

Implementation of Net Meter For Rooftop Solar System

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ABSTRACT

Net metering mechanism usages of a bidirectional meter which has facility to record both import and export energy values. In net metering, prime focus is on utilizing self produced electricity by renewable energy sources and excess sold to grid. It results into reduction of electricity bills. Solar photovoltaic system is used significantly in net metering. Solar energy is clean, inexhaustible and environment friendly resources among all renewable energy options in this paper, concept of net metering through solar system and analysis of data carried out is explored for the beneficial of consumers for studying the feasibility of net metering in India. The study also analyzes the annual saving of electricity and economic feasibility of electricity and economic feasibility in solar rooftop photovoltaic system.

Key Words: Net meter, solar system, grid etc.

1. INTRODUCTION

Today entire globe facing fossil fuel deficit, energy shortage, hazardous effects due to increasing level of Green House Gas (GHG) emission, drastically increasing oil prices. Therefore, it is prime necessity to develop an alternative energy resource with high efficiency and low emission. Among the several renewable energy resources, energy generated by solar photovoltaic (PV) system can be considered the most essential sustainable resource because of the clean, inexhaustible and environment friendly resources among all renewable sources.

In the grid connected PV systems, DC power generated is converted into AC power and then after is fed into the grid. Electricity generated during peak hours is primarily consumed by the building and then excess gets fed into the grid. Electricity is drawn from the grid during the hours of insufficient power generation. In such a case, captive loads are served by drawing power from the grid. For such a system, grid acts like its battery backup. Agreement for imported or exported energy from grid is done by mechanism. Ideally, grid connected solar PV system do not require battery backup as grid acts as the backup for feeding excess power and vice-versa. There is a strongly recommendation of a minimum battery backup of one hour of load capacity for the improvement of reliability performance of the overall system.

Net metering is an electricity policy which allows utility customers to offset some or all of their electricity use with self produced electricity from the system of renewable energy sources for power generation. Net metering works by utilizing a meter that is able to spin and record energy flow in both directions. The concept of net metering involves measuring the net energy between the export of generated energy and import of energy from distribution licensee for a given period of time. This can be done by using bidirectional meter which has the facility to record both import and export of energy.

NET METERING-A CONCEPT

Net metering is an electricity policy which allows utility customers to offset some or all of their electricity use with self-produced electricity from PV systems. Net metering works by utilizing a meter that is able to spin and record energy flow in both directions. The meter spins forward when customer is drawing power from the utility grid(i.e. using more energy than they are producing) and spins backward when energy is being sent back to the grid (i.e. using less energy than they are producing). At the end of a given month, the customer is billed only for the net electricity used. Net metering works only for grid connected system and what makes it so beneficial, besides offsetting a home's energy consumption with a PV system, is that excess energy sent to the utility can be sold back at retail price. If more energy is produced than consumed, producers receive benefit for this positive balance. Such as, renewable energy credits (REC), which is credited on the customer's account toward the next billing cycle. If at the end of the year a surplus remains, then the customer depending on the utility policy may paid for total REC collected at avoidance cost rate or retail cost rate, or, the total REC collected can be transferred and could be used as a compensation.

WORKING OF NET METER:-

It is the advance technology which uses the renewable energy source. In this system, we generate the electricity from the solar energy and we use for our home appliances. And excess power is fed back to the grid through the net meter. Let's see the working of the prototype model of the net metering system. In our system firstly, we generate the electricity from the solar panel. Generated electricity is in the form of the DC, which is stored in the battery. At the positive terminal of the battery, we use diode. Diode prevents the reverse flow of the power. For charging and discharging indication of the battery, we use the health monitoring circuit. Health monitoring circuit indicates the percentage of charge stored in the battery with the help of the LED. Stored power is converted into AC with the help of inverter (sine wave inverter). Supply needed for the home appliances I the dc hence there is necessary to convert it into the ac. Output of the inverted is given to load through the change over switch. What amount of power is generated from the solar is measured by the energy meter or what amount of power is utilized by the home appliances.

