ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 11, Issue 4, April 2024

Possibilities of Using Solar Panels

Tolipov F.N., Muratov K.M., Erkinov B.N., Tolipov J.N.

Researcher, Institute of Energy problems, Academy of Sciences, Tashkent, Uzbekistan
Director, Institute of Energy problems, Academy of Sciences, Tashkent, Uzbekistan
Head of Laboratory, Institute of Energy problems, Academy of Sciences, Tashkent, Uzbekistan
Senior Researcher, Institute of Energy problems, Academy of Sciences, Tashkent, Uzbekistan

ABSTRACT: Solar power plants are seen as an alternative source of electricity generation that is becoming more popular in the world. It is often used to create an independent power supply in rural houses and private housing and is designed to serve as a backup power supply in addition to the main power supply. Proper installation of solar power plants ensures high energy efficiency on sunny days and rainy weather. Proper installation of such a system for housing requires the selection and installation of optimal technical elements. By studying the schemes and methods of connecting solar panels, it leads to the efficient use of these devices. This article describes in detail how the transition to "green energy" allows for the use of natural resources, how to set up an efficient system, how to connect solar panels to the main electricity grid, and other important subtleties.

KEY WORDS: Solar Power Plants, Installation, Technical Elements, Green Energy, Solar Panels, Electricity Grid, Connections

I. INTRODUCTION

Solar power station, also known as a solar park is a large-scale grid-connected photovoltaic power system (PV system) They differ from most building-mounted and other decentralized solar power systems. They supply power at the level of utility, rather than to a local user or users. First of all, we need to know exactly what the components of this system are. Solar panels are a collection of cells that use photovoltaic cells. They are able to convert "green energy" into electricity. The power of the system's electricity is directly determined by the intensity of solar radiation, that is, the brighter the sun, the more energy the system can produce.

Solar cells are characterized by high sensitivity to the correct connection and location of the components included in the system. Even the smallest mistake can lead to a drastic decrease in efficiency. It is important to carefully control the angle of placement of photomodules and the ratio of the parameters of the components. Proper connection ensures the efficiency of the solar power plant and a faster payback period.

Engineers have developed effective methods of connecting several independent solar power plant elements. The main purpose of solar panels is to collect ultraviolet radiation. Concentrated light is converted into electricity using special devices and redirected to the 220 V network or energy storage device. The main advantages of the system are flexibility and automatic operation. Its disadvantage is that it usually depends on external conditions (weather, climate, shade).

II. THE RESEARCH OBJECTIVE AND METHOD

Components should be selected to pay for themselves as quickly as possible. The efficiency of the further operation of the system directly depends on its assembly. Alternative solar power plants are distinguished by a large number of components:
- SB - panels equipped with a special coating. Collecting and storing UV rays and heat, the photo modules transfer it to a storage device for later conversion into energy.
- controllers - show the user the state of the battery pack and the level of charge and discharge;
- inverters - are responsible for the process of converting ultraviolet radiation into electric current of a certain value;
- batteries and power sources are integral components that collect and consume energy according to consumer demand;
- fuses - serve to minimize the risk of short circuit;
- MC4 connectors.

Each solar cell has a multi-layer construction:
- glass cover, resistant to external negative events and mechanical stress.

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 11, Issue 4, April 2024

- film transparent layer (EVA).
- silicon element. It attracts and interacts with UV light.
- hermetic film.

Accumulator batteries adjusting the charge cycle are connected through controllers. On the reverse side of the battery, cables are laid to the inverter. First, the battery pack and the controller are connected, then the controller is connected to the solar panels, and then the inverter is connected to the battery cells. At the final stage, the network will be directed to consumers.

Uncontrolled energy flow poses many risks, including over-consumption or over-charging. Under the influence of both factors, the energy storage device wears out quickly and is prone to failure. To avoid this problem, it is necessary to install the controller between the battery cells and the panels. This device is responsible for managing the charging and discharging cycle (fig.1.).

