Окончание

$П_{мес}$, т	**Расход ЭЭ, тыс. кВт · ч**	**Удельный расход ЭЭ, кВт · ч /т**	**Технологический расход ЭЭ, $W_{тех}$ЭЭ, тыс. кВт · ч**	**Вес технологической составляющей расхода ЭЭ в общем расходе, $W_{техн}/W_{сум} \cdot 100$, %**	**Условно-постоянная расхода ЭЭ, тыс. кВт · ч**	**Вес условно-постоянной составляющей расхода ТЭ в общем расходе $W_{усл\text{-}пост} / W_{сум} \cdot 100$, %**
45000	5774,4	128,3	3361,5	58,2	2412,91	41,8
50000	6147,9	123,0	3735,0	60,8	2412,91	39,2
….	….	….	….	….	….	….
110000	10629,9	96,6	8217,0	77,3	2412,91	22,7
115000	11003,4	95,7	8590,5	78,1	2412,91	21,9
120000	11376,9	94,8	8964,0	78,8	2412,91	21,2

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CREATING A MAP OF THE SOLAR ENERGY POTENTIAL OF THE REPUBLIC OF TAJIKISTAN

D. T. Isozoda, I. B. Makhsumov

Tajik Power Engineering Institute, Kushoniyon district, Tajikistan

The article presents data on the solar energy resources of the main settlements of Tajikistan, their energy potential is determined. To obtain accurate data on wind speed and total daily solar radiation on the territory of the republic, NASA data and the RESTcreen Expert program were used. With the help of the Solar Atlas web resource, a preliminary map of solar energy supply to the territory of the Republic of Tajikistan was created.

Keywords: renewable energy, solar radiation, solar potential map.

The role of green energy and its production in the modern world are becoming day

by day key trends for maintaining a clean environment. The Republic of Tajikistan, located in Central Asia, due to its geographical location, has a significant energy potential of renewable energy sources. However, the introduction of green energy facilities is proceeding at a slow pace. Despite the huge hydropower potential, which is estimated at 527 billion kWh/year, the Republic of Tajikistan cannot fully provide the country with electricity in winter [1]. Large-scale use of renewable energy could cover the energy deficit in the winter. The Government of the Republic of Tajikistan has adopted a new path for the development of rural electrification through alternative sources of electricity, the essence of which is the transition of the energy sector to the use of regional renewable energy sources (RES), including non-traditional resources [2]. To implement the above, the Government of the Republic adopted a number of laws on programs for short-term, medium-term and long-term implementation, development and use of alternative energy sources (solar, wind, biomass, small hydropower and others) [2].

About 10 million people live in developing Tajikistan, more than 3% of whom have practically no access to centralized electric networks. Alternative energy sources can provide hard to reach mountain settlements with a cheaper type of energy than the construction of hydroelectric power plants and long transmission lines, which can also help the country's economic development.

The global source of energy for any territory, including the Republic of Tajikistan, is the Sun. Solar radiation is considered a basic element of the climate as a source of all types of renewable energy. According to its natural and climatic conditions and geographical location, Tajikistan is one of the most promising territories in Central Asia for the use of solar energy [3]. According to local experts, the solar potential of Tajikistan is estimated at about 25 billion kWh/year, which could provide 10–20% of the national energy demand. The total value of solar radiation in a clear sky is 700–800 W/m^2 or 7,500–8,000 MJ/m^2 [3]. The total duration of solar study ranges from 2100 to 3170 hours/year.

The results of measurements of some local meteorological stations show the following values of the total duration of sunshine in the republic:

– meteorological station “Fedchenko Glacier” – 2116 hours at an altitude of 4169 m in the Pamirs;

– meteorological station “Dekhauz” – 2097 hours at an altitude of 2500 m in the upper reaches of the Zarafshan river;

– meteorological station “Pyanj” – 3000 hours in the southern part of Tajikistan;

– meteorological station “Karakul” – 3166 hours in the Eastern Pamirs.

In these territories, it is most expedient to use solar power plants. Local experts believe that the intensity of direct solar radiation is estimated from 10.3 kWh/m^2 (June–July) to 5.9 kWh/m^2 (December–January). To cover the deficit of thermal and electrical energy, the use of solar radiation is the most relevant direction not only today, but also in the near future [3].