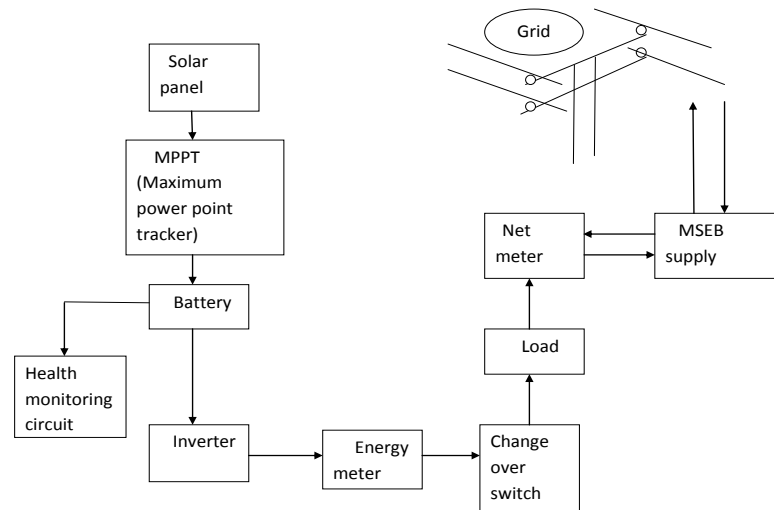


Figure 1: block diagram of net metering system

Change over switch I the most important part in our system. Whenever the solar source is unable to supply the load at that time, change over switch automatically disconnect the supply from the solar and connect MSEB supply to the load.

In this system we use the three types of the load that is capacitive, inductive, resistive load. When generated power is remaining then it is fed back to the grid. In our system, we use grid as another load. Power is taken from the MSEB and the power given to the MSEB after use is going through the net meter. Net meter is the bidirectional meter which calculates the import and export of the energy. Total system saves the electricity. In the past the energy generated from the solar is used in the home appliances only. But this system gives the flexible use of the MSEB supply.

By using this system we are consumer and producer also. Use of that system reduces the overall demand on the different power station, which will reduce the fissile fuel and reduces the pollution from the different thermal power station. Net meter shows the overall calculation about the import and export of the energy. This system will encourage the use of renewable energy source.

Table 1 Import and Export table

Import (from the MSEB)	Export (from the solar)	Net meter reading
+ 80	-100	-20
+50	-20	+30
+40	-80	-20
+100	-100	0

Battery Health Monitoring Circuit

Battery health monitoring system is microprocessor based intelligent system capable of monitoring the health of battery bank. The battery health monitoring system calculates the net charge of battery bank, deterioration of batteries in battery bank during charge or discharge cycles and actual efficiency of batteries.

Continuously monitors each cell in the battery bank to identify deterioration in the cell prior to failure.

Sine Wave Inverter

It is device which converts or inverts a low voltage, high DC potential into a low current high alternating voltage such as from a 12v automotive battery source to 220v AC output. The circuit diagram shows the inverter. It mainly consist ICCD4047, two MOSFETs with IRFZ44, transformer of 12-0-12/5A, two resistors of 100ohm, 0.5w used capacitor and resistor combination used as filter.

When the 12v DC supply is given as an input to the circuit, the input is connected to the pins 4, 5, 6, and 14. And second terminal is connected to pins 7, 8, 9, and 12. The Q is connected to pin 10 and 11. And resistor of 100ohm is connected to pin 10 and 11. As shown in fig. this resistors are connected to the gate terminal of MOSFET.

Drain terminals are connected to the transformer of 12v and 12v. Positive terminal of input is connected to zero of transformer output of transformer is 230v AC. This MOSFET is operating as a switching therefore the output is generating as an AC.

Block diagram of Net Meter

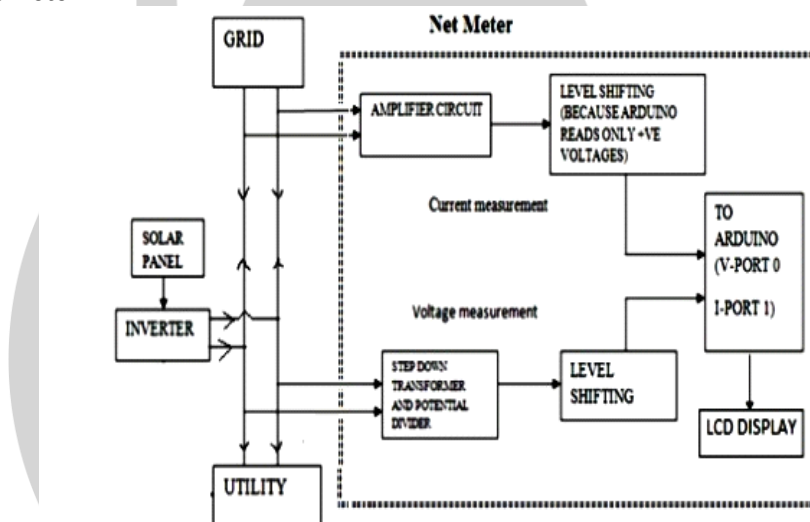


Figure 2: Internal structure of net meter

Solar panel

Solar system today has no way of storing the electricity generated by their rooftop solar energy systems to use latter. That menace solar panels produce electricity .Solar power system produces less electricity than need or if need energy when the sun it not shining at all, the power is automatically supplied from the utility grid. If solar power system produces more electricity than need, the extra electricity gets delivered back to the utility grid.