Wires are connected to the terminals of the device, taking into account the polarity. A simplified connection diagram is less common, and with this approach, the voltage generated in the modules should not overcharge the energy storage devices. Otherwise, the battery will soon fail completely.

A simplified installation method is used when the accumulator battery has completed a full charge / discharge cycle:

1. for areas with reduced daylight hours;
2. in areas with little sunlight;
3. with reduced power photoelectric modules.

The protective diode is installed directly near the energy storage device. This is to prevent short circuits.

Batteries are included in the basic set of solar power plants, and if necessary, they can be purchased additionally, taking into account the basic parameters, and their number is not limited. Some consumers build a battery bank to have a significant backup. Such batteries must have the same characteristics and be connected in series. Such a block can be compactly placed in a rack or in a special place.

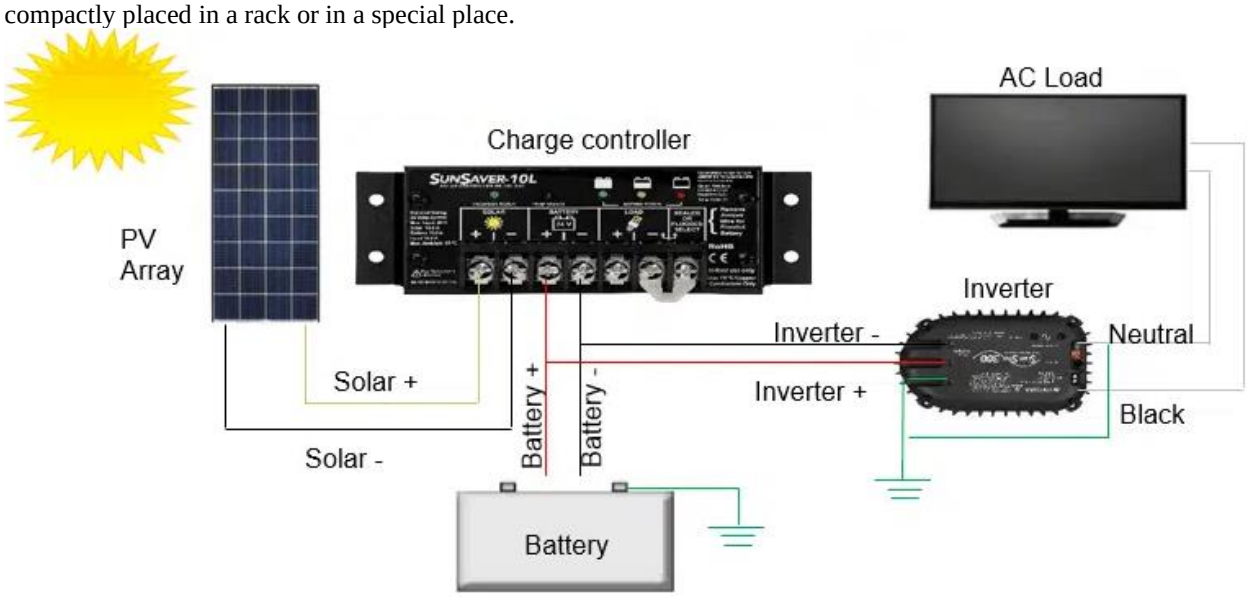


Fig.1. Off-grid Diagram with AC Load

III. RESEARCH RESULTS

The controller has terminals for power consumption for 12 and 24 V. The lines of such devices are connected directly to the contacts. To create a three-phase network, it is necessary to install inverters. This device converts electrical energy into a given voltage with a frequency of 50 Hz. The consumer will have the opportunity to deliver electricity to the rural courtyard houses as efficiently as the central power transmission line.

1. A single photovoltaic cell has a basic wiring diagram and the panel is connected with the correct connectors. Several connection methods are considered for assembling two or more sections. In parallel installation, terminals of the same polarity are connected to each other. The output voltage is 12 V.

