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TECHNIQUES FOR REDUCING LOSSES IN PV-PANELS

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Abstract

The recent upsurge in the demand of PV systems is due to the fact that they produce electric power without hampering the environment by directly converting the solar radiation into electric power. Solar energy is completely natural; it is considered a clean energy source. So the study on improving the efficiency of solar panel is very necessary In this paper we are discuss various methods of efficiency improvement of solar panel. We can improve efficiency of solar panel by using automatic dust detecting and cleaning robot. Dust is barrier between sunlight and solar panel. Second method to improve the efficiency of solar panel by sensing the shadow when it is on solar panel and change the direction. As panel temperature increases output voltage of solar panel decreases so cooling of panel is necessary for improvement of efficiency. Other method is degeneration for solar panel and also minimizes the mismatch losses, which improve efficiency of panel. Aim of this paper is to increase the efficiency and power output of the solar panel.

Index Terms: *Dust cleaner robot, shadow effect, temperature losses, degeneration, efficiency etc.*

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1. INTRDUCTION

After the invention of the solar panel the solar technology reached skies with the implementation of solar panel which use the solar energy to generate electrical energy. The renewable energy usage is growing in all the areas of industries etc; they use huge number of solar panels in the form of an array. In the same time due to the rapid growth in the robotic industry it has taken a place in everyday life and the industry too. Now the problem with the implementation of solar panels is their maintenance. The cleaning of dust particles on the solar panel is a huge job and a time taking process and requires lot of man power and money. To remove this limitation robotics is a good choice for no man operations, We can improve efficiency of solar panel by using automatic dust detecting and cleaning robot. Dust is barrier between sunlight and solar panel. Second method to improve the efficiency of solar panel by sensing the shadow when it is on solar panel and change the direction. As panel temperature increases output voltage of solar panel decreases so cooling of panel is necessary for improvement of efficiency. Other method is degeneration for solar panel and also minimizes the mismatch losses, which improve efficiency of panel. It also economical and autonomous as it requires no man to monitor.

2. WORKING PRINCIPLE OF PV-PANEL

When a photovoltaic cell is exposed to sunlight it absorbs the photon's hitting the semiconducting materials. Electrons are excited and move up to a higher molecular or atomic orbital. To dissipate the extra energy, the electron can either go back to it's original orbital, converting the excess energy into heat, or it can travel through the material to an electrode, thereby cancelling the potential. Regardless of the size, a cell will generate roughly 0.45 volts DC. This implies that the available power generated by the cell will be strictly dependent on the area of the cell that is irradiated by the sun and the material used for the absorption of the photons. To reach higher voltages, cells are installed in series.

Fig-1: PV-Panel

3. LOSSES IN PV-PANEL

1. Soiling Losses
2. Shadow Effect
3. Over temperature Losses
4. Mismatch losses

4. TECHNIQUES TO OVERCOME THE LOSSES

4.1 Dust Tracker And Cleaner

The electrical parameters of solar panel are sensitive to the dust density so it is very essential to provide auto cleaning mechanism to remove the dust particles from the surface of the panel in order to ensure high performance. Dust is the lesser acknowledged factor that

significantly influences the performance of the PV installation. Dust prevents sunlight from reaching the solar cells in your solar panels. Due to dust efficiency of solar panel can decrease. So Deserts are sunny, so they're ideal for solar power. But they're also very dusty, so solar panel efficiency decreases. (lose about 0.4-0.8% in efficiency *per day*). But hosing panels down with water in the middle of an arid area is problematic on so many levels. And anything that requires a lot of human labor in the middle of a remote desert where temperatures can go over 122 degrees Fahrenheit during the day. These are the problems that the **NO**-water **M**echanical **A**utomated **D**usting **D**evice (NOMADD) robot. As shown in fig.

Fig-2: Dust cleaning arm

Little robots are mounted on tracks along rows of panels, and at least once a day they pass over the panels, cleaning them with a brush designed and without any water required. This makes a big difference over manual cleaning which only happens every week or two most of the time. A single NOMADD can clean a row of panels about 600 feet long, with plans to upgrade that to 900 feet. Because each row of panels has its own NOMADD robot, they can work in parallel and it doesn't take longer to clean a gigantic solar farm. The NOMADD is not a cleaning solution developed in mild conditions. It is a system designed, developed and tested for the harshest desert conditions.

