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A STUDY ON GRID CONNECTED PV SYSTEM

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Abstract— At present, photovoltaic (PV) systems are taking a leading role as a solar-based renewable energy source (RES) because of their unique advantages. This trend is being increased especially in grid-connected applications because of the many benefits of using RESs in distributed generation (DG)systems. Grid-connected photovoltaic (PV) systems are increasingly attracting the attention of industry and academia as a means of providing an alternative to conventional fossil-fuel generation. In grid-connected PV systems, a key consideration is the design and operation of power converters and how to achieve high efficiency for different power configurations This chapter presents a comprehensive overview of grid connected PV system and control structures for grid-connected PV systems
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Index Terms – PV system, Net metering, Solar batteries

I. INTRODUCTION

The grid connected PV systems have solar panels that provide some or even most of their power needs during the day time, while still being connected to the local electrical grid network during the night time. Solar powered PV systems can sometimes produce more electricity than is actually needed or consumed, especially during the long hot summer months. This extra or surplus electricity is either stored in batteries or as in most grid connected PV systems, fed directly back into the electrical grid network. In grid connected PV systems, electricity flows back-and-forth to and from the mains grid according to sunlight conditions and the actual electrical demand at that time The main advantage of a grid connected PV system is its simplicity, relatively low operating and maintenance costs as well as reduced electricity bills. Since grid tied systems feed their solar energy directly back into the grid, expensive back-up batteries are not necessary and can be omitted from most grid connected design

II. BLOCKDIAGRAM OF GRID CONNECTED PV SYSTEM

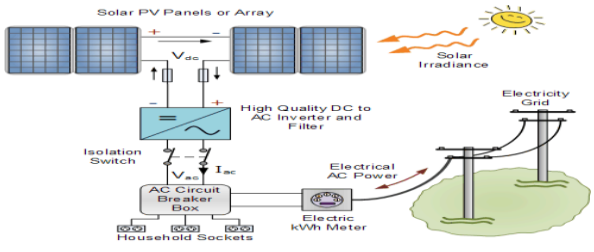

Fig. 1 Block diagram of Grid connected PV system

Grid connected PV systems always have a connection to the public electricity grid via a suitable inverter because a photovoltaic panel or array (multiple PV panels) only deliver DC power. As well as the solar panels, the additional components that make up a grid connected PV system compared to a standalone PV system are:

A. INVERTER:

The inverter is the most important part of any grid connected system. The inverter extracts as much DC (direct current) electricity as possible from the PV array and converts it into clean mains AC (alternating current) electricity at the right voltage and frequency for feeding into the grid or for supplying domestic loads. It is important to choose the best quality inverter choice are Power- Maximum high and voltage power the inverter can handle and Efficiency – How efficiently does the inverter convert solar power to AC power

B. ELECTRICITY METER:

The electricity meter also called a Kilowatt hour (kWh) meter is used to record the flow of electricity to and from the grid. Twin kWh meters can be used, one to indicate the electrical energy being consumed and the other to record the solar electricity being sent to the grid. A single bidirectional kWh meter can also be used to indicate the net amount of electricity taken from the grid. A grid connected PV system will slow down or halt the aluminium disc in the electric meter and may cause it to spin backwards. This is generally referred to as net metering. AC Breaker Panel and Fuses: The breaker panel or fuse box is the normal type of fuse box provided with a domestic electricity supply and installation with the exception of additional breakers for inverter and/or filter connections.

C.SAFETY SWITCHES AND CABLING:

A photovoltaic array will always produce a voltage output in sunlight so it must be possible to disconnect it from the inverter for maintenance or testing. Isolator switches rated for the maximum DC voltage and current of the array and inverter safety switches must be provided separately with easy access to disconnect the system. Other safety features demanded by the electrical company may include earthing and fuses. The electrical cables used to connect the various components must also be correctly rated and sized.

