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RESEARCH ARTICLE

SOLAR ELECTRIC SYSTEM INSTALLATION

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ABSTRACT

The cost of electricity production is increasing day by day due to the absence of conventional energy. If we continue to depend on the conventional sources, one day will definitely come when we will have to spend our life without electricity. This problem may be solved if we can produce electricity by using non-conventional energy such as Solar, wind, tidal. But there is a question about the availability of such energies in the desirable place except solar energy. As the Sun is available almost every part of the world for at least 6-8 hours every day, solar power can be installed in industries, institutes and houses also without facing so much difficulties. It can be installed on roofs or walls of buildings without using extra land. Power generation is also nearby the load, no requirement of transmission. Hence transmission related losses are minimized. Photovoltaic (PV) cell converts solar energy to electrical energy. Though the installation cost of this system is high enough, it can be neutralized if the system is used for 20-25 years. This survey paper is written to inspire people about solar electric system installation. They can learn from this paper what the factors are there to install it.

INTRODUCTION

Photovoltaic (PV) systems convert sunlight directly to electricity. They work any time the sun is shining, but more electricity is produced when the sunlight is more intense and strikes the PV modules directly (as when rays of sunlight are perpendicular to the PV modules). Unlike solar thermal systems for heating water,[1] PV does not use the sun's heat to make electricity. Instead, electrons freed by the interaction of sunlight with semiconductor materials in PV cells are captured in an electric current. PV allows us to produce electricity without noise or air pollution from a clean, renewable resource. The basic building block of PV technology is the solar -cell.‖ Multiple PV cells are connected to form a PV -module,‖[2] the smallest PV component sold commercially. Modules range in power output from about 10 watts to 300 watts. A PV system connected or -tied‖ to the utility grid.

Mounting Location

Solar modules are usually mounted on roofs. If roof area is not available, PV modules can be pole-mounted, ground-mounted and wall-mounted or installed as part of a shade structure.[3,4]

ORIENTATION AND TILT:

Optimal orientation for solar panels is true south. As we move away from true south, a system will suffer production losses, up to as much as 15–25% for panels oriented east or west. However with advancements in technology these losses are decreasing as inverter manufacturers learn how to maximize off-of-south orientations.[5] It is seen that solar panels produce the maximum power annually when mounted at a tilt of roughly 30 degrees.

Shading

Shading should be avoided as much as possible. Even minimal shading can significantly impact power production. The designer has to consider potential shading from trees, buildings, power lines, telephone poles, and obstructions like chimneys and vent pipes.[6,7] The contractor should include the impact of obstructions on the power production estimate.

Roof Types

A significant portion of our system cost will be in the installation of the panels, so if there is a plan on replacing the roof in the next 5–7 years; it should be considered doing that first. Otherwise, installer will need to come back to remove the panels for the new roofing to be added, and then re-install the panels.[8] It will be cost effective. Overall, the roof should be in excellent long-term condition, because PV systems are designed to last a minimum of 20 years and many will last

even longer. So, if it is unsure about the structural integrity of the roof, it should be professionally inspected to verify its condition and suitability.[9]

Most residential and small commercial PV systems are installed on sloped roofs, yet it is possible to install on a flat roof. Contractors typically avoid penetrating a flat roof and instead use some sort of ballasted (weighted) means of securing the panels against wind.[10,11] Building code officials will be concerned about the wind shear and roof loading of such a system. If a flat roof system is in the future, plan to submit a professional engineer (PE) stamped drawing illustrating how the system will be secured to the building.

Tracking

Most residential and commercial PV installations are mounted to roofs and are fixed in place. If the system is going to be mounted on a pole or a flat roof, there is the choice of installing a tracking device.[12] The simplest form of tracking is to seasonally adjust the tilt angle of the panels. Automatic tracking devices allow the panels to follow the sun as it moves through the sky, receiving direct light more often than a fixed system. Electrically operated and thermally operated trackers have their own costs, benefits, and drawbacks. Keep in mind that without a tracker, our PV system has no moving parts.[13] While automatic trackers can increase production by 20–40%, they do add moving parts to the system, so there are operation and maintenance concerns to consider. Pole-mounted systems also have the additional cost of the pole installation.