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 11, Issue 4, April 2024

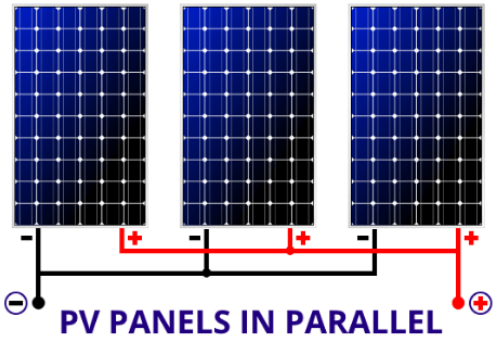


Fig. 2. a Schematic of parallel connected PV modules.

2. When panels connected in series, the "+" pole of the first component is connected to the "-" of the second photocell. The remaining terminals of different poles are connected to the controller, and the output voltage is 24 V. If the current I_{M1} is the maximum power point current of one module and I_{M2} is the maximum power point current of other module, total current of the parallel-connected module will be $I_{TOT} = I_{M1} + I_{M2}$. If we keep on adding modules in parallel the current keeps adding up. It is also applicable for short-circuit current Isc.

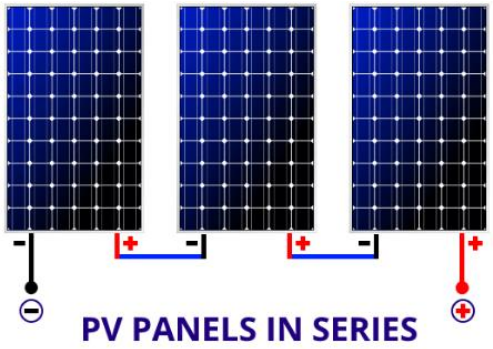
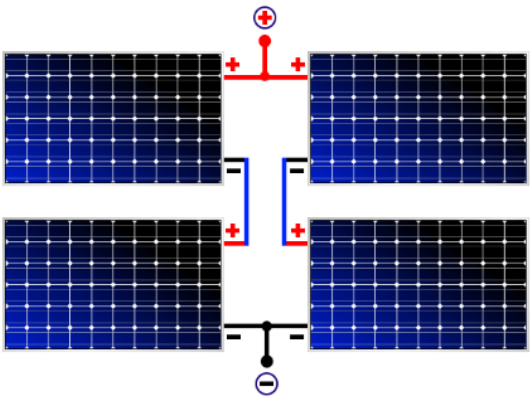


Fig.3. Schematic of series connected PV modules.

3. In the combination of mixed connection, that is, in both parallel and series connection, the internal section of the element is connected in parallel, and the groups are connected in series. If a module has an open circuit voltage V_{OC1} of 24 V and other connected in series has V_{OC2} of 24 V, then the total open circuit of the string is the summation of two voltages

$$V_{OC} = V_{OC1} + V_{OC2}$$
$$V_{OC} = 24\ V + 24\ V = 48\ V$$

It is important to note that the summation of voltages at the maximum power point is also applicable in case of PV array.



ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 11, Issue 4, April 2024

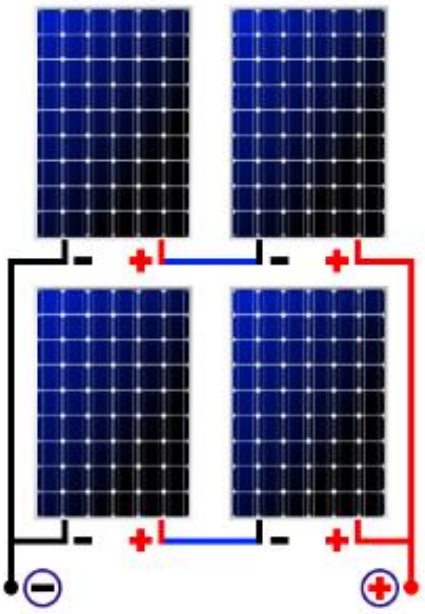


Fig.4. Schematic of series - parallel connected PV modules.

