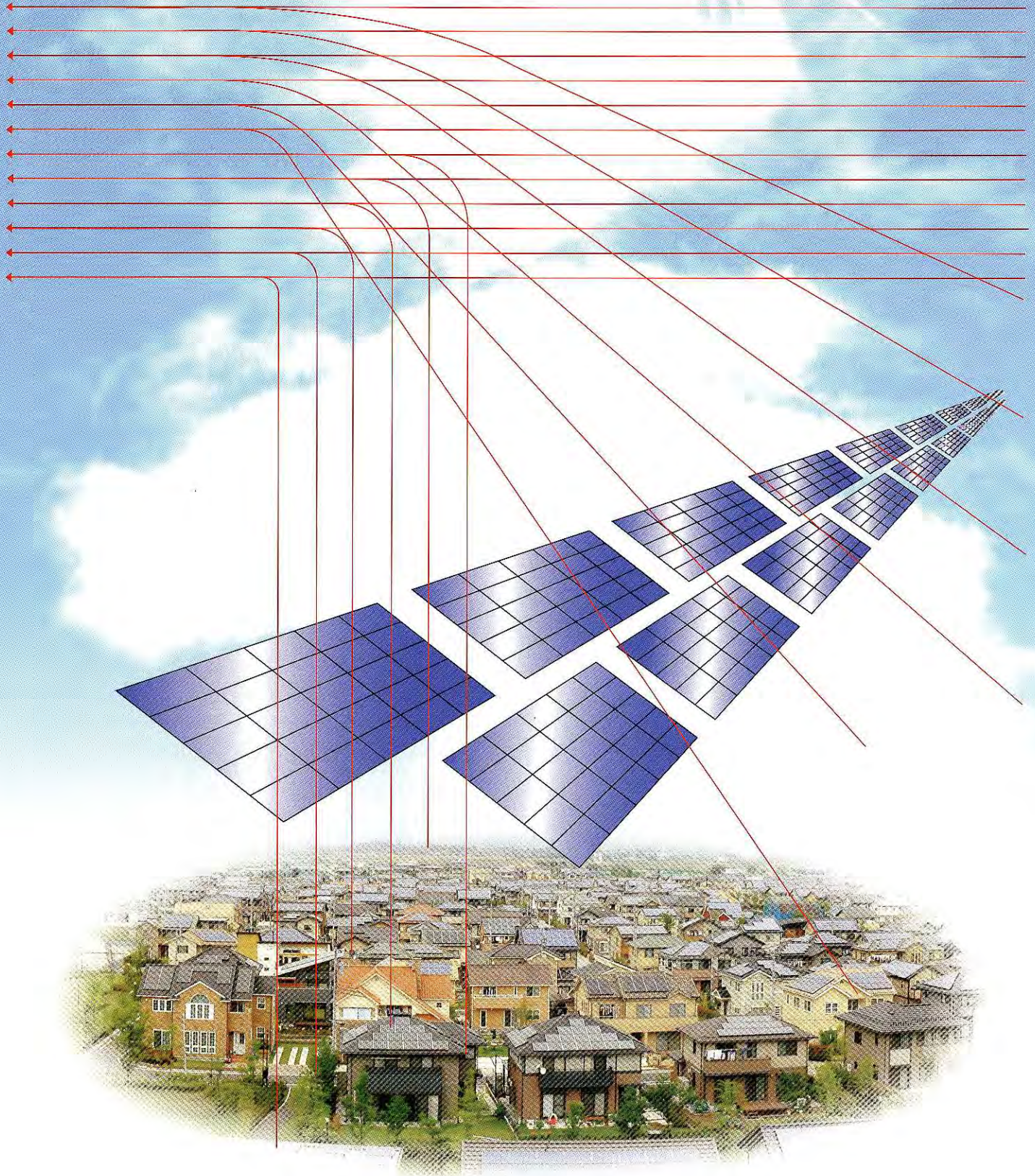


Demonstrative Research on Clustered PV Systems

Commissioned by New Energy and Industrial Technology Development Organization (NEDO)

A large number of photovoltaic (PV) systems are installed on the roofs of houses in the new "Pal Town Josai-no-Mori" residential complex in Ota City, Gunma Prefecture, and connected to the power grid as a cluster for this research project. This demonstrative research aims to evaluate performances and capabilities of the PV systems, examine their negative influence on distribution lines, and develop the technology to resolve potential issues. The number of PV systems to be installed in this project will eventually reach to around **550** houses and total capacity will be approximately **2,200kW**, one of the world's largest residential clustered PV systems connected to a single distribution line.



