. Controlling the rational use of underground waters and establishing their accounting, creating an effective monitoring system to further increase their reserves, protecting them from depletion and pollution, as well as providing the population of our republic with high-quality drinking water are one of urgent issues [1].

According to the United Nations, about 40 percent of the world's population lives in places where there is not enough clean drinking water. By 2025, 6 out of 10 people, or 5.5 billion people, may live in an area where clean drinking water is scarce. Also, more than 80 percent of infectious diseases are related to the low quality of drinking water and violations of sanitary and hygienic rules in water supply. Today, about 3 billion of the world's more than 8 billion people consume contaminated water, and as a result, almost 2 billion of them are infected with various diseases. The saddest thing is that every day 6 thousand children in the world die prematurely due to drinking water that does not meet sanitary and hygienic requirements[2].

According to sanitary standards, a person needs 50 liters of water a day for a healthy life. 1.1 billion people in developing countries in dry climate regions use only 5 liters of water a day. In European countries, this indicator is 200 liters per day, and in the USA it is 400 liters. The same distribution of water is observed in the regions of our country, in particular, in the city of Tashkent, the daily water consumption per capita is 280-350 liters, while in Karakalpakstan, Kashkadarya and Navoi regions, this indicator is 20-50 liters. In the long term, providing the population with high-quality drinking water based on the implementation of complex measures and targeted programs for the development and modernization of the drinking water supply system is one of the priorities of the social policy in our country. consistent reforms in the field of water use, including water supply and water release, taking comprehensive measures to ensure its use, quality and safety, as well as introducing modern innovative systems of water consumption accounting is increasing. In order to ensure effective regulation of water use, new water resources management structures have been created, and active efforts are being made to involve the private sector in the field of water supply and water extraction. In order to prevent accidents in drinking water networks, the application of GAT technologies to the system also gives positive results. Creating a drinking water quality management system that includes water quality control and monitoring in our republic is a modern way of controlling and accounting for the rational use of clean drinking water. establishing methods, increasing their reserves by creating an effective monitoring system, protecting them from depletion and pollution, as well as introducing water quality control and monitoring systems at water intake sites and in the process of drinking water production are one of urgent issues. Currently, the needs of the population of 69 cities, 335 villages and 2,902 rural settlements are met at the expense of underground water reserves. At the same time, the rapid development of industry and agriculture in the last 40-50 years had a negative impact on the state of fresh groundwater, which in turn led to the depletion of groundwater resources due to the unauthorized construction of water intake structures and uncontrolled water extraction. which led to a percent decrease and depletion of water reserves in some sources. Applying the technology of solar panels, which is considered a renewable energy source, to the water transmission networks in our country, as well as to all sectors, allows to eliminate technical failures and excess energy consumption in the system and provide the population with water at the same rate[3,4,5,6].

2 Material and Method

In Khavos district of Syrdarya region, the nominal depth for drinking water suitable for private consumption starts from 45 meters.

Table 1. Nominal parameters of the submersible water pump designed to provide drinking water to people in Khavos district of Syrdarya region[7,8].

Model	Rated current (Q)	Rated pressure (meter H)	Rated power (kW,P)
EPA4EGN10/34-7,5	14.5	50	7.5

Fig. 1. The current condition of the submersible water pump, which provides drinking water to the population of Khavos district of Syrdarya region, has become unusable today.

Table 2. Technical parameters of the proposed GRUNDFOS SP 17-8 pump[9,10].