Required Area

Residential and small commercial systems require as little as 50 square feet for a small system up to as much as 1,000 square feet. As a general rule for the Pacific Northwest, every 1,000 watts of PV modules requires 100 square feet of collector area for modules using crystalline silicon (currently the most common PV cell type).[14]

When using less efficient modules, such as amorphous silicon or other thin-film types, the area will need to be approximately doubled. If our location limits the physical size of our system, we may want to install a system that uses more-efficient PV modules.[15] Keep in mind that access space around the modules can add up to 20 percent to the required area.

The components of pv system

PV Array

Multiple PV panels installed together are called a PV array. Mounting arrays to rooftops is most common, yet they can also be located on a pole, a ground mounted rack, parking area shade covers, window awnings, etc. The PV array produces Direct Current (DC) power.[16]

DC Disconnect

The DC Disconnect is a safety device that, when manually opened, stops power running from the array to the rest of the system. The DC disconnect is used during system installation and anytime your contractor needs to work on the system.

DC/AC Inverter

The PV array produces DC electricity, however, we use Alternating Current (AC) electricity in our buildings and power grid. The Inverter converts the DC power to AC power.[16]

AC Disconnect

The AC Disconnect is another safety device and is often incorporated into the Inverter. Some places do not require an AC Disconnect on most small residential systems.[17]

Production Meter

The Production Meter measures the energy output (in kilowatt-hours kWh) from our system and is used to record the amount of electricity consumed.

Building Breaker Box and Standard Utility Meter

Also called as building's circuit panel or electrical service panel, the Breaker Box is where the power from the PV System enters the building. If the building is using electricity, the PV-produced electricity will be used first.[17] If the building needs more electricity than the PV System is producing, utility grid power is automatically pulled into the building. When the PV System produces more electricity than is needed, the excess flows back out to the utility, spinning our utility billing meter backwards inthe process.[18] We earn credit for the excess power produced and can use that credit when the system is not producing energy. This process is referred to as -net metering.‖[19]

ADVANTAGES

Less space

Every electric system requires extra space for installation. But to install solar electric station no extra land is required as it can be installed in the buildings.

No cost for land

As extra land is not required to install this system, the cost for land is saved.

No transmission loss

The distance between generating station and load is very less. So transmission of electrical power is not required. Losses like copper loss, corona loss are almost negligible.[20]

No cost for transmitting power

Conductors, Insulators, towers etc. are required to transmit power from generating station to the consumers. As a result the cost for transmitting power is huge. In case of solar electric system no cost is required for this purpose.

Net Marketing

If the electricity produced by solar electric system is beyond the requirement of the building, the excess power can be sent

to the grid. Cost of Installation is partly neutralized by this process.

Uninterrupted power supply

As the Sun is not available for whole day, power cannot be generated in the evening or at night and during cloudy atmosphere.[21] But if a battery is connected to the system to store the power, there will be no interruption of power supply anytime.

Availability of resource

Generating stations like thermal, diesel etc. are installed where the resource are easily available. For that reason generating stations cannot be installed where it requires. As the Sun is available almost everywhere in the world it can be installed as per requirement.

No voltage drop

During transmission and distribution of power from generating station to consumers huge voltage drop occurs due to resistance and inductance of line. These voltages are compensated by some equipment.[21] Here for this system no voltage drop occurs due to absence of transmission and distribution system and cost of compensating equipment is also saved.

No cost for resource

Resources like coal, diesel is required for other generating stations as a fuel. There is no such cost for solar electric system as solar power is used here as resource.[22]

Indirect cooling effect

If the solar arrays are installed on walls or roofs of buildings, they do not allow heat to enter inside the room. Thus the rooms can be kept at normal temperature in summer.

CONCLUSIONS

Solar power has been already accepted in many countries for generation electricity. Many buildings, industries, institutions are running by solar power. Solar street light system, solar car, solar battery chargers are also used now a day. Still solar power has not accepted as a conventional one due to some reasons. Firstly, installation cost of this system is high enough. It is not possible to invest a huge amount of money at a time for common people. Secondly, the efficiency of solar cell is around 15% which is much lower than thermal or diesel power plant. Research work is necessary to improve it. Thirdly, solar panels become useless without sunlight. In rainy season if the weather remains cloudy for 4-5 days, the power will be unavailable in spite of having a battery backup system.

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