1. Development, analysis and evaluation of the te

(1) Output suppression avoidance system

Generated output power will be used for house load in residential PV systems and surplus power will be supplied to the power grid. The voltage in the distribution line rises as the increasing of the amount of such surplus output power and the voltage sometimes exceeds the operational range. PV systems have a built-in function to reduce its output when the voltage reached to the upper limitation of the operational range to prevent over voltage, however, this phenomenon (excess voltage) may occur frequently in clustered PV systems and results suppression of the output and lower the system efficiency significantly. To solve this problem, this demonstrative research project is tasked to develop an "output suppression avoidance system" which uses a battery as energy storage. Surplus power, which may be suppressed in conventional systems, will be stored in the battery. This output suppression avoidance system will allow PV systems to generate their maximum output power even when they are clustered.

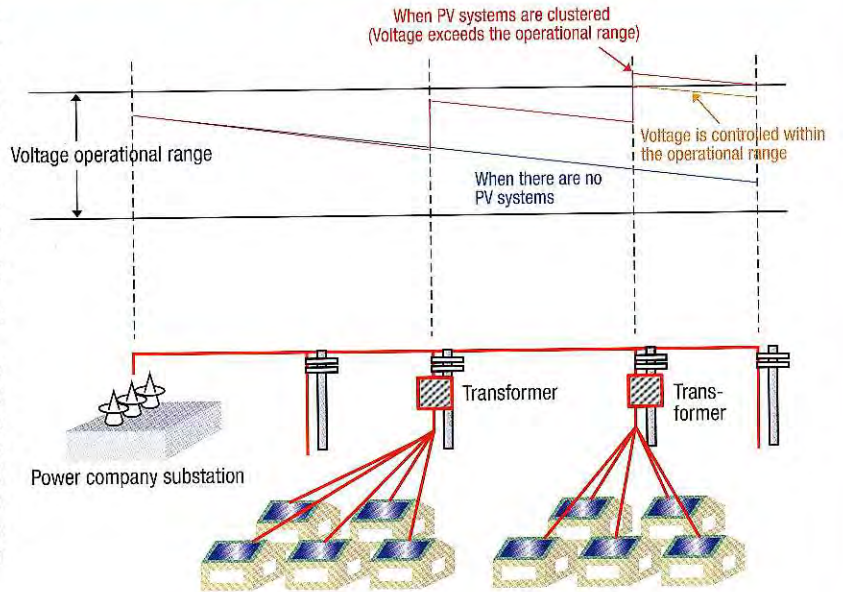
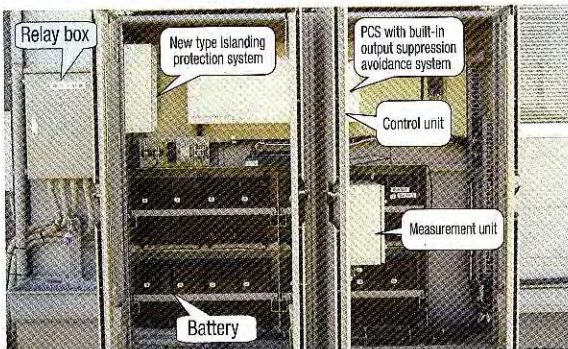
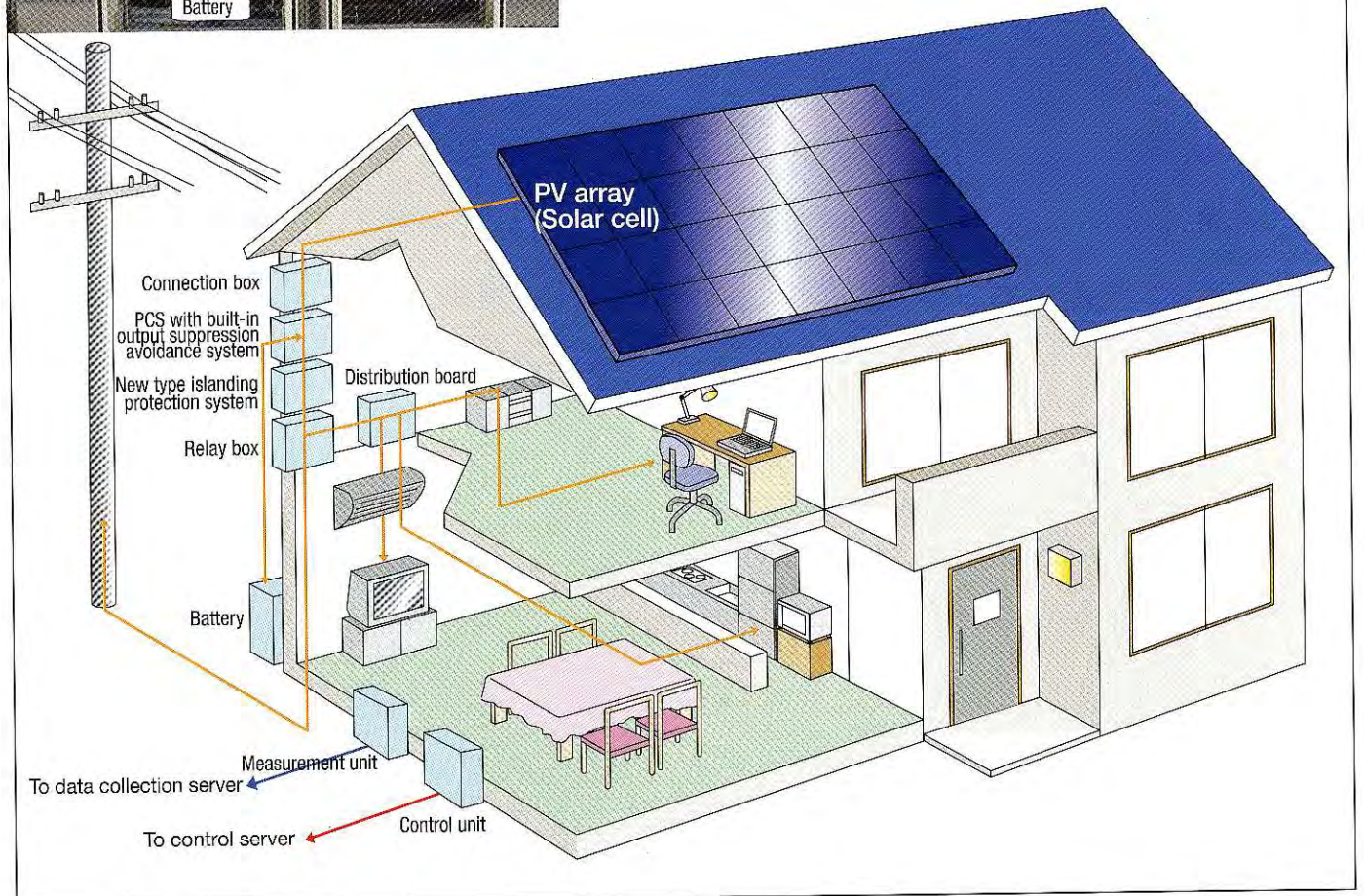