Model	GRUNDFOS SP 17-8
Nominal pressure (meter. H)	65
Rated current (Q)	17
Nominal power (kW, P)	5.5
Liquid	water
Fluid temperature range	-15…40
Rated voltage (V)	380-400-415 V
Nominal rotation speed (rpm)	2900
Maximum working pressure (bar)	60

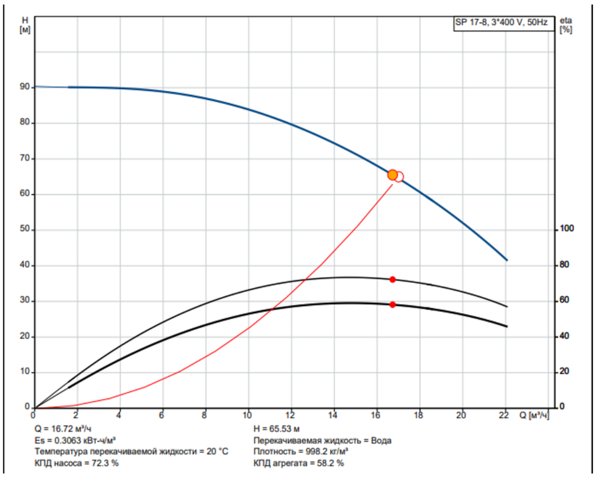

Fig. 2. Work graph at nominal work point

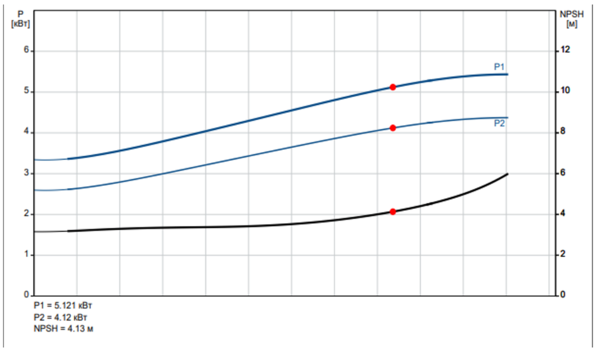

Fig. 3. Power graph

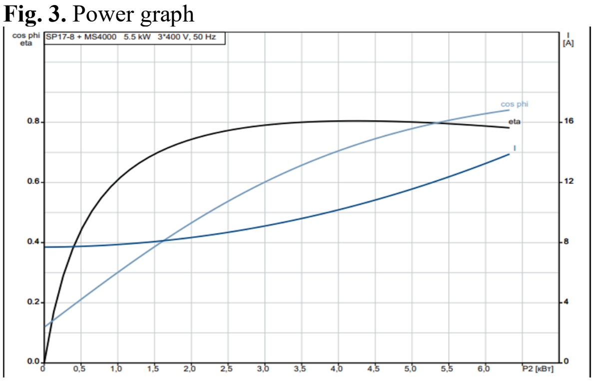

Fig. 4. graph of cos γ and current

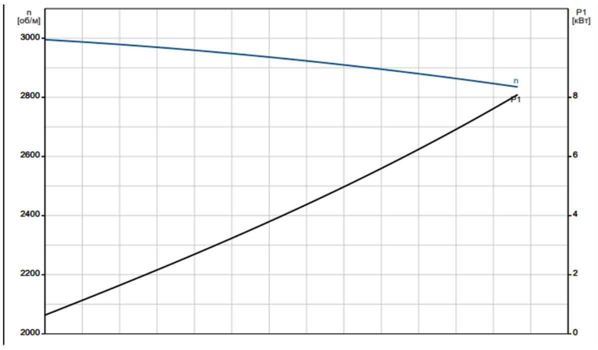

Fig. 5. Rated RPM and rated power graph

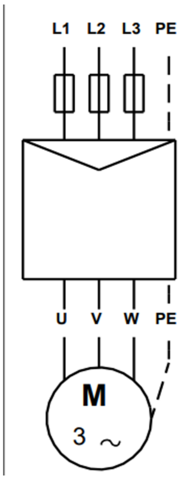

Fig. 6. Connection diagram

"GLOBAL SOLAR ATLAS" program was used to calculate the solar potential of the area where the pump is installed and the energy supply that is sufficient for us in order to provide the electric energy demand of this pump with the help of solar panels[11].