Table 1 Pro's and Con's of Auomated dust cleaner

Pro	Con
Very robust	Only 1 row of panels
Highly autonomous	Custom made

4.2 Shadow Effect

Since PV systems generate electricity based on the amount of sunlight they receive, it makes sense that when a shadow is cast on a panel, for example by a nearby tree, its power output decreases. However, the decrease in power could be a lot worse than it initially seems. Shading a solar cell is similar to introducing a clog in a pipe of water. The clog in the pipe restricts the flow of water through the entire pipe. Similarly, when a solar cell is shaded, the current through the entire string is reduced.

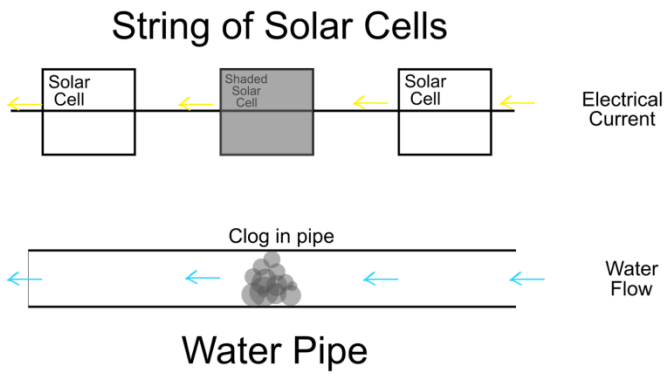

Fig-3: Shadow Effect On PV-Panel

This is significant because every cell in the cell string has to operate at the current set by the shaded cell. This prevents the unshaded cells from operating at maximum power. Therefore, only a small amount of shading can have a dramatic effect on the power output of a solar panel.

Similar principles apply to PV modules connected together. The current flowing through an entire string of modules can be heavily reduced if even just a single module is shaded, leading to potentially significant loss of power output.

Fortunately, there are a number of different mechanisms that can be used in a PV system to reduce shading losses. They include stringing arrangements, bypass diodes, and module level power electronics (MLPEs).

Stirring Arrangement

Modules connected in series form strings, and strings can be connected in parallel to an inverter. The current through all the modules of a string has to be the same, and the voltage of parallel strings has to be the same. As we saw in the last section, a shaded module in a string can bring down the power output of the string significantly. However, a shaded module in one string does not reduce the power output of a parallel string. Therefore, by grouping shaded modules into separate strings, the overall power output of the array can be maximized.

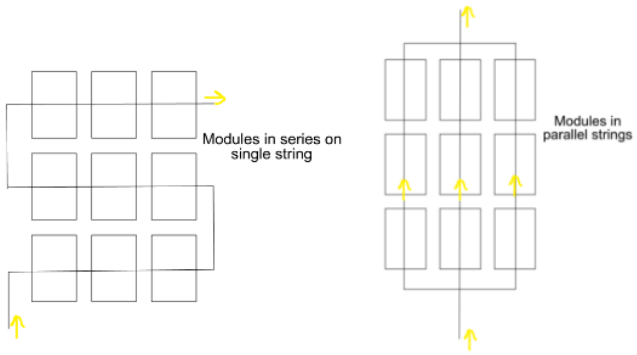

Fig-4: Arrangement of module series

For example, in a commercial system with parapet walls, it can be beneficial to group modules that receive shade from the parapets into strings, and keep modules that do not receive shade from the parapets in separate, parallel

strings. This way the unshaded strings can maintain a higher current and power output.

4.3 Cooling Technique

Photovoltaic panels (PV) get overheated due to excessive solar radiation and high ambient temperatures. Overheating reduces the efficiency of the panels. The ideal *P–V* characteristics of a solar cell for a temperature variation between 0 °C and 75 °C are shown in Fig.3.The *P–V* characteristic is the relation between the electrical power output *P* of the solar cell and the output voltage, *V*, while the solar irradiance, *E*, and module temperature, *Tm*, are kept constant. The maximum power output from the solar cells decreases as the cell temperature increases, as can be seen in Fig.3. This indicates that heating of the PV panels can affect the output of the panels significantly.