Image of voltage in distribution system



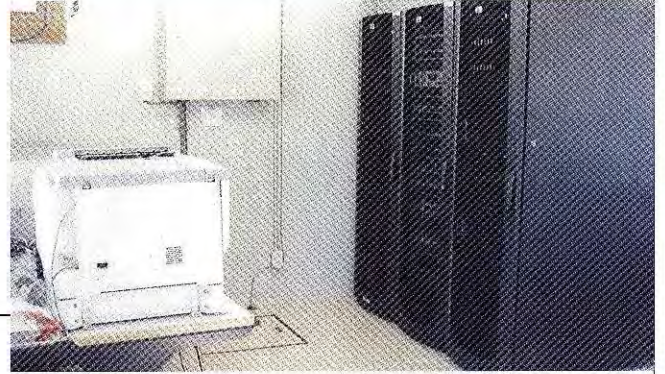
PV system with built-in output suppression avoidance system



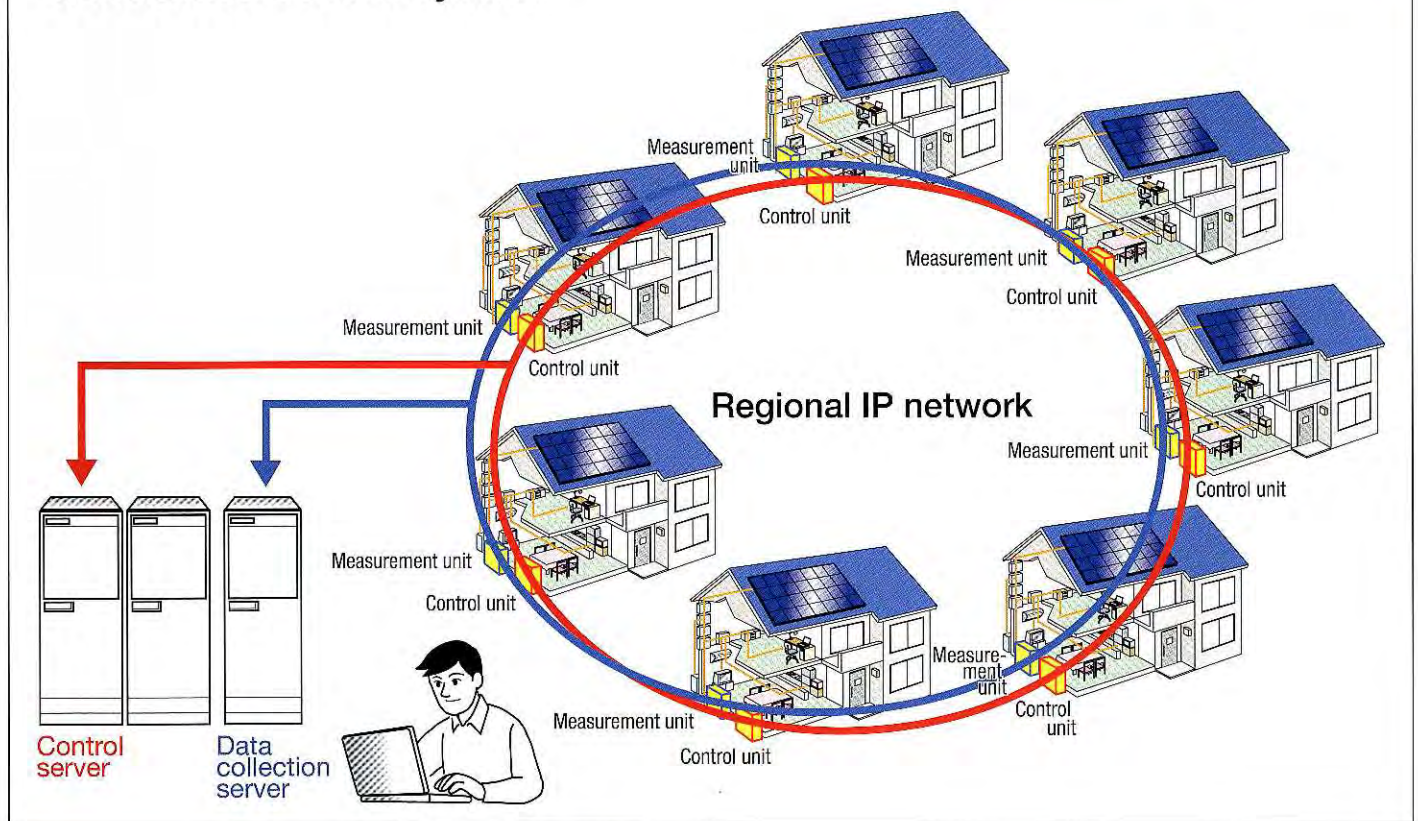
Technology designed to avoid output suppression