Table 3. Indicators of the "GLOBAL SOLAR ATLAS" program by region

Average radiation of the area (kW/m2)	1406.6
High horizontal radiation (kW/m2)	1623.8
Diffuse horizontal radiation (kW/m2)	733.2
Irradiance incident on the panel at the optimal angle (kW/m2)	1835.5
The optimal angle for installing a photovoltaic solar panel	320/1800
Air temperature for optimum performance (0C)	15.9

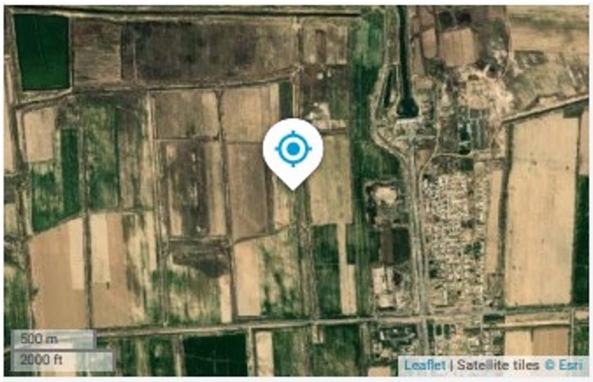

Fig. 7. Location of the facility

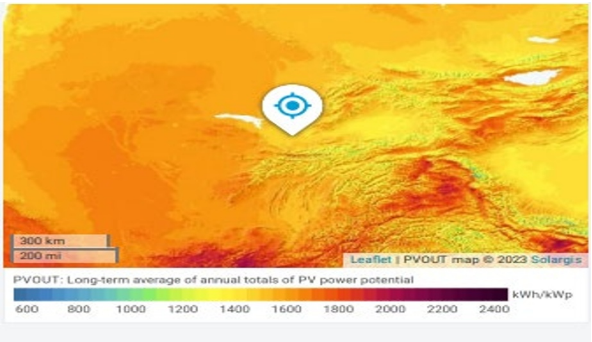

Fig. 8. Solar map of the area

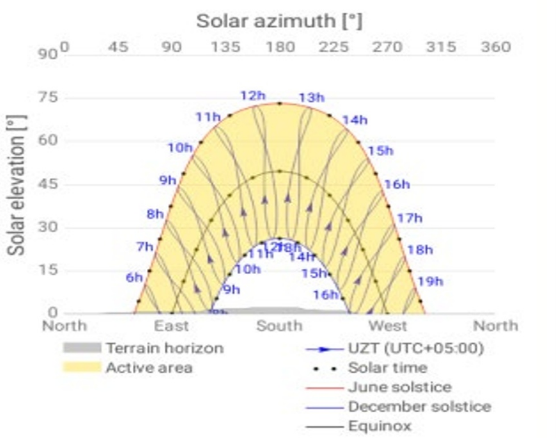

Fig. 9. The way of the sun

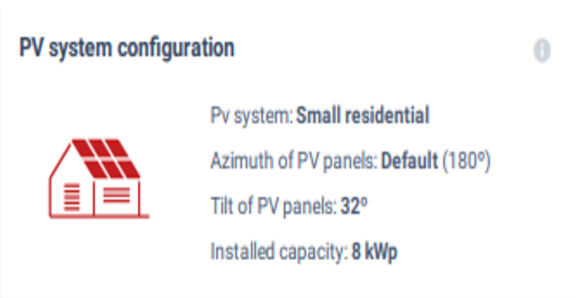

Fig. 10. Adjustment of the photoelectric system

Fig. 11. Annual averages

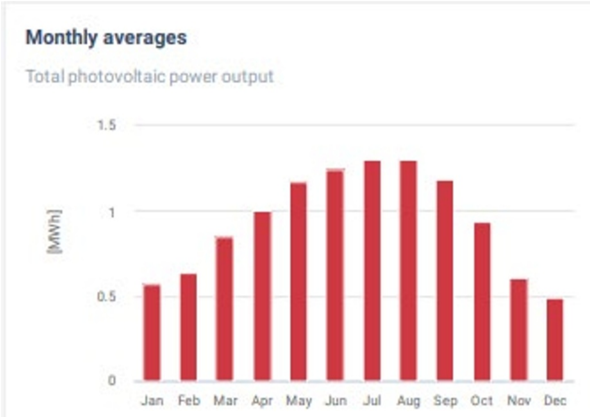

Fig. 12. Monthly averages

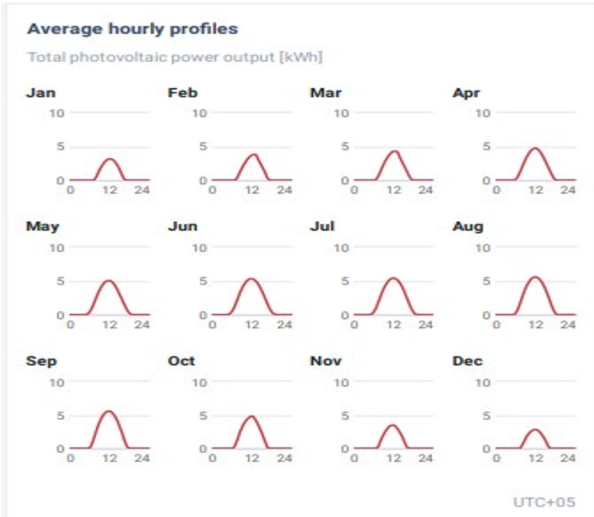

Fig. 13. Hourly indicators

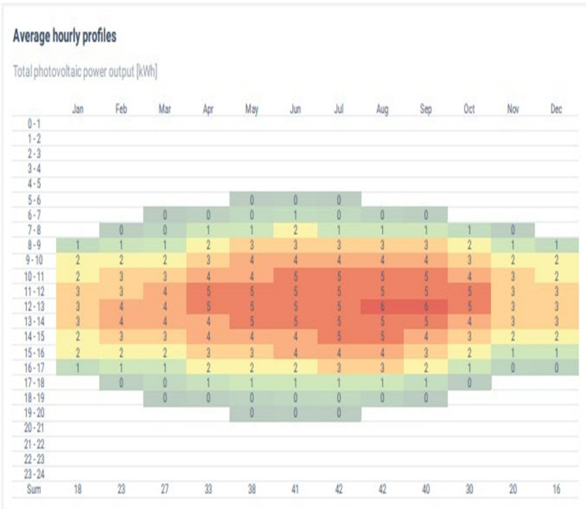

Fig. 14. Hourly solar radiation for months

Fig. 15. Annual average solar radiation

3 Results and Discussion

This study showed that if we consider an average water consumption of 50 liters per day per capita and 8 hours of work per day[13].

The current pump capacity (the values calculated according to the data in the technical passport of the pump, these technical parameters have decreased significantly at the moment): $\frac{14500}{50} = 290 \times 8 = 2320$ inhabitants are enough to be supplied with drinking water[14].

The proposed pumping capacity: $\frac{17000}{50} = 340 \times 8 = 2720$ inhabitants can be provided with drinking water.

If we evaluate from the technical and energetic side:

Current pump capacity:

$7.5 \times 8 = 60\ kWt/day$, $60 \times 350 = 21000\ kWt/year$

Proposed pumping power:

$5.5 \times 8 = 44\ kWt/day$, $44 \times 350 = 15400\ kWt/year$

4 Conclusion

The results of this study show that the system we have conducted is effective not only in providing drinking water to the population, but also for irrigation of livestock and field crops in remote areas where the electricity network does not reach and there is a great need for water. we believe that If we consider the average service life of solar panels as 25 years, and the service life of the pump as 25 years (if we take into account high-quality and timely maintenance), then for many years there will be no problems with water consumption[12].

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