

An aerial photograph of a densely packed residential neighborhood. The houses are mostly two-story buildings with dark grey or black roofs. Many of these roofs have solar panels installed. The houses are arranged in a grid-like pattern with narrow streets. In the background, there are some hills and utility poles with power lines. The sky is overcast.

***DEMONSTRATIVE PROJECT ON
GRID-INTERCONNECTION OF CLUSTERED
PHOTOVOLTAIC POWER GENERATION SYSTEMS***

**New Energy and Industrial Technology
Development Organization
(NEDO)**

Demonstrative Test Site



Location of Ota city



Test site in Ota city

Objective

Clustered grid connected PV systems in local area possibly induce unprofitable phenomena to power system.

Such as

- Voltage swell by output of PV systems (should be $101 \pm 6V$, $202 \pm 20V$)
- Unintentional Islanding (Not allowed)
- Harmonics (should be less than 5% on high voltage distribution line) etc.,



The objective of this program is to demonstrate as follows ;

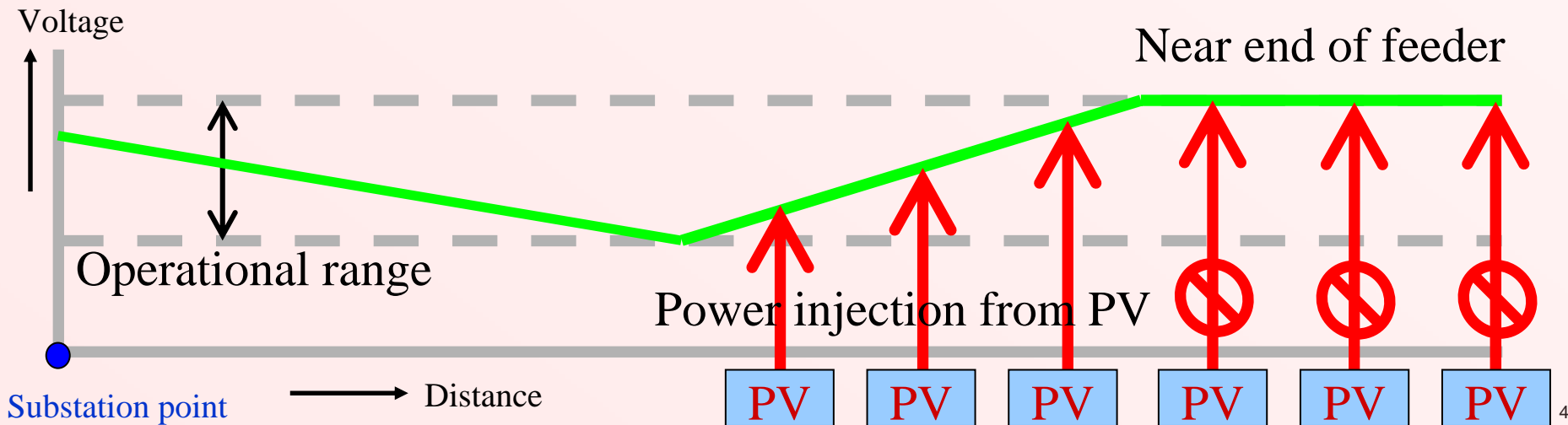
- 1.Development of the technology to avoid restriction of PV system output
- 2.Analysis and Development of function to prevent unintentional islanding
- 3.Analysis and evaluation of harmonics
- 4.Development of applied simulation technologies

