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THE EFFECT OF THE EXTERNAL ENVIRONMENT ON THE PHOTOELECTRIC SOLAR POWER PLANT

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Abstract
This article provides an overview of solar cells, their location, and the effects of the external environment on them. In addition, the article analyzed the volt-ampere characteristics of solar cells for 8 hours every day for 1 month and made conclusions.

Key words
solar, light, renewable energy, non-renewable energy, generation, signal, wind, azimuth, cloud, hydrometrology.

Introduction: After generating electricity, the main goal in photoelectric solar power plant with optimal power and power distribution scheme is to deliver it to consumption centers. But this period is considered the next stage. Because in the interval up to this period, it will encounter a number of obstacles that need to be properly analyzed [7].

It is known that the following important terms play a key role in the installation and use of solar batteries:

photovoltaic module – a device with structurally interconnected photovoltaic solar cells and an output terminal for connecting an external consumer;

efficiency of the solar module – the ratio of the electric power of the solar module to the solar energy flow density multiplied by the module area;

base structure - a device that maintains the spatial location of the solar battery;

tracking system of photovoltaic devices - a set of mechanisms and devices that ensure the operation of the tilting device in order to direct the solar cell in a certain way to the flow of sunlight;
In order to assess the influence of climatic factors on the installation of solar batteries, it is important to obtain the following meteorological data from the Center of the Hydrometeorological Service of the Republic of Uzbekistan (Uzgidromet) for the region where promising fields are located, at least for the last 10 years. we can say that it is finding its reflection [8].

- maximum and minimum ambient temperature;
- relative air humidity and pressure;
- wind direction and maximum/minimum speed;
- the number and interval of sandstorms;
- amount of precipitation and their interval;
- the maximum amount of snow thickness and snow loads;
- risk of floods and landslides.

Light and calm winds have been found to have a positive effect on the production of electricity in a photovoltaic solar mini plant, as they have a cooling effect on the solar modules [10-

18]. However, high wind speeds have been found to adversely affect production performance as they can raise dust and debris and create loads that can damage the support structure and clamps of the solar modules. In order to determine the optimal value of the average annual wind speed and to estimate its impact on the mini-photoelectric solar power plant, it was found that the following points are indicated according to the Beaufort scale adopted by the World Meteorological Organization.

Table 1.

Indicator	**Points on the Beaufort scale**	**Average annual speed, m/s**
Positive	0-2	0 – 3,3
Acceptable	3 – 4	3,4 – 7,9
Negative	5 – 6	8,0 – 13,8
Not allowed	7 and above	13,9 and above

The average annual temperature of the environment was also analyzed. Average annual temperature on the performance of photovoltaic modules
affects. Module performance at high temperatures is different and it has been shown that for one additional degree Celsius (ºC) it can decrease by 0.2 to 0.4 percent[6].

Table 2.

Indicator	**Average annual speed, m/s**
Positive	up to 25 ºC
Acceptable	25 ºC to 35 ºC
Negative	35 ºC to 40 ºC
Not allowed	above 40 ºC

In general, almost all regions of Uzbekistan are suitable for the full operation of solar batteries, but in order to achieve high indicators of the efficiency of electricity production and, as a result, to reduce the prices of solar electricity, first of all, in identifying promising places, GHI It is appropriate to take into account the indicator [19-27].

Hail resistance of welding batteries under normal test conditions tests for display (GOST R 56980-2016). A crystal above the groundsilicon photoelectric modules. Test methods 25 mm ± 5% diameter is checked at the speed of 23 m/s of spherical hailstones [28]. But Australia, according to the standards, the batteries must withstand the direct impact of hail with a diameter of 35 mm. Some of the world's leading manufacturers conduct tests on the resistance of welding batteries to the impact of hailstones with a diameter of 45 mm at a speed of 30.7 m/s under special test conditions. In this regard, areas with a diameter of up to 25 mm are considered the most suitable for the installation of fuse batteries, and areas with a diameter of more than 45 mm are not suitable.

Table 3

Indicator	Hail diameter, mm ±5%
Positive	up to 25 mm
Acceptable	25 to 35 mm
Negative	35 to 45 mm
Not allowed	Above 45 mm

In order to determine the expediency of choosing promising areas with a slope, taking into account the specific characteristics of the construction of a photovoltaic solar power mini-station, the following criteria were adopted:

Table 4

Indicator	The slope angle of the field
Positive	up to 2%
Acceptable	2% to 7%
Negative	7% to 15%
Not allowed	15% higher

the azimuth angle of the sun should also be taken into account.

