

Principal Research Results

Development of Methods to Control Voltage in Autonomous Demand Area Power System – Voltage Control Method by use of Distributed Generators –

Background

In the distribution system, capacity of distributed generation (DG) is growing and may have influence on power quality and safety. In recent years, reverse power flow of DG causes voltage increases and the output power of DG is reduced to control voltage * 1. To cope with such problems, “Autonomous Demand Area Power System (ADAPS)” was proposed and the control method by use of a flexible power flow control device “Loop Power Controller” was developed. A new control method by use of DG is necessary to achieve it at lower cost.

Objectives

To develop voltage control methods by use of DG: one is the autonomous control method, and the other is the remote control method.

Principal Results

1. Autonomous Voltage Control Method

The autonomous voltage control method, which controls reactive power by “threshold of reactive power control” lower than the current threshold level (107 V), was developed. The effectiveness of the method is verified analytically by a model distribution system of residential area with photovoltaic (PV).

(1) In case of the voltage increases, the line voltage is controlled efficiently by the reactive power of PVs, unless the penetration capacity of PVs becomes much larger.

(2) The total output power of PV is improved up to 7 %, and the output power of PV is improved up to 60 %.

2. Remote Voltage Control Method

The remote voltage control method, which is effective even if a large number of DG systems are installed, was developed. The developed method is designed as the DG sends and receives information each other via information infrastructures, considering that unspecified number of DG systems can be controlled, the reactive power of DG is equalized and DG can be operated properly at sudden voltage change.

The developed control method is tested at the ADAPS demonstration facility of CRIEPI. Test results show that the reactive power is shared by DG properly and the output power imbalance is improved.

Future Developments

The developed voltage control methods will be demonstrated with various distribution system and various DG.

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References

Y. Hirabaru, et.al., 2007, “Development of a Distribution System Voltage Control Method for PV Systems”, CRIEPI Report R06012 (in Japanese)

H. Hatta, et.al., 2007, “Control Method to keep Output Power of Distribution Power Generations during Voltage Regulation”, DRIEPI Report R06011 (in Japanese)

* 1 : When the line voltage exceeds the threshold, DG controls reactive power to reduce the voltage. If the reactive power is not enough, DG reduces active power keeping the power factor.

4. Power Delivery - Optimum energy application technology

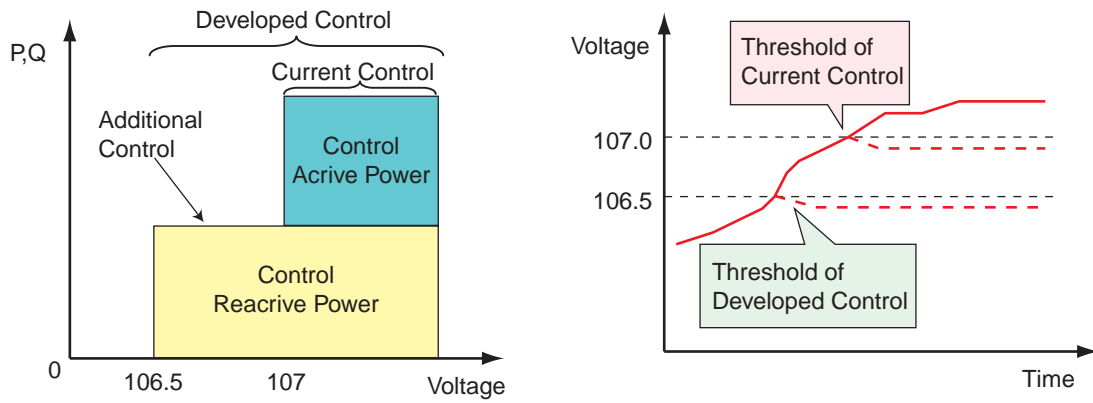
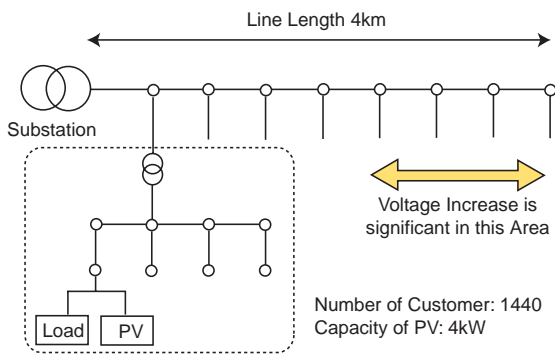
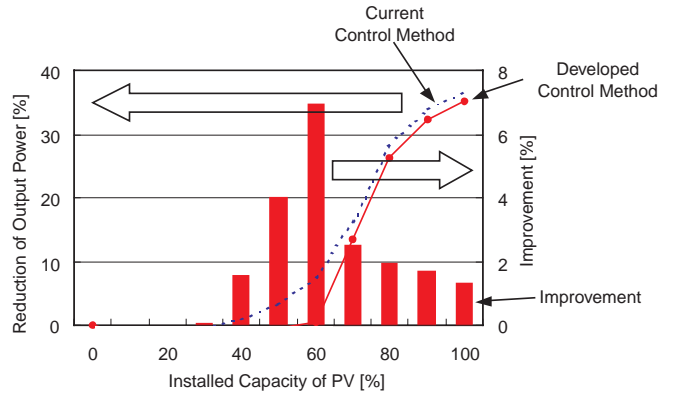


Fig.1 Developed Autonomous Voltage Control Method

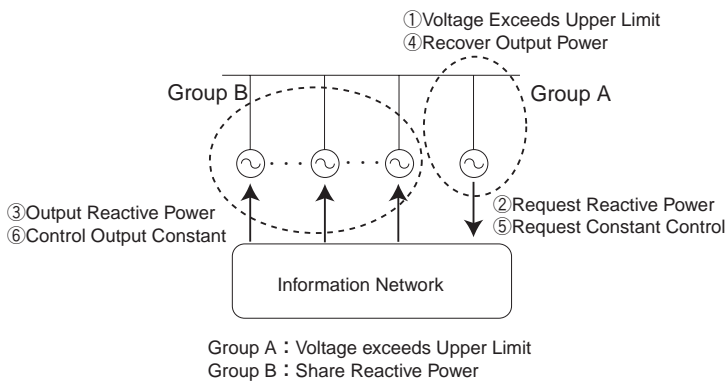


(a) Model Distribution System with PV

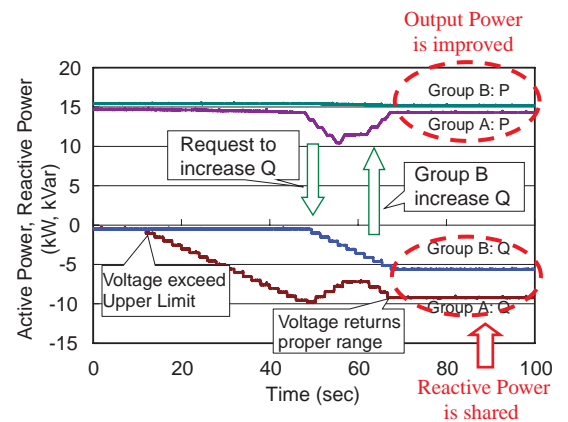


(b) Simulation Result

Fig.2 Simulation Analyses of Autonomous Voltage Control Method



(a) Developed Remote Control Method



(b) Demonstrated Test Result

Fig.3 Developed Remote Voltage Control Method and Test Results