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TITLE :

Simulation study to compare the centralized and de-centralized voltage control

In recent years, large number of Photovoltaics (PVs) are installed in distribution systems. When PV systems are installed in distribution systems, voltage fluctuation is a problem. Therefore, voltage control devices such as step voltage regulators (SVRs) and the reactive power control of PV is used to cope with the voltage rise. The constant power factor control is used for the reactive power control of PV in Japan.

On the other hand, many customers will have energy storage devices such as battery storage systems and electric vehicles (EVs) in near future. Then, the reactive power output by the constant power factor control may be excessive because the reverse power flow from customers will be decreased by the self-consumption of PV power. Therefore, it is necessary to develop control methods to control reactive power properly.

As a de-centralized control method, the control method through communication between customers in the same LV network was proposed. In this method, the information of voltages and power factors is shared among customers, and the reactive power is controlled only when the voltage exceeds the upper limit. Then, the reactive power is reduced compared with the constant power factor control because a constant reactive power output is not necessary for the proposed method.

Simulation study to compare the centralized control and the proposed de-centralized control was carried out. In the simulation study, the distribution system model considering an actual distribution substation and 7 distribution feeders in Japan was used, and 3 control methods such as the autonomous control method (constant power factor 0.95), the proposed method (de-centralized method) and the centralized control (using LRT, SVR and reactive power of PVs) were compared.

Simulation results show that the reactive power is significantly decreased by the proposed control and the centralized control compared with the autonomous method. The distribution line loss and the number of tap change (an LRT and two SVRs) are decreased by the proposed control and the centralized control. The proposed method may be the reasonable measure before the centralized control considering the cost of communication network.