Development of Pilot Demand Supply Interface (DSIF)
− Verification of System Function in Anonymous Demand Area Power System −

Background

Anonymous Demand Area Power System (ADAPS), which supports efficient energy usage and smooth introduction of distributed generation (DG) in case of extensive penetration of DG, is proposed in CRIEPI. Demand Supply InterFace (DSIF) that provides energy demand-supply control between customers and power quality improvement is also proposed as one of the most important components of ADAPS. DSIF, which is installed near the customer distribution panel, monitors energy use of each customer, controls and manages customer load and DG beneficially to both customers and distribution network utility using real time information such as electric tariff and network power flow, and provides energy management and ancillary service to each customer. Basic design for ADAPS management logic with Low Voltage Network Management System (LVNMS) and DSIF has been conducted. Demonstration test with pilot DSIF is required to verify system functions.

Objectives

To develop pilot Demand Supply Interface in order to verify system functions, to demonstrate ancillary service functions such as voltage raise restriction and un-interruptive power supply in case of medium voltage network fault.

Principal Results

1. Development of pilot Demand Supply InterFace (DSIF)

A Pilot DSIF and demonstration test facilities as shown in Figure 1 was developed. Energy management and ancillary service functions with DG could be demonstrated using pilot DSIF and test facilities.

2. Voltage raise prevention control in case of surplus generation

Coordinated control method that supervises active and reactive output between each customer-owned DG with LVMNS using information collected by each DSIF was developed to prevent customer voltage rise in case of surplus generation. Demonstration test showed the proposed method could reduce the imbalance DG output between customers and restriction of DG output due to differences of control logic of each DG and grid connected location in case of stand-alone control of each DG inverter. 12% output restriction was saved throughout the LV network in the test case shown in Figure 2.

3. Non-interruptive power supply of each customer in case of voltage dip or interruption

Non-interruptive power supply of each customer was available by adding small capacity battery and semi-conductor switch in case of upper power system fault such as voltage dip or interruption. Demonstration test showed no effect to low voltage customer load even though voltage dip in medium voltage network occurred (Figure 3).

Future Developments

Non-interruptive power supply under pole transformer bank, and total demonstration test of Anonymous Demand Area Power System in cooperation with ADAPS management system and pilot DSIF system using hybrid ADAPS demonstration facilities in Akagi Test Center will be performed. Practical DSIF for several types of customer will be developed.

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Reference

M. Asari, et.al., 2003, “Demand Supply Interface (Vol.1) -- Management methodology for Low Voltage Distribution Systems with Demand Supply Interface -- ”, Technical Report T02045 (in Japanese)
M. Asari, 2005, “Ancillary Service for Low Voltage Distribution Network with Demand Supply Interface - Integrated Voltage Control and Non-interruptive Power Supply with Distributed Generation --”, Technical Report R04021 (in Japanese)