Inverter

It is device which converts or inverts a low voltage, high DC potential into a low current high alternating voltage such as from a 12v automotive battery source to 220v AC output.

Amplifier circuit

Amplifier is an electronic device that can increase the power of a signal. An amplifier uses electric power from a power supply to increase the amplitude of a signal.

Level Shifter

Level shifter is used to convert one voltage into another voltage. Level shifter is used to convert dc level into different level.

LCD Display

It is used to indicate cumulative amount of excess energy that has been generated by the customer and returned to power system.

This is not an indication of the total amount of energy generated by the customer but only the remainder of the generated power after the customer energy needs have been met.

Step down transformer

Step down transformer is one whose secondary voltage is less than its primary voltage. It is designed to reduce the voltage.

Relay operated automatic switch

When energy produces at the afternoon time from the solar panel this energy consume the consumer. That time the energy from the grid not uses the consumer. At evening the energy from solar panel not fulfillment to the consumer, that time consumer use energy from the grid system. This process takes place by using relay operated switch.

ADVANTAGES OF THE DESIGNED SYSTEM

Net metering makes residential solar energy system ownership even more attractive and affordable for many families. It can save homeowners hundreds more dollars per year on their utility bills, and it makes the process of accounting for the energy flowing to and from the utility simpler and easier to administer.

The system is easy and cheap in cost. It enables people to get real value for the electrical energy they produce, without having to install a second meter as well as an expensive battery storage system.

Net metering allows you to receive credits for any energy that your system produces but your home doesn't use. The policies for your utility's net metering program may vary a bit, however most utilities allow you to roll over the credits each month. Then, at the end of the year if you still have leftover credits, you can choose to receive a check for the amount of energy your panels produced, or continue to roll the credits over.

It encourages energy consumers to play an active role in alternative energy production, which both protects the environment as well as helps preserve natural energy resources.

CONCLUSION

This paper mainly concentrates on green energy which is more focused for the power generation nowadays, because of the lack of conventional resources. As it is based on the availability of the resources, the generation will be done in the distributed manner. To get benefit out of the generation net metering concept is emerging area. The concept states that classification of consumers based on their production and utilization will gave their payback period. More is the generation, less utilization then payback period will be low. Over all net metering gives the picture of clean energy and development of the sustainable society.

REFERENCES

- [1] Rooftop solar and net metering in India - Detailed analysis; White Paper from Efficient Carbon.
- [2] Matcher, R  ther R. Economic performance and policies for grid-connected residential solar photovoltaic systems in Brazil. Energy Policy, 2012, 49, 688-694.
- [3] Yusuf El Toes, 'Feasibility of residential grid connected PV system under the Jordanian net metering renewable energy law', Journal of Energy Technologies and Policy www.iiste.org ISSN 2224-3232 (Paper) ISSN 2225-0573 (Online) Vol.3, No.7, 2013.
- [4] Andreas Poulakis, George Kouretas, Ionic Hadjipaschalis, 'A review of net metering mechanism for electricity renewable energy sources', International Journal of Energy and Environment (IJEE), IEEE, Volume 4, Issue 6, 2013, pp.975-1002.
- [5] M.Sahanaa sere, S.Arunkumar, K. Kalidasa Murugavel, 'Feasibility Study for the Net Metering Implementation in Residential Solar PV Installations across Tamil Nadu', 978- 1-4 799-3826-1/14  20 14 IEEE, 2014 International Conference on Computation of Power, Energy, Information and Communication (ICCPETC).
- [6] Evolving Net-metering Model Regulation for rooftop based solar PV projects, Forum of Regulators Working Group Report.
- [7] Neil Redfield, Joe Redfield, 'the Garage of the Future: Maximizing the Economic Value of Solar Panels', 978-1-4244-5275-0/10  2010 IEEE.