The results of the analysis of the electricity production of the solar cells installed on the roof of our institute on the technology of evaluating the efficiency of renewable energy and the impact of the external environment on them were obtained continuously every hour during the day for 3 months. In the following pictures, we can see the work done on the solar cells installed on the roof of the institute and their performance, and we refer to the general result obtained from the analysis..



Figure 1. The procedure of checking the volt-ampere characteristics of solar panels

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Table 5

Андижон машинасозлик институти худудида кундуз кунги холатига қуёш батареясини ишчи волт-ампер холатини текшириш.

2023й	тахлил	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	ўртача киймати	жами(кмд)	қуввати(вт)
01.авг	кучланиш (В)	16,44	17,61	18,20	19,37	19,96	20,55	20,96	20,84	18,89	19,00	19,18	191,83	487,74
	ток кучи (mA)	230,95	247,45	255,70	272,20	280,45	288,69	294,47	292,82	189,38	190,50	254,26	2 542,61	
	температура (°C)	28	30	31	33	34	35	35	35	34	34	32,9		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	булутли қуёш	булутли қуёш			
02.авг	кучланиш (В)	15,65	16,21	18,20	19,37	19,96	20,55	20,84	19,56	19,00	18,89	18,82	188,23	430,13
	ток кучи (mA)	156,88	162,49	255,70	272,20	280,45	288,69	292,82	196,10	190,50	189,38	228,52	2 285,20	
	температура (°C)	28	29	31	33	34	35	35	35	34	34	32,8		
	об-хаво	булутли қуёш	булутли қуёш	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	булутли қуёш	булутли қуёш	булутли қуёш			
03.авг	кучланиш (В)	17,03	17,61	18,20	19,37	19,96	19,56	19,39	19,34	19,00	18,89	18,83	188,35	425,53
	ток кучи (mA)	239,20	247,45	255,70	272,20	280,45	196,10	194,42	193,86	190,50	189,38	225,93	2 259,26	
	температура (°C)	29	30	31	33	34	35	35	35	34	34	33		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	булутли қуёш	булутли қуёш	булутли қуёш	булутли қуёш	булутли қуёш			
04.авг	кучланиш (В)	16,44	17,61	18,20	19,37	19,96	20,55	19,84	19,79	19,73	19,67	19,12	191,16	513,39
	ток кучи (mA)	230,95	247,45	255,70	272,20	280,45	288,69	278,80	277,97	277,15	276,32	268,57	2 685,67	
	температура (°C)	28	30	31	33	34	35	34	34	34	34	32,7		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	булутли қуёш			
05.авг	кучланиш (В)	16,44	17,03	18,20	19,37	19,96	20,55	20,43	19,00	18,94	18,83	18,88	188,76	457,45
	ток кучи (mA)	230,95	239,20	255,70	272,20	280,45	288,69	287,04	190,50	189,94	188,82	242,35	2 423,50	
	температура (°C)	28	29	31	33	34	35	35	34	34	34	32,7		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	булутли қуёш	булутли қуёш	булутли қуёш			
06.авг	кучланиш (В)	17,03	17,03	18,20	19,37	19,96	20,55	20,49	20,37	20,25	19,49	19,27	192,74	521,94
	ток кучи (mA)	239,20	239,20	255,70	272,20	280,45	288,69	287,87	286,22	284,57	273,85	270,79	2 707,95	
	температура (°C)	29	29	31	33	34	35	35	35	35	33	32,9		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
08.авг	кучланиш (В)	17,03	17,61	18,20	19,37	19,96	20,55	20,43	20,37	20,25	19,67	19,34	193,45	523,76
	ток кучи (mA)	239,20	247,45	255,70	272,20	280,45	288,69	287,04	286,22	284,57	276,32	271,78	2 717,84	
	температура (°C)	29	30	31	33	34	35	35	35	35	33	33		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
09.авг	кучланиш (В)	19,55	20,22	20,90	22,24	22,92	23,59	23,53	23,39	23,26	22,58	22,22	222,17	693,50