D.THE ELECTRICITY GRID:

Finally, the electricity grid itself to connect too, because without the utility grid it is not a Grid Connected PV System

III. GRID CONNECTED SYSTEM WITH BATTERIES

A grid connected system without batteries is the simplest and cheapest solar power setup available, and by not having to charge and maintain batteries they are also more efficient. It is important to note that a grid connected solar power system is not an independent power source unlike a standalone system. Should the mains supply from the electrical grid be interrupted, the lights may go out, even if the sun is shining. One way to overcome this is to have some form of short-term energy storage built into the design.

A small scale photovoltaic solar system that has storage batteries within its design, also operates in conjunction with the local electricity company. The short-term peak demand is met by the battery without drawing from the grid and paying the extra charge. When used in grid connected PV systems, storage batteries can be classified into short term storage for a few hours or days to cover periods of bad weather and long-term storage over several weeks to compensate for seasonal variations in the solar irradiation between the summer and winter months.

Incorporating batteries into a grid connected system requires more components, is more expensive, and lowers the systems overall efficiency. But for many homeowners in remote areas who regularly experience a loss of their grid supply during bad weather conditions or have critical electrical loads that cannot be interrupted, having some form of backup energy storage within their grid connected system can be a great benefit

Grid Connected Net Metering

Connecting your solar panels or solar array to the local power grid enables you to engage in one of the most advantageous parts of generating your own electricity:

IV. NET METERING OR NET BILLING.

If during a sunny day more electricity is produced by your solar PV system then you use or consume, this excess solar power is delivered back to the utility grid with the effect of rotating your electric meter backwards. When this happens, you will normally be given credits by the local power company for the amounts of electricity produced by your grid connected PV system.

If during the billing period you use or consume more electrical energy than you generate, you are billed for the "net amount" of electricity consumed as you would be normally. If, however, you generate more solar energy than you consume, you are credited for the "net amount" of electricity generated which may be either a reduction in your monthly electricity bill or a positive repayment directly to you or the account holder.

When installing a PV system, if net metering is available by your local electricity company, you may be required to install a new second electrical meter instead of using a single electricity meter that spins in both directions. This new meter allows for a measurement of net energy consumption, both entering and leaving the system and would be used to reduce your electricity bill. However, each electrical utility company has its own policy regarding the buying back of energy generated by your own small solar power station.

While net metering is the ideal way to resell your solar generated excess power, some companies buy-back energy at a lower wholesale rate than the electricity you consume from the same power company. This means that you may need to generate more solar power than you would normally consume just to break even.

V. GRIDCONNECTED PV SYSTEM WITH BATTERY STORAGE

PV system with battery storage is basically the same as for the previous grid connected PV system with the addition of the batteries and charge controller. The battery charge controller, determines whether the power generated by the solar panels is needed for home use, to run low voltage equipment and lighting or whether it will charge the deep-cycle backup batteries to be used later on

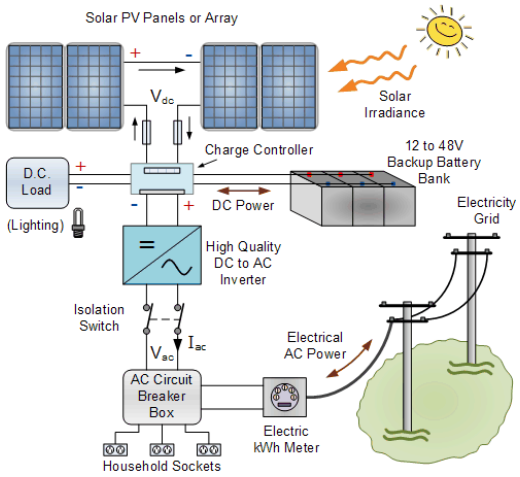

Fig 2 Grid connected PV system with battery storage

The DC current leaving the controller passes through the DC to AC inverter, transforming it into electricity usable by general household appliances. Any surplus electricity not being consumed or used by the home can be sent to the electricity companies power grid. It is better to run DC rated lighting and appliances first directly off your solar system before the current is converted to AC from the inverter. This will gain the most efficiency.