(2) Centralized control system

The project team develops a centralized control system that will collectively control PV systems based on data such as the amount of power generated by the PV systems, the amount of battery charge/discharge, and the amount of power consumed. It is expected that such centralized control will improve the overall efficiency of the area where PV systems are clustered and enhance the performance significantly. Furthermore obtained data will also be utilized for diagnosing battery life and facilitate early detection of system malfunction.



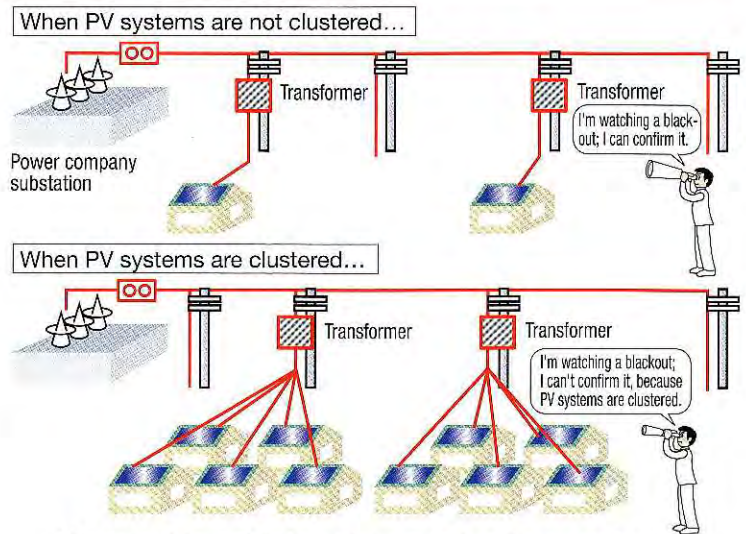
Centralized control system



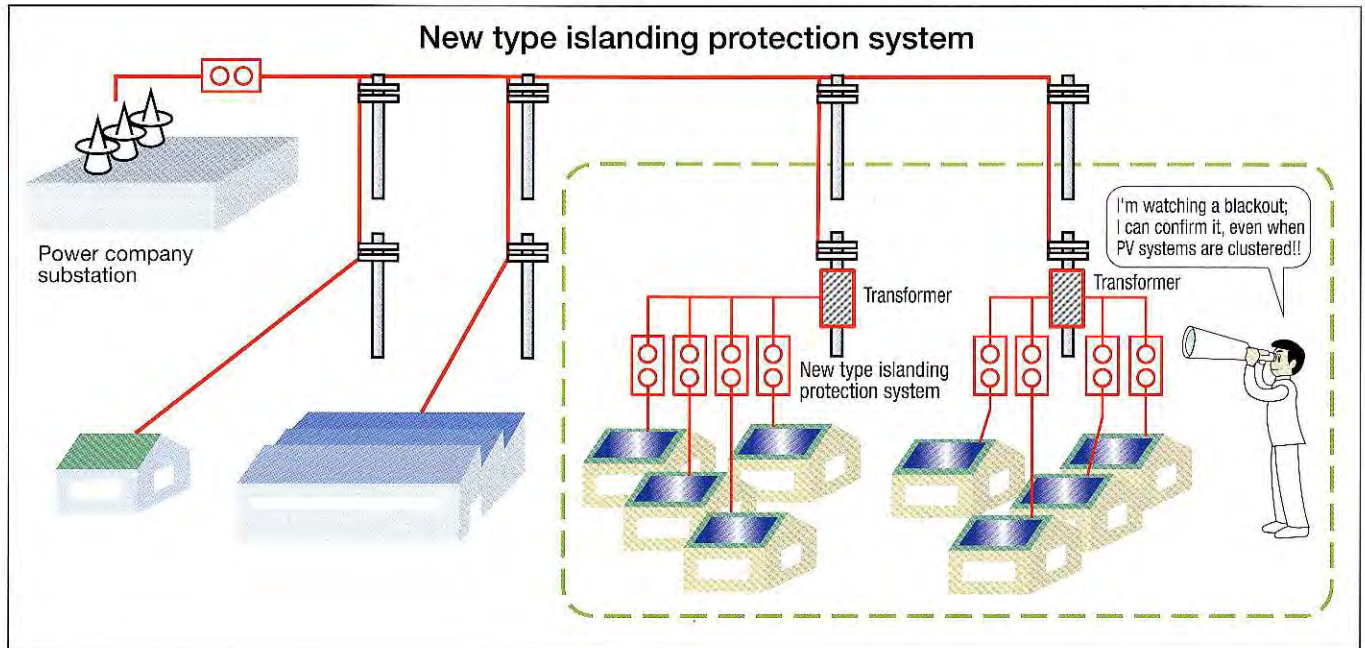
2. Development, analysis and evaluation of the new type islanding protection system

