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Comparative Analysis of String Inverter and Micro Inverter for Solar Based Power System

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ABSTRACT: There are many types of inverter used for converting the direct current produced by the PV to alternating current. The conversion is must in order to suit the AC grid system. This paper gives the introduction about solar power system using string inverter and micro inverter. As both methods have its own merits and demerits according to different technical parameters as well as monetary aspects

KEYWORDS: Grid, Micro Inverter, MPPT, PV, Solar, String inverter

I.INTRODUCTION

Solar photovoltaic (PV) energy is currently one of the most important available non-conventional resources because is free, abundant, and pollution-free and distributed all over the world. Different types of photovoltaic cell with yield different energy output also the controlling technique of inverter is very crucial in championing the PV system. Inverter design should consider the size and capacity of the plant, meanwhile choosing the right controlling technique is also important to achieve an efficient renewable energy system. The inverter is an integral component of the power conditioning unit of a photovoltaic power system and employs various dc/ac converter topologies and control structure. It has to meet various international standards before it can be put in commercial use. The function of inverter in distributed power generation system on top of photovoltaic generation includes dc-ac conversion, output power quality assurance, various protection mechanisms, and system controls. The requirements in terms of low cost, high efficiency, high reliability, and tolerance over wide range of input voltage variations have driven the inverter development toward simpler topologies, lower component counts, and tighter modular design. Historically, the inverters employed in PV technology may be classified based on number of power processing stages, type of power decoupling, types of interconnection between the stages, and types of grid interface. Based on power processing stage, the inverter may be classified as single stage and multiple stage inverters. This paper presents a comprehensive review of various inverter topologies and control structure employed in PV applications with associated merits and demerits.

II. SOLAR POWER SYSTEM ADVANCEMENT

PV cells have been used in many applications to generate electricity. A few of these are briefly discussed in this section.

A.LOG CABIN SYSTEM

A simple 12 volt DC system provides lighting for isolated cabins. Low wattage (<100W) solar panels are connected directly to a battery.. The battery life is compromised by unregulated current charging. Available appliances are limited for 12 volt DC power, because wire resistance limits power to a few hundred watts. This system is not connected to AC power lines and is considered to be "off the grid".

B.COUNTRY HOME SYSTEM

Larger panels providing 24-96 volts are connected to an inverter to yield 120/240 VAC to operate standard lighting .Battery life is improved with a regulated charging module. The higher DC voltages support moderate power levels. This system is not connected to AC power lines and is considered to be "off the grid".

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C.URBAN HOME SYSTEM

Larger panels providing 200-400 volts are connected to an inverter to yield 120/240 VAC at medium power levels (2-10kW). This system is connected to AC power lines (i.e., connected to the grid) . The customer sells power to thepower company during the day and buys power from the power company during the night. The grid-connected approach eliminates expensive and short-lived batteries

A COUPLE OF ISSUES EXIST WITH ABOVE SYSTEM.

The inverter has impending as a single point of failure non-optimal power harvesting from the solar panels, especially in partial shading conditions.

SINGLE INVERTER WITH MULTIPLE DC/DC CONVERTERS

The use of DC/DC converters per string provide enhanced power harvesting from solar panels .The DC/DC converters may be separate modules or reside within the inverter module. This method is still subject to single-point-failure of the inverter, and involves the distribution of high voltage DC power a potentially dangerous situation because direct current power fusing is difficult to achieve.

URBAN HOME SYSTEM WITH STRING INVERTERS

Panels providing 200-400 volts are connected to multiple inverters to yield 120/240 VAC at medium power levels (2-10kW). The inverters are connected to the grid as Use of multiple inverters provides enhanced power harvesting from solar panels and also provides enhanced system reliability.

MODULE INCORPORATED INVERTERS

Each solar panel module incorporates its own inverter. Module-incorporated inverters are also known as micro inverters. The incorporation of inverters into the solar panels greatly reduces installation labour costs, improves safety, and maximizes the solar energy harvest.

