Area 9: PV System Integration Including smart grid

DAY AHEAD PLANNING OF PV POWER GENERATION TO MINIMIZE IMBALANCE COST CONSIDERING SOLAR RADIATION FORECAST ERROR

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In Japan, the market for photovoltaic generation has expanded due to the implementation of Feed-in Tariff in July 2012. In line with the reform of the electric power system in April 2016, “balancing of planned value system” was introduced. In this system, balancing between the supply and demand plan submitted on the previous day and the actual supply and demand is required. Therefore, solar power producers need to predict the amount of power generation on the day before and prepare optimal plan based on that. However, PV is difficult to generate power as planned because PV generation is heavily influenced by weather conditions. If the planned value is set too small relative to actual value and surplus electric power is wasted, so called “opportunity loss”, which is the electric power that should have been sold if the planned value was set higher, will occur. On the other hand, if the planned value is set too high and deficiency occurs, “imbalance”, which is the deficiency of electricity that supposed to be generated as planned, will occur. The imbalance settled with an imbalance fee that is more expensive compared with the normal electricity price. The imbalance fee has been changed from April 2016, and it became a mechanism linking with the market price from the prescribed fee. As a result, if imbalance is occurred in a period in which the market price is high, the loss becomes larger. Therefore, in this paper, we aim to prepare a PV power generation plan that minimizes loss caused by prediction error of solar radiation amount.

The PV power generation plan was set to maximize profit by predicting the time zone when the imbalance fee becomes expensive and reducing the amount of imbalance by suppressing the amount of power generation during that time period. The power generation forecast value is calculated from the solar radiation forecast value. The rate of decreasing power generation forecast value is taken as the ‘predicted value reduction rate’, and three patterns were examined: case1 with reduction ratio in middle, case2 with small reduction ratio, and case3 with large reduction ratio.

The simulation results are shown in Fig.1. Four patterns were taken into consideration: when the prediction was overestimate, underestimate, balance (overestimate and underestimate were equally distributed), and equal to the measurement. We also assumed that the FIT price will decrease in the future and compared the results. As a result, when the FIT price declined and the effect of the loss due to the imbalance fee became large, it was shown that the total profit increases by the proposed method, except in the case of underestimation.

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