New type islanding protection system

The residential PV system features a built-in function for detecting islanding. The function is designed to prevent the occurrence of accidents resulting in injuries or death as well as equipment malfunctions by instantaneously halting PV system power generation during blackout. However, the use of a conventional islanding protection system in clustered PV systems may result in a failure of islanding detection or unnecessary cut off. To avoid the failure of islanding protection in clustered PV systems, the research project team develops the new type islanding protection system. The new type islanding protection system will be able to shut off rapidly and securely in the event of distribution system power failure, and during normal operation, will ensure they remain free of malfunctions.



Conventional islanding protection system



▼ Site of demonstrative research experiments



The Japanese government set the goal of a total capacity of 4.82 million kW by year 2010 to promote the introduction of PV systems. (1.13 million kW had been already introduced by the end of FY2004.) In order to achieve this goal, a variety of stimulation programs have been created including subsidies from the central government.

Background

The installation of the PV systems may concentrate on the local power distribution system in some cases through the process of their rapid spread and expansion. (This situation called "clustered PV systems".) This tends to induce excess voltage in the related power network's distribution lines, which may results in suppression of PV system output and islanding. These events could affect the promotion of PV system's introduction.

Purposes

In order to promote the introduction of PV systems smoothly and in a reasonable manner, a five-year project, "Demonstrative Research on Clustered PV systems," was launched in FY2002. This project aims to develop the generalized technology, which will prevent the suppression of clustered PV system's output caused by the excess voltage on the distribution system. The project also aims to demonstrate their effectiveness using the actually installed clustered PV systems.

Research subjects to be pursued

- ① Development, analysis and evaluation of the technology designed to avoid output suppression
- ② Development, analysis and evaluation of the new type islanding protection system
- ③ Analysis and evaluation of higher harmonics
- ④ Development of applied simulation techniques