III.COMPARISION BETWEEN STRING INVERTER AND MICRO INVERTER

It converts the high voltage DC output from the PV array to AC for connection to the electricity grid. For residential and commercial installations, the inverter will characteristically be rated at 3kWp or 5kWp. In a typical 7kWp system, two string inverters may be used. Some companies now offer so-called “optimizers” so that the more power can be pull out from each solar module .A small inverter is attached to the back of or integrated into the solar module. A 7kW system might use 29 micro-inverters each rated at 240W. It might seem that the micro-inverter architecture is more complex and more expensive. Noticeably, compared to conventional solar PV systems it has more components. Micro-inverters are also less efficient in power conversion than central inverters. However, when considering the lifetime economics of solar PV systems, those based on micro-inverters can be shown to offer a 20% advantage in LCOE terms. The following analysis compares a conventional string inverter system with one in which micro-inverters are integrated into the solar module to produce a so-called “AC module”.Micro-inverters are today connected as separate devices to DC solar PV modules but there is a developing trend to integrate them into the modules

CAPITAL COSTS

When the cost of inverters plus modules is added together, a micro-inverter based system costs around 10% more than the string inverter system. When it comes to installation costs, the picture changes and don’t need DC wiring when using AC modules, simply connect the modules in parallel and feed the result into the grid. There are no high voltage DC switch boxes and protection circuits that need specialist skills and training to install. Solar modules within a DC string have to be closely matched to optimize system performance don’t need to do this with AC modules. Furthermore, with AC modules don’t need to allocate an area within the building for the installation of the string inverters.The main costs of installation are design and planning, mounting structure kit and labor costs for mounting, assembly, integration and commissioning AC modules offer around 24% saving in installation costs. Combining the total equipment plus installation and commissioning costs results in a compelling argument for considering AC-modules with built-in micro-inverters. That’s a saving of nearly 7% in capital costs.

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POWER HARVESTING

It's in power harvesting that PV systems with micro-inverters show the greatest advantage over string inverter systems. With DC strings, shading from any source such as tree branches or even something as small as an antenna or vent pipe can dramatically reduce the energy produced. Also, grime and other debris that build up unevenly on solar module surfaces causes some modules or even a few cells of modules to see less solar energy. Because the modules are connected in series the whole system only performs at the level of the poorest performer in the string. A solar module in shadow limits the PV system's performance and the higher potential energy of the other modules that are not shadowed is wasted. Under these real world conditions the penalty to the potential energy harvest is severe with conventional string inverters systems.

With AC modules, each module is an independent, standalone, solar AC grid connect system with its own optimized energy production output. Maximum Power Point Tracking (MPPT) is used to achieve the highest possible power yield. This is an electronic technique that varies the electrical operating point of the module in order to extract the maximum available power from it. Any degradation in the performance of a module, due to clouds, shadows, dirt or other obstructions, does not affect the performance of other modules and therefore has much less negative impact on the power harvested from the system as a whole when using micro-inverters or integrated AC modules. However, this marginal difference is more than contradicted when you consider the system level issues described above.

In addition, string inverter systems typically lose about 2% of potential harvested power due the mismatch of solar modules, and a further 2% due to the use of DC wiring. Further, the inverter itself has been presented by experience to be the most unreliable part of the system and, as it is a single point of failure, a failed inverter means that no power is harvested until it is fixed or replaced. A factor that reduces energy harvesting, perhaps by a further 2% over the life of the system.When all of these factors are taken into account, systems that use micro-inverters yield more power from every solar module, result in less downtime, and reduce the cost per W yielded from the system over its lifetime. The specific figures will depend upon external factors, such as the installation location and solar radiation available. Current best estimates show that the initial cost per yielded watt is around 12% lower for systems using a micro-inverter integrated with a solar module (AC module).

MAINTENANCE

PV solar systems with string inverters are relatively expensive to maintain. The first problem is that the installation can only be monitored at a system level, not at the level of each individual module. Finding a faulty solar module or one that has a shadow cast over it is a time-consuming and expensive task.

By distinction, AC modules are monitored individually. Installers and maintenance companies can even monitor systems online, right down to the level of individual solar modules, from a web-enabled interface. This enables them to immediately identify the exact location of any faults and quickly fix it.

VI.CONCLUSION

Solar radiation perhaps being the least predictable the best available data today suggests that AC modules with integrated micro-inverters will result in 20%lower cost of ownership compared with conventional systems using string inverters. Greatly improved energy harvest, lower installation costs, and reduced maintenance are the key factors that contribute to this saving. Most of this saving can also be realized by using micro-inverters installed at the back of solar modules.

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