Needs and methods of accurate measurements and forecasts for PV power output

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Abstract

Renewable energy sources such as PV and wind are increasingly connected to power systems all over the world especially in the U.S. and European countries. Control of renewable energy sources such as PV and wind is much more difficult than control of conventional power sources such as nuclear, thermal and hydro because renewable energy sources change power output rapidly depending on climate conditions. Therefore, accurate measurements and forecasts for PV power output are needed to secure a balanced control between supply and demand (i.e. frequency control). In addition, when inverter power sources such as PV connected to power systems via inverters increase, synchronous generators utilized in conventional power sources decrease. And inertia and synchronizing power of power systems also decrease. This may lead to 1) increased frequency fluctuations, 2) power system instability and 3) increased voltage fluctuations and harmonic distortions. To solve these three potential problems, more synchronous generators are needed to connect to power systems. Therefore, accurate measurements and forecasts for PV power output are also needed to precisely understand how many synchronous generators should be connected to power systems.

In this presentation, examples of accurate measurements and forecasts for PV power output both in the U.S. and Japan will be presented. There are two primary methods to achieve accurate measurements and forecasts for PV power output. These two primary methods are a) accurate measurements and forecasts for irradiance, and b) accurate measurements and forecasts for installed capacity and operational status of PV facilities. First, to achieve accurate measurements and forecasts for irradiance, images taken from weather satellites are utilized and irradiance is accurately measured and forecasted considering motions and specifications of clouds. Recently, images taken from latest weather satellites have high resolutions and are frequently updated. Therefore, utilizing these images, irradiance can be more accurately measured and forecasted. Second, to achieve accurate measurements and forecasts for installed capacity, electric power utilities both in the U.S and Japan have access to all information about all PV facilities connected to power systems. Therefore, electric power utilities both in the U.S. and Japan can compile databases of all PV facility information including their specifications and locations, and they can accurately understand the installed capacity of PV facilities. As for the operational status of PV facilities, some PV facilities with relatively large installed capacity can be assessed both in the U.S. and Japan. Other PV facilities with relatively small installed capacity will need to be assessed in the future.

Through these methods, PV power output can be accurately measured and forecasted. And by utilizing accurate PV power output, power system control will be much easier, and problems on the characteristics of power systems will be overcome. On some Japanese isolated islands, many PV power sources are increasingly connected to power systems, and the control of power systems is much more difficult. Therefore, electric power utilities may demand PV owners to reduce power output. By applying the aforementioned methods to isolated Japanese islands, there will be less of a need for electric power utilities to demand a reduction in PV power output.