Grid Connected PV Plant with Battery Storage System: Recent Results of Wakkanai Mega-Solar Project

Akira Kuwayama

Engineer, R&D Department,

Hokkaido Electric Power Co., Inc., Japan

Abstract

The mega-solar demonstration project named "Verification of Grid Stabilization with Large-scale PV Power Generation systems" began in 2006 at Wakkanai, the northernmost city of Japan. NEDO, New Energy and Industrial Technology Development Organization of Japan conducts this project and HEPCO, Hokkaido Electric Power Co., Inc manages the overall project.

The following are the features of this project: (1) Mega-PV integrated with battery storage system; (2) Using weather forecasting data to output control; (3) Installation at harsh climate conditions, abundant snowfall and frigid temperatures.

Some 5MW of PV modules and 1.5-MW (1.0+0.5MW, 7.2h) sodium-sulfur (NAS) battery systems have already been constructed and are in operation. This system connects to utility's (HEPCO's) 33kV power grid. NAS absorbs fluctuation in PV output within its limit of kW and kWh capacity. For more efficient and effective operation of NAS, we are developing and testing several control algorithms of battery system for smoothing PV output and for scheduled operation using solar radiation forecast.

The control schemes have been developed to smooth fluctuations in PV generation output using the battery storage system. The field test results show the effectiveness of developed control algorithm that selects suitable control mode according to the PV output condition. Consequently, the control algorithm could reduce required kW capacity of NAS.

For the PV owner and also electric power system operator, it is advantageous to operate a PV power plant on a schedule like any other controllable generators. Developing scheduled-operation technologies using a battery storage system is one of the most important objectives of this project. In the scheduled operation, the station output for the next day is determined based on the PV output power estimated from the solar radiation forecast data. Mismatch between the scheduled station output and actual PV output is absorbed by the NAS battery. Therefore, accuracy of the solar radiation forecast plays a very important role in the scheduled operation. In this project, various forecast techniques and meteorological observation data are applied to refine the accuracy of radiation forecasts. The field test results show that our mission is to develop more efficient planning methods that are robust against the forecasting error.

Wakkanai PV project will give useful knowledge for grid stabilization technology using battery storage system and for further implementation of large-scale PV power generation systems in Japan.