Period of this program: FY2002 to FY2007

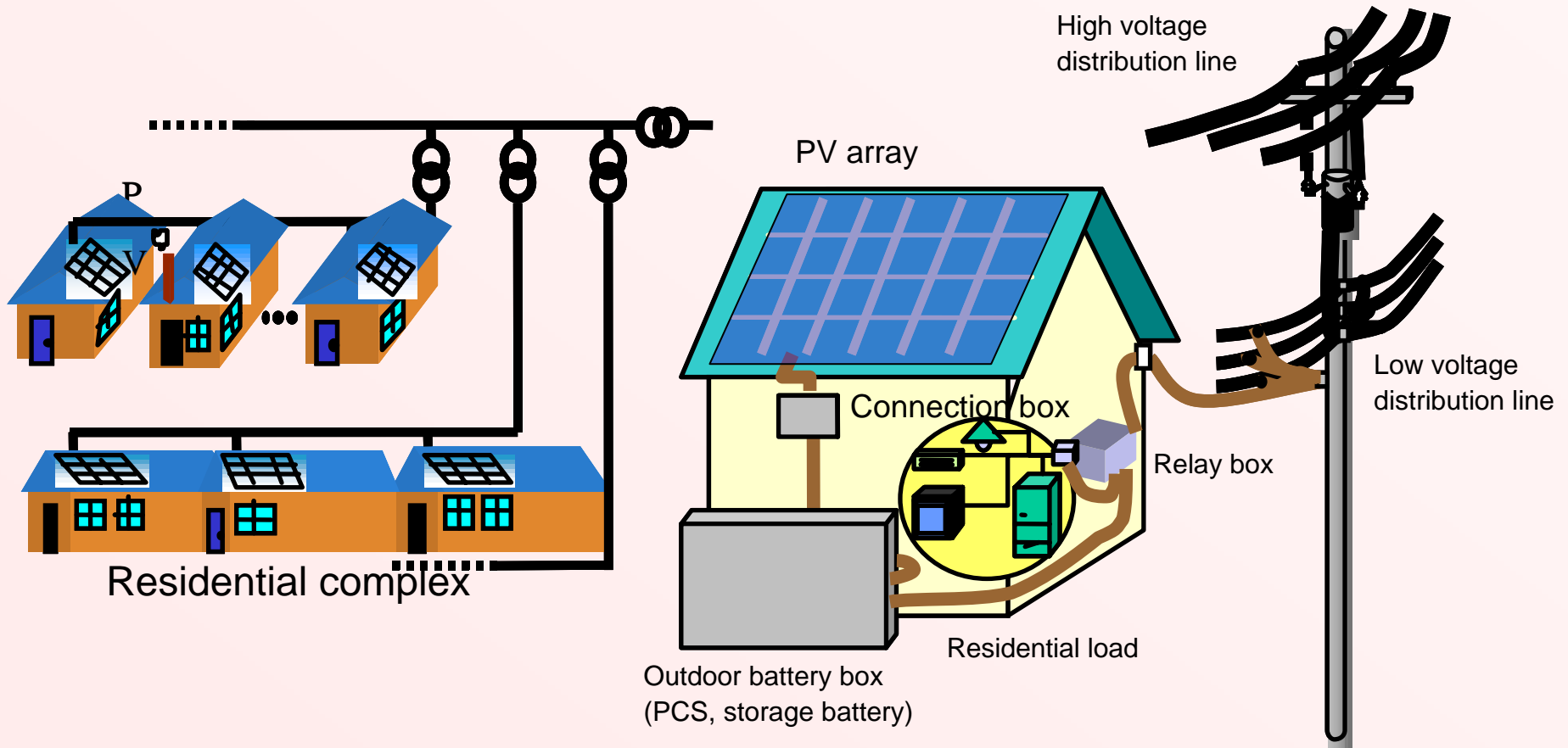
Development of technology to avoid restriction of PV system output (SUBJECT 1)

The voltages in distribution line sometimes becomes higher than the maximum nominal voltage of 107V or 222V because too much power injection from PV system. In such case, output of PV is restricted to keep line voltage within operational range ($101 \pm 6V$, $202 \pm 20V$).