NASA data and the RESTcreen Expert program were studied to identify promising areas for the use of solar energy. With the help of the Solar Atlas web resource, a preliminary map of solar energy supply to the territory of the Republic of Tajikistan was

created.

In table Table 1 shows the total monthly solar radiation in the main settlements of Tajikistan in W/m^2. The theoretical value of solar radiation entering a horizontal area on a clear day at the middle latitude of Tajikistan (39 °N) is shown in Table 2.

Table 1

Total monthly solar radiation in some settlements of Tajikistan, W/m^2

Settlements	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Dushanbe	87	122	156	209	275	327	330	294	244	168	112	77
Khujand	87	114	164	229	290	330	322	290	243	164	100	65
Bokhtar	80	115	153	213	277	333	322	290	232	165	110	73
Kulyab	87	122	156	209	275	327	330	294	244	168	112	77
Regar	87	122	156	209	275	327	330	294	244	168	112	77
Javan	87	122	156	209	275	326	330	294	244	168	112	77
Shahritus	80	115	153	213	277	333	322	290	232	165	110	73
Nurek	87	122	156	209	275	327	330	294	244	168	112	77
Kanibadam	87	114	164	229	290	330	322	290	243	164	100	65
Ura-Tube	87	122	156	209	275	327	330	294	244	168	112	77
Penjikent	87	122	156	209	275	327	330	294	244	168	112	77
Khorog	96	137	187	320	304	350	340	305	258	172	114	86
Dangara	87	122	156	209	275	327	330	294	244	168	112	77
Jirgatal	96	137	187	320	304	350	340	305	258	172	114	86
Komsomolabad	87	122	156	209	275	327	330	294	244	168	112	77
Garm	87	122	156	209	275	327	330	294	244	168	112	77
(Spita-men)	87	114	164	229	290	330	322	290	243	164	100	65
Isfara	87	122	156	209	275	327	330	294	244	168	112	77

Table 2

Theoretical parameters of solar irradiation of a horizontal area on the Earth's surface at the latitude of Tajikistan

The amount of solar irradiation	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
MJ/m^2.day	13	15	20	25	27	28	26	25	19	15	12	11
W/m^2.av.day	150	174	231	289	312	324	301	289	220	174	139	127

Global horizontal irradiance (GHI) is the most important parameter for calculating the energy output and evaluating the efficiency of photovoltaic (PV) technologies with flat solar modules. The solar resource map (Fig. 1) provides a summary of the estimated solar energy available for power generation and other energy applications. It is a long-term

average of the annual daily sum of global horizontal exposure (GHI) [4, 5].

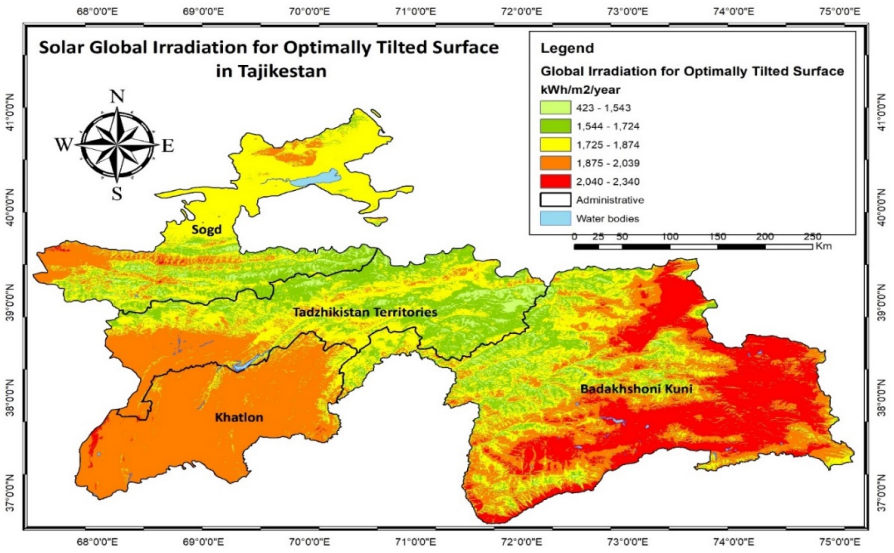

Fig. 1. Map of solar global irradiance to determine the optimal tilt of solar modules

Direct normal irradiation is the most important parameter for calculating the energy yield and evaluating the efficiency of concentrating solar energy (CSP) and solar photovoltaic (GHI) technologies. DNI is also important for calculating the global irradiance received by tilted or solar-tracking PV modules. The map (Fig. 2) provides a summary of the estimated solar energy available for power generation and other energy applications [4, 5].