	ток кучи (mA)	274,64	284,11	293,58	312,52	321,99	331,46	330,52	328,62	326,73	317,26	312,14	3 121,43	
	температура (°C)	29	30	31	33	34	35	35	35	35	34	33,1		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
10.авг	кучланиш (В)	18,20	19,60	21,00	22,40	23,80	23,66	23,52	21,71	21,38	21,04	21,63	216,31	601,54
	ток кучи (mA)	255,70	275,37	295,04	314,71	334,38	332,41	330,44	217,71	214,31	210,91	278,10	2 780,98	
	температура (°C)	26	28	30	32	34	34	34	32	31	31	31,2		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	булутли қуёш	булутли қуёш	булутли қуёш			
11.авг	кучланиш (В)	18,54	18,81	20,90	21,57	22,92	23,59	24,27	23,26	22,58	22,38	21,88	218,80	672,62
	ток кучи (mA)	260,44	264,22	293,58	303,05	321,99	331,46	340,93	326,73	317,26	314,42	307,41	3 074,08	
	температура (°C)	27	28	31	32	34	35	36	35	34	34	32,6		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
12.авг	кучланиш (В)	18,20	18,87	20,90	22,24	22,92	23,59	24,27	23,93	23,26	22,78	22,10	220,96	685,95
	ток кучи (mA)	255,70	265,17	293,58	312,52	321,99	331,46	340,93	336,20	326,73	320,10	310,44	3 104,39	
	температура (°C)	27	28	31	33	34	34	36	35	34	34	32,6		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
13.авг	кучланиш (В)	18,54	18,81	20,90	22,24	22,92	23,59	24,27	23,93	23,26	22,65	22,11	221,10	686,79
	ток кучи (mA)	260,44	264,22	293,58	312,52	321,99	331,46	340,93	336,20	326,73	318,20	310,63	3 106,28	
	температура (°C)	27	28	31	33	34	35	36	35	34	34	32,7		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
15.авг	кучланиш (В)	19,44	20,74	21,32	22,69	24,05	23,92	23,79	23,34	23,27	23,01	22,56	225,55	714,73
	ток кучи (mA)	273,05	291,32	299,53	318,71	337,89	336,06	334,24	327,84	326,93	323,28	316,89	3 168,85	
	температура (°C)	30	32	33	35	37	37	37	36	36	36	34,9		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
16.авг	кучланиш (В)	19,50	20,80	21,45	22,75	24,05	23,73	23,79	23,08	22,95	22,69	22,48	224,77	709,90
	ток кучи (mA)	273,96	292,23	301,36	319,63	337,89	333,32	334,24	324,19	322,36	318,71	315,79	3 157,90	
	температура (°C)	30	32	33	35	37	37	37	36	36	36	34,9		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
17.авг	кучланиш (В)	18,14	18,07	18,85	19,50	20,80	22,10	22,75	22,56	21,97	21,78	20,65	206,51	599,13
	ток кучи (mA)	254,79	253,87	264,83	273,96	292,23	310,49	319,63	316,89	308,67	305,93	290,13	2 901,28	
	температура (°C)	28	28	29	30	32	34	35	35	34	34	31,9		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
18.авг	кучланиш (В)	18,20	18,13	18,00	20,22	21,57	23,59	22,24	22,11	22,04	21,23	20,73	207,35	604,01
	ток кучи (mA)	255,70	254,75	252,86	284,11	303,05	331,46	312,52	310,63	309,68	298,32	291,31	2 913,09	
	температура (°C)	27	27	29	30	32	35	33	33	33	34	31,3		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
19.авг	кучланиш (В)	18,20	18,90	20,30	21,00	22,40	22,33	22,26	22,12	21,98	21,84	21,13	211,33	627,45
	ток кучи (mA)	255,70	265,53	285,20	295,04	314,71	313,72	312,74	310,77	308,81	306,84	296,91	2 969,07	
	температура (°C)	26	27	29	30	32	32	32	32	32	32	30,4		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
20.авг	кучланиш (В)	17,50	18,90	20,30	21,00	22,40	22,26	21,70	21,56	21,00	20,79	20,74	207,41	604,39
	ток кучи (mA)	245,87	265,53	285,20	295,04	314,71	312,74	304,87	302,91	295,04	292,09	291,40	2 914,00	
	температура (°C)	25	27	29	30	32	32	31	31	30	30	29,7		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			