< Research schedule >

• FY 2002 • FY 2003 • FY 2004 • FY 2005 • FY 2006 •

Development of the output suppression avoidance system

Development of the new type islanding protection system

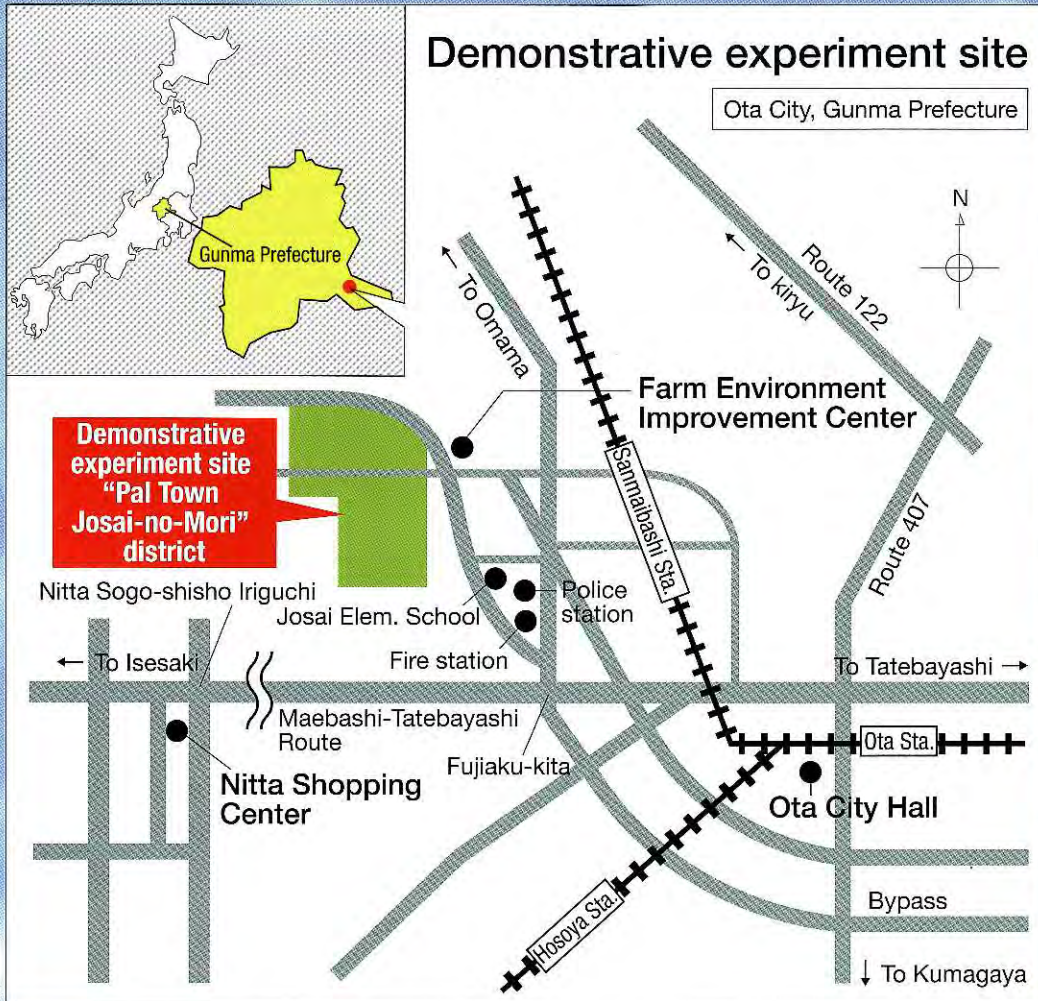
Development of applied simulation techniques

Introduction of experimental equipment

Collection, analysis and evaluation of data

Interim evaluation

Reporting of research results



■ Organization for the Demonstrative Research Project

Consignor: New Energy and Industrial Technology Development Organization (NEDO)

Consignee: Kandenko Co., Ltd.

Re-consignees : MEIDENSHA CORPORATION

Electric Power Engineering Systems Co., Ltd.

Shin-Kobe Electric Machinery Co., Ltd.

Matsushita Ecology Systems Co., Ltd.

OMRON Corporation

Tokyo University of Agriculture and Technology

Nihon University

Ota City Office

For further details, please contact:



Kandenko Co.,Ltd.

Kandenko Co., Ltd.

Head Office: 4-8-33 Shibaura, Minato-ku,

Tokyo 108-8533, Japan

Tel: +81-3-4431-3486 Fax: +81-3-4431-3499

URL: <http://www.kandenko.co.jp>

※This project is an undertaking commissioned by the New Energy and Industrial Technology Development Organization (NEDO). It is being implemented with the cooperation of Tokyo Electric Power Co., Ltd. in addition to the R&D consortium mentioned above.