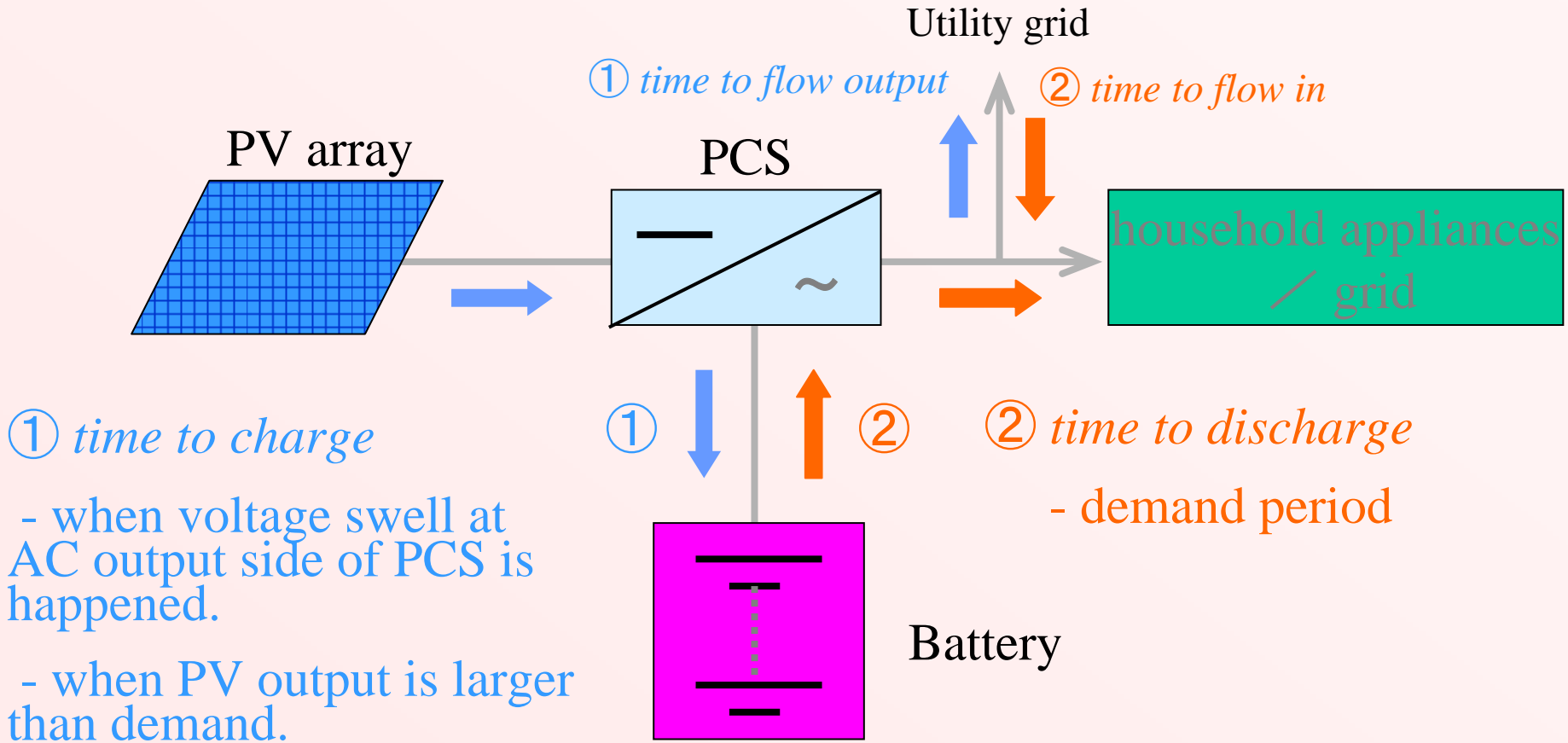
Various suppressions of the PV output are analyzed, and then new technologies to reduce such suppressions are developed in this project.



System Configuration



An example of proposed solution to avoid restriction of PV system output



Scheme of a residential PV system

Analysis and Development of function to prevent unintentional islanding (SUBJECT 2)

- A function to prevent islanding operation disconnects the PV system from the power grid in the case of service interruptions. Interferences among the equipments for preventing islanding are induced when the clustered PV systems are installed.
- Methods to avoid mis-actuations of such function in the clustered PV systems are developed, the methods will be verified through demonstration.

Analysis and evaluation of harmonics

(SUBJECT 3)

Clustered PV systems tend to increase the higher harmonics because of increase of inverter. Such harmonics negatively influence to equipments in the power systems and household appliances.

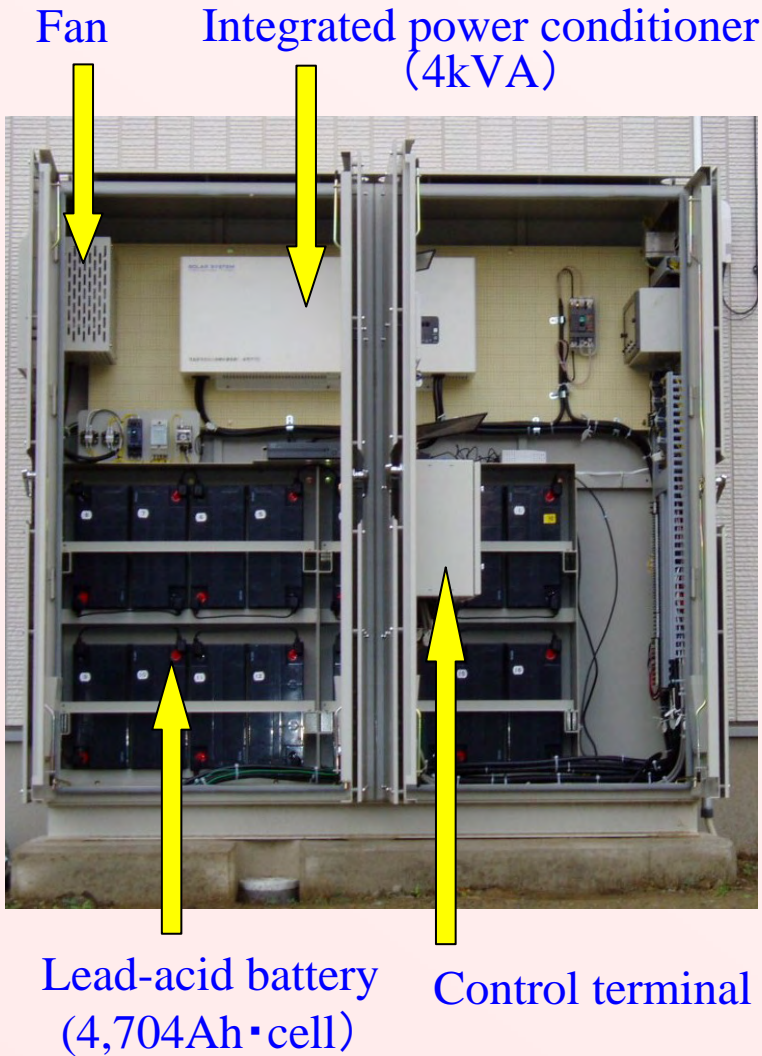
In this project, analysis and evaluations are made using data correlating the number of PV systems and the measured harmonics induced from them.