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22.авг	кучланиш (В)	17,50	17,43	18,20	18,48	19,60	21,00	22,40	22,75	20,93	20,79	19,91	199,08	536,82
	ток кучи (mA)	245,87	244,88	255,70	259,63	275,37	295,04	314,71	319,63	294,06	292,09	279,70	2 796,96	
	температура (°C)	25	25	26	26	28	30	32	32	30	30	28,4		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
23.авг	кучланиш (В)	16,80	17,50	18,20	18,06	19,60	21,00	22,40	22,26	20,93	20,86	19,76	197,61	548,63
	ток кучи (mA)	236,03	245,87	255,70	253,73	275,37	295,04	314,71	312,74	294,06	293,07	277,63	2 776,31	
	температура (°C)	24	25	26	26	28	30	32	32	30	30	28,3		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
24.авг	кучланиш (В)	16,80	17,50	18,20	20,30	21,70	22,40	21,71	21,04	20,36	20,36	20,04	200,36	496,75
	ток кучи (mA)	236,03	245,87	255,70	285,20	304,87	314,71	217,71	210,91	204,11	204,11	247,92	2 479,22	
	температура (°C)	24	25	26	29	31	32	32	31	30	30	29		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	булутли қуёш	булутли қуёш	булутли қуёш	булутли қуёш			
25.авг	кучланиш (В)	16,80	16,80	17,50	19,60	21,00	22,40	22,33	20,93	20,79	20,65	19,88	198,80	555,25
	ток кучи (mA)	236,03	236,03	245,87	275,37	295,04	314,71	313,72	294,06	292,09	290,12	279,30	2 793,03	
	температура (°C)	24	24	25	28	30	32	32	30	30	30	28,5		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
26.авг	кучланиш (В)	16,74	16,74	17,47	20,38	21,84	23,30	23,15	22,57	21,69	21,48	20,54	205,37	592,55
	ток кучи (mA)	235,24	235,24	245,47	286,38	306,84	327,30	325,25	317,07	304,79	301,73	288,53	2 885,32	
	температура (°C)	23	23	24	28	30	32	32	31	30	30	28,3		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
27.авг	кучланиш (В)	16,48	17,23	18,72	20,97	22,47	23,97	23,82	22,09	22,02	21,87	20,96	209,64	617,44
	ток кучи (mA)	231,50	242,02	263,07	294,63	315,68	336,72	334,62	310,42	309,37	307,26	294,53	2 945,29	
	температура (°C)	22	23	25	28	30	32	32	30	30	30	28,2		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
29.авг	кучланиш (В)	17,23	17,98	18,72	19,47	20,22	22,47	23,22	22,32	22,17	21,87	20,57	205,67	594,28
	ток кучи (mA)	242,02	252,54	263,07	273,59	284,11	315,68	326,20	313,57	311,47	307,26	288,95	2 889,52	
	температура (°C)	23	24	25	26	27	30	31	31	31	31	27,9		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
30.авг	кучланиш (В)	17,23	17,98	18,72	19,47	20,22	22,47	23,97	23,59	23,07	22,92	20,96	209,64	617,44
	ток кучи (mA)	242,02	252,54	263,07	273,59	284,11	315,68	336,72	331,46	324,10	321,99	294,53	2 945,29	
	температура (°C)	23	24	25	26	27	30	32	32	31	31	28,1		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
31.авг	кучланиш (В)	17,23	17,98	18,72	19,47	20,22	22,47	23,97	23,82	23,67	23,22	21,08	210,76	624,08
	ток кучи (mA)	242,02	252,54	263,07	273,59	284,11	315,68	336,72	334,62	332,52	326,20	296,11	2 961,07	
	температура (°C)	23	24	25	26	27	30	32	32	32	31	28,2		
	об-хаво	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли	қуёшли			
											ОБЩ 26 КУНЛИК ЭНЕРГИЯ КУВВАТИ			15277,37

Checking the working volt-ampere state of the solar battery in the area of the Andijan Machine-building Institute during the day.

Conclusion. From these analyses, it can be seen that the working condition of the solar cell reaches its maximum level in sunny and dry weather, and in rainy and foggy weather, the energy current from the solar cell decreases, which leads to a sharp decrease in the power obtained from the solar cell.

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