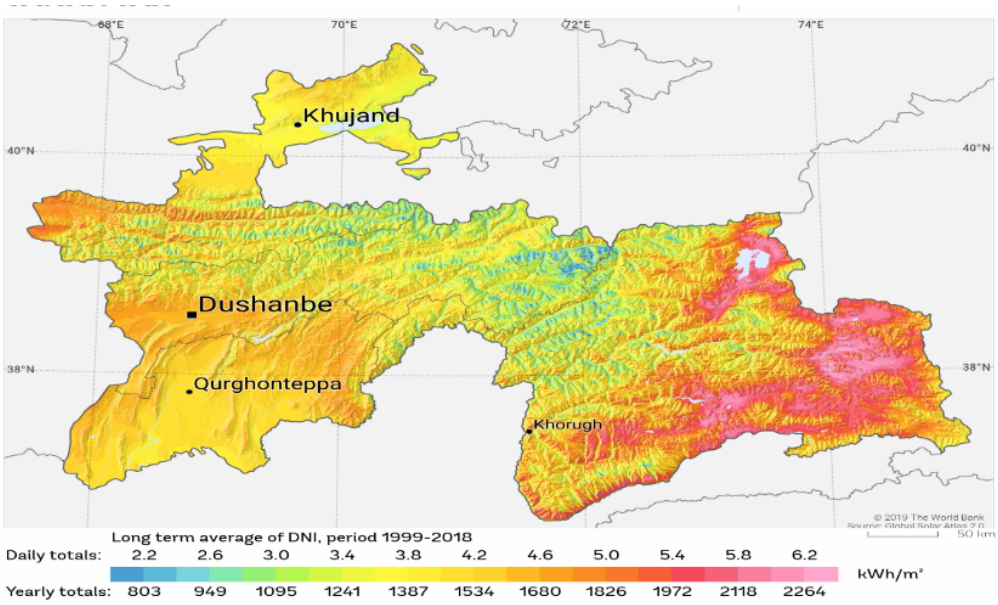

Fig. 2. Normal direct solar radiation on the territory of Tajikistan

Thus, the potential of solar energy in Tajikistan is very high and its use will be able

to provide uninterrupted electricity and heat supply to objects and settlements of the republic at any time of the year. But this requires energy programs both at the state and local levels. It is necessary to educate the public about the benefits of clean energy, using the media and special courses in educational institutions. For such a sunny republic as Tajikistan, there is a great need for solar energy specialists who could design, install and operate solar installations not only at the household level for individual use, but also for more energy-intensive facilities and enterprises. Using environmentally friendly solar energy, we will preserve the natural resources of the republic and create comfortable living conditions for the local population.

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УДК 621.315.2

ИССЛЕДОВАНИЕ ХАРАКТЕРИСТИК ЭЛЕКТРИЧЕСКОГО ПОЛЯ В СИЛОВЫХ КАБЕЛЯХ И СОЕДИНИТЕЛЬНЫХ МУФТАХ ДЛЯ ПОГРУЖНЫХ НЕФТЕДОБЫВАЮЩИХ СИСТЕМ

Д. И. Зализный, Д. Г. Кроль, Ю. А. Рудченко, Д. В. Сучков

Учреждение образования «Гомельский государственный технический университет имени П. О. Сухого», Республика Беларусь

Исследовано влияние электрического поля на пробой кабельных муфт, применяемых в системах электроснабжения погружных насосов нефтедобывающих станций ОАО «Белоруснефть». Получены картины напряженности поля в кабельной муфте в продольном и поперечном направлениях.

Ключевые слова: нефтедобывающая станция, погружная система, силовой кабель, соединительная муфта, электрическое поле, пробой изоляции.

ANALYSIS OF THE ELECTRIC FIELD CHARACTERISTICS IN POWER CABLES AND CONNECTING COUPLINGS FOR SUBMERSIBLE OIL PRODUCING SYSTEMS

D. I. Zalizny, D. G. Krol, Yu. A. Rudchenko, D. V. Suchkov

Sukhoi State Technical University of Gomel, the Republic of Belarus

The influence of the electric field on the breakdown of cable boxes used in the power supply systems of submersible pumps at oil-producing stations of the Belorusneft has been studied. The pictures