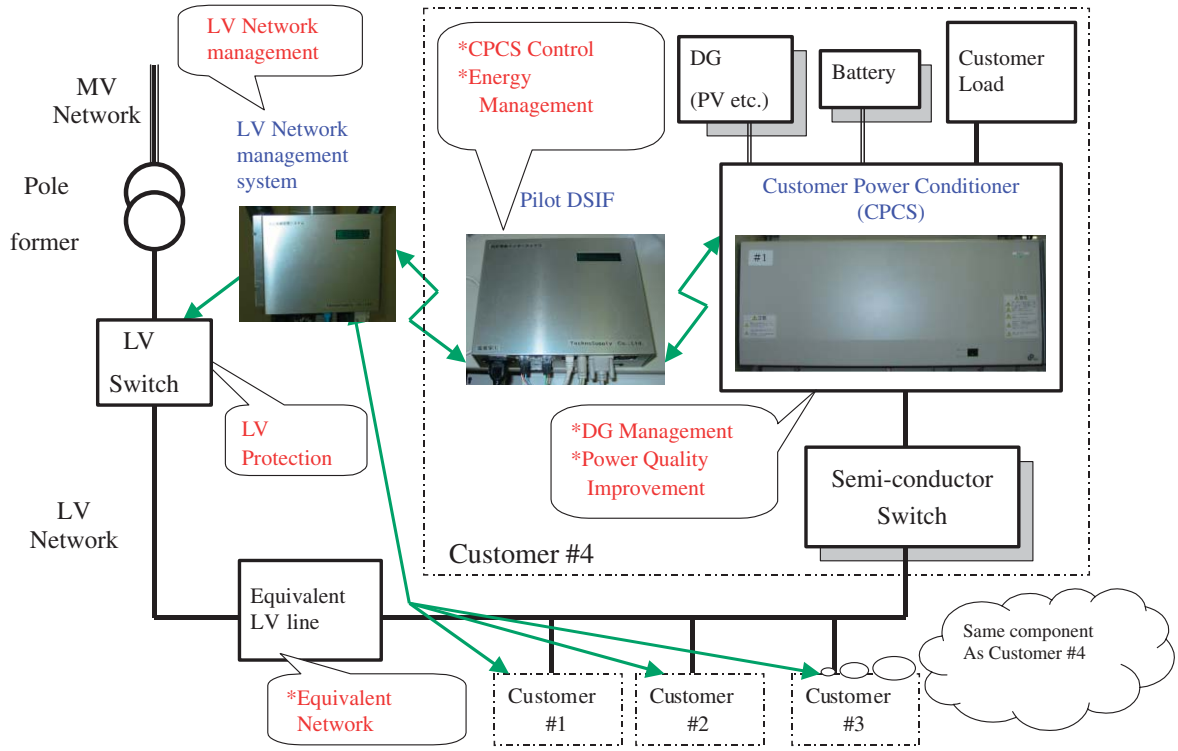
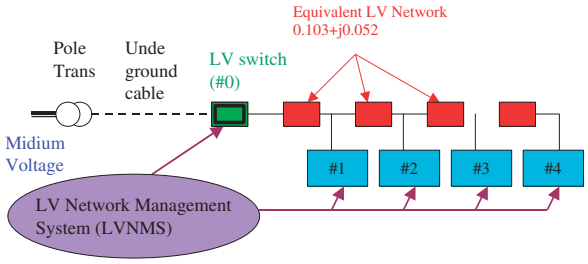
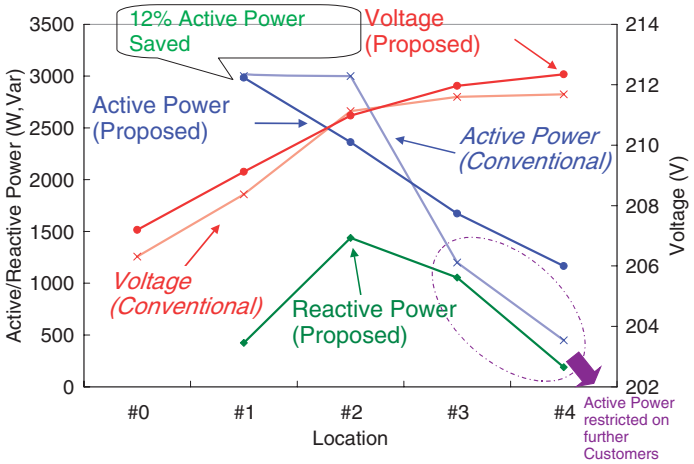


Fig.1 Developed Pilot Demand Supply Interface and Demonstration Facility

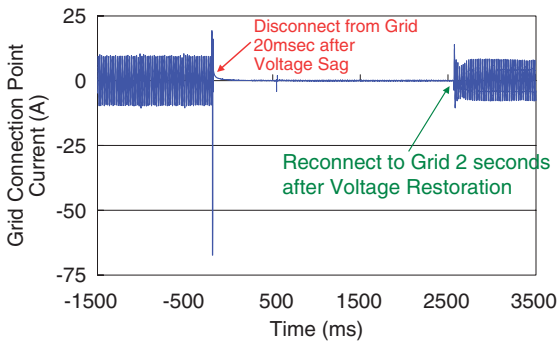


(a) Test circuit

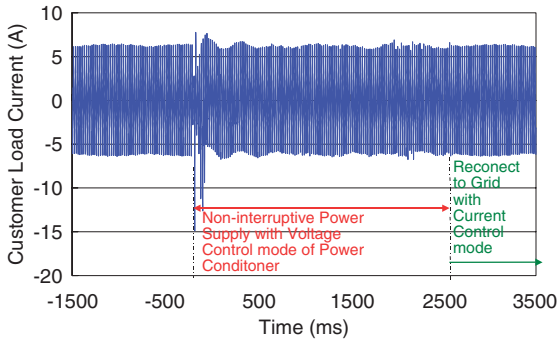


(b) Voltage raise prevention control

Fig.2 Voltage raise prevention control in case of surplus generation



(a) Current at grid connection point



(b) Current at customer load Dip 70%, Dip Duration 720ms

Fig.3 Un-interruptive power supply for total customer load (MediumVoltage Dip)