Living with a grid connected solar PV system is no different than living with just the normal grid power, except that some or all of the electricity that is consumed comes from the sun. PV solar systems designed for grid connection are usually designed to meet at least half of home owner's electrical needs. Purchasing a home solar photovoltaic panel array large enough to supply the entire electrical needs of a home would be extremely expensive with the solar array taking up a large amount of space. The solar power generated by a grid connected system is therefore only partial, with the

remaining energy being made up by the power company.
The advantage of a Grid Connected PV System, either with or without storage batteries is that on clear blue sunny days, when the photovoltaic system is producing large amounts of current and the home is consuming low energy levels, for example, if you are out of your home all the day working, solar system keeps generating electricity. The excess electricity generated does not go to waste but is fed back into the power grid to be used by your neighbouring homes who unknowingly end up using the clean, renewable energy themselves while making money for you through your "net metering" arrangement.

VI. THE ADVANTAGES AND DISADVANTAGES OF GRID-TIED SOLAR POWER SYSTEMS

ADVANTAGE:

(1) Using clean, renewable natural solar energy to generate electricity, does not consume non-renewable, limited resources of carbon-bearing fossil energy, no greenhouse gas and pollutant emissions in use, harmonious with the ecological environment, in line with economic and social sustainability development strategy.
(2) The power generation can be fed into the power grid, and the power grid is used as the energy storage device to save the battery. The investment in the construction of the independent solar photovoltaic system can be reduced by 35% to 45%, thereby greatly reducing the power generation cost. Eliminating the battery avoids secondary contamination of the battery and increases the average time between failures of the system.
(3) The perfect combination of photovoltaic cell components and buildings can not only generate electricity but also be used as building materials and decorative materials, so that the full utilization of material resources can play various functions, which not only helps to reduce construction costs, but also increases the technological content of buildings. Increase the "selling point".
(4) Distributed construction, nearby local power distribution, flexible access to and exit from the power grid, not only to enhance the ability of the power system to withstand wars and disasters, but also to improve the load balance of the power system and reduce line losses.
(5) It can be used for peaking. The networked solar photovoltaic system is the hotspot and focus of the developed countries in the world in the field of photovoltaic applications. It is the mainstream development trend of the world's solar photovoltaic power generation, with huge market and broad prospects.

DISADVANTAGE:

1. There are intermittent and random applications in the ground. The amount of power generation is related to climatic conditions. It cannot or rarely generates electricity at night or in rainy days.
2. The energy density is low. Under standard conditions, the intensity of solar radiation received on the ground is 1000W/M^2. When used in large size, it needs to occupy a large area;
3, the price is still relatively expensive, 3 to 15 times the conventional power generation, the initial investment is high.

VII. CONCLUSION

Photovoltaic Systems have developed into a mature technology used for mainstream electricity generation. However, they introduce numerous negative impacts into the electrical networks. Studies on three such impacts have been provided. A grid connected PV test system was considered and simulated in RSCAD software. Harmonic content introduced by 4MW PV system with a 3-phase, 2-level DC/AC inverter, at PCC was found to be within the limits. Reactive power support with regards to varying load power factor and varying PV penetration levels was studied. Anti-islanding function of the PV system was studied and found that the critical islanding time of the PV system for the system considered is 125ms. Further, the Performance Ratio of a typical grid connected system in India was calculated in order to compare the performance of the PV system with other systems throughout the world. The studies carried out will help PV power generators and utilities the issues to be studied for a grid connected PV system.

REFERENCES

1.Elhodeiby, A.S.; Metwally, H.M.B; Farahat, M.A (March 2011). "PERFORMANCE ANALYSIS OF 3.6 KW ROOFTOP GRID CONNECTED PHOTOVOLTAIC SYSTEM IN EGYP" (PDF). International Conference on Energy Systems and Technologies (ICEST 2011): 151–157.
2. "Grid Connected PV Systems". Acmepoint Energy Services. .
.3."Grid Connected Solar Electric - Photovoltaic (PV) Systems". Powerrnaturally.org.
4"Grid-connected photovoltaic system" (PDF). soe-townsville.org. Retrieved
5 "International Guideline for The Certification Of Photovoltaic System Components and Grid-Connected Systems". iea-pvps.org. Retrieved