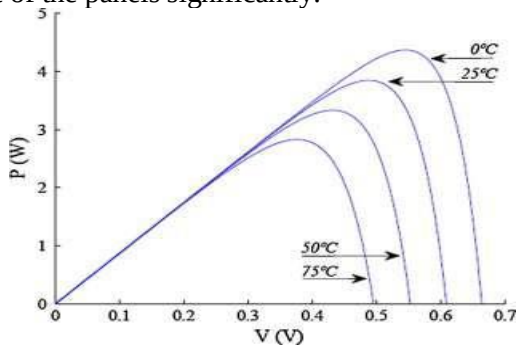

Fig.6

Hybrid Photovoltaic/Thermal (PV/T) solar system is one of the most popular methods for cooling the photovoltaic panels nowadays shown in fig4 . The hybrid system consists of a solar photovoltaic panels combined with a cooling system. Water is circulated around the PV panels for cooling the solar cells, and the warm water leaving the panels pump back to water tank. Warm water mixed with cool water of tank.

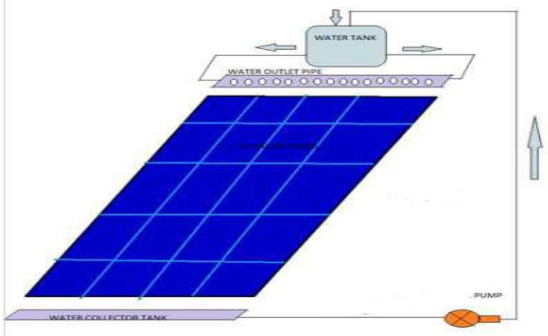

Fig-5: Construction of cooling technique

It is concluded that the cooling system could solve the problem of overheating the PV panels due to excessive solar radiation and maintain the efficiency of the panels at an acceptable level by the least possible amount of water.

4.4 Reduction Technique Of Mismatch Losses

It also have many problems that are due to the forward voltage drop the excessive heat developed, normal failures due to over voltages, energy losses in the form of leakage currents and failures due to lighting surges, switching surges etc. These limitations are overcome by active bypass diodes; it is also called an active electronic smart circuit because it has a maximum voltage drop which corresponding reduction in heat dissipation. Active diodes are thin and integrated in PV lamination. If the voltage drop is low, then power will be dissipated. Active bypass diodes can also used for monitoring or active enhanced short circuiting of the module for safety. In active bypass the conduction losses in mismatch situations can be mitigated.

AC-Modules, when modules can be connected in parallel then this ac-module are used. The output of the module is in ac form so it called ac-module. To achieve the highest output power every solar module is continuously operated at maximum power point. This can be reached by using module-integrated inverters. The current mismatch occur a larger impact on the power than the voltage mismatch, it is to be expected that the system connected in parallel PV-modules have a higher power. Module-integrated inverters lead to higher especially with solar modules that are partially shaded with different angles. The advantages of ac modules that are the design of the PV system is flexible and that it can easily be expanded; in addition, cost is also less. The performance of AC-modules will be same as module based maximum power point tracker. However, it does not avoid shading problem completely. The voltage of AC modules with similar performances and reliability as larger PV systems with central or string inverters is significant. Power Optimizers, This is used to reduce mismatch losses in string. It is provided for each module so that input and output voltage of each module is independent and maximum power point voltage can be individually set for each module. This can monitor and maximize the power of each individual solar panel. The modules which have problem of shading because of existing trees, chimneys etc are provided with power optimizers. This configuration helps to reduce mismatch losses in string because of predictable shading sources. Distributed maximum power point tracking is same as AC-modules in which each module can operate to its maximum power point. DMPPT can be useful to reduce shading. Mismatch losses are eliminated but power conversion and losses are increased because of additional electronic circuit. If only the part of the module is shaded, then the power of the shaded part across bypass diodes will be reduced.

5. CONCLUSION

The reasonable and effective utilization of solar energy is an important path which can deal with the global energy crisis at present. Photovoltaic (PV) cell, which converts sunlight to electrical current, without any form for mechanical or thermal interlink. So the study on improving the efficiency of solar panel is very necessary.

We have proposed several methods (using solar dust cleaner, reduction technique of shadow effect ,cooling technique of panel, reductions techniques of mismatch losses etc.,) to improve the efficiency of solar panel. Practice has proved that the use of these methods can effectively improve the efficiency of solar power generation.

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