let's call it the string 1, module 1 and module 2 are connected in series. The open-circuit voltage of the string 1 V_{OC1} is added i.e.

$$V_{OC1} = V_{OC} + V_{OC} = 2V_{OC}$$

Whereas the short-circuit current of string 1 I_{SC1} is the same i.e.

$$I_{SC1} = I_{SC}$$

Similar to string 1, the modules 3 and 4 make up the string 2. The open-circuit voltage of the string 2 V_{OC2} is added i.e.

$$V_{OC2} = V_{OC} + V_{OC} = 2V_{OC}$$

Whereas the short-circuit current of string 2 I_{SC2} is the same i.e.

$$I_{SC2} = I_{SC}$$

Now string 1 and string 2 are connected in parallel, nowhere the voltage remains the same but the current is added i.e. open-circuit voltage of the PV module array

$$V_{OCA} = V_{OC1} = V_{OC2} = 2V_{OC}$$

And Short circuit current of the PV module array

$$I_{SCA} = I_{SC1} + I_{SC2} = I_{SC} + I_{SC} = 2I_{SC}$$

The same calculation is applicable for voltage and current at the maximum PowerPoint.

Photo panels must withstand the maximum input current from solar cells. To calculate the value, the nominal value of the controller is taken and the short-circuit current of the photovoltaic cells is determined from the contour (this parameter is indicated in the instructions for solar panels; as a rule, it is above the working limit). During normal operation, the modules produced by the elements when connected should be lower than those indicated in the instructions for the controller.

IV.CONCLUSION

In this article, an fully study of the solar panels and array was carried out. The need, structure, and type of connection of the modules for higher power level was studied. We saw an explanation of the PV module array along with its need and connection combination. Calculation and procedure for the design of series, parallel, and mixed connections were done in detail along with the study of mismatch in voltage and current of the modules. Study of photovoltaic module and array is a must requirement for a designer of the PV system. The article also gives a significant design understanding of important components (modules and array) in the solar system, which can be utilized to make a proper, efficient, and reliable design in a solar system.

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 11, Issue 4, April 2024

REFERENCES

[1] M. Hirakata, T. Shimizu, and G. Kimura, "Generation control circuit for PV system," in Proc. ICEE'96, vol. 2, Aug. 1996, pp. 992–996.
[2] B. S. Borowy and Z. M. Salameh, "Methodology for optimally sizing the combination of a battery bank and PV array in a wind/PV hybrid system," IEEE Trans. Energy Conversion, vol. 11, pp. 367–373, June, 1996.
[3] A. Chauhan, "Optimal Sizing of a Stand-alone PV / Wind / MHP / Biomass Based Hybrid Energy System Using PSO Algorithm," pp. 7–12.
[4] A. Sharma and M. Sharma, "Power & energy optimization in solar photovoltaic and concentrated solar power systems," Asia-Pacific Power Energy Eng. Conf. APPEEC, vol. 2017-Novem, pp. 1–6, 2018.
[5] A. Chen, W.Z. Song, F. Li, J.M. Velni Distributed Cooperative Energy Management in Smart Microgrids with Solar Energy Prediction 2018 IEEE Int. Conf. Commun. Control. Comput. Technol. Smart Grids, SmartGridComm 2018 (2018), pp. 1-6
[6] A. Gupta, H. Anand Analysis of scheduling of solar sharing for economic/environmental dispatch using PSO 12th IEEE Int. Conf. Electron. Energy, Environ. Commun. Comput. Control (E3–C3), INDICON 2015 (2016)
[7] CHOWDHURY, Md Shahariar, et al. An overview of solar photovoltaic panels' end-of-life material recycling. Energy Strategy Reviews, 2020, 27: 100431.
[8] https://www.electricaltechnology.org/2020/09/series-parallel-and-series-parallel-connection-of-solar-panels.html