Development of applied simulation technologies (SUBJECT 4)

Simulation methods covering a wide use are developed based on the data and the results obtained in the above 3 subjects.

The simulations are designed to contribute to planning of other clustered grid-connected PV systems and precise evaluation of the data obtained in this project.

Test Facility

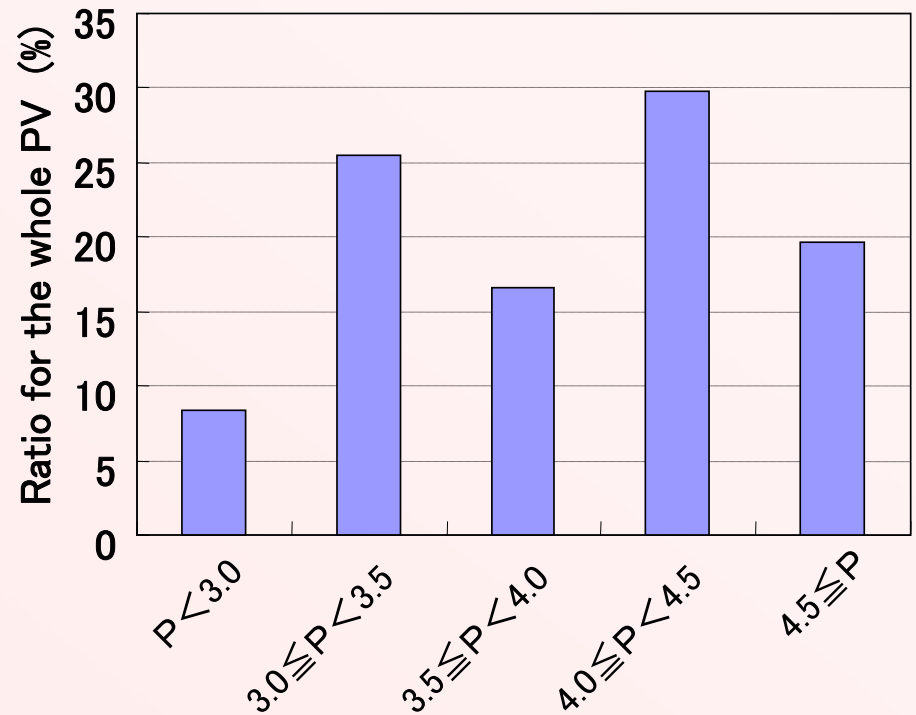


Components of outdoor battery box

Number of PV : 553

Total Capacity : 2,129kW

Average of installed PV capacity : 3.85kW



PV Array Range of Rating (kW)

Capacity of PV system

(as of Aug. 2006)

Schedule of Activities



FY	2002	2003	2004	2005	2006	2007
Development of technology to avoid restriction of PV output		Development of prototype		Field test		Comprehensive evaluation
Development of function to prevent unintentional islanding		Study of test method		Field test and simulation		Comprehensive evaluation
Analysis and Evaluation of Higher Harmonics		Study of test method	Field test and simulation			Comprehensive evaluation
Development of applied simulation			Development of applied simulation			
Number of installed PV system (accumulated)	0 (0)	130 (130)	198 (328)	167 (495)	58 (553)	0 (553)