Social Infrastructure

Power System and Distribution
Energy Management
Social Environment

Outlook

In the power system and distribution field, Fuji Electric develops and delivers supervisory control systems for various facilities related to power transmission and distribution and telecontrol (TC) equipment required for remote control. It also handles dam management systems and power generation centralized supervisory control systems required for the power generation field.

In power transmission and distribution, efficient operation of power equipment in line with the forthcoming “electricity system reform” and efficient application of water, as represented by hydroelectric power plants, will be increasingly important. In this situation, Fuji Electric has continuously delivered power system and distribution supervisory control systems and delivered new power generation centralized supervisory control systems for Miyazaki Prefecture Public Enterprise Bureau, Iwate Prefecture Public Enterprise Bureau and Arakawa Hydro Electric Power Co., Ltd., new remote monitoring consoles for Kurobe Dam and Sennindani Dam of the Kansai Electric Power Co., Inc. and new dam management systems for Kamuro Dam in Yamagata Prefecture and Yanase Dam of Shikoku Regional Development Bureau. In addition, we make use of the dam gate control technology to work on the introduction of remote supervisory control of floodgates and land sluices as measures against tsunami. We have also delivered remote supervisory control systems for seven floodgates in the harbor district of the Bureau of Port and Harbor of the Tokyo Metropolitan Government.

As part of overseas development, we have started demonstrating a distribution automation system in Asia based on our track record in Japan and intend to continue to make international contributions mainly in emerging countries.

In the energy management field, with the power system reform imminent, the time for a structural change is here. This should include the establishment of market competition such as having new players enter the electric power industry, and the selection of power companies.

As the selection-based, competitive market environment progresses, full-scale efforts are expected to be made for adjustments to the peak hour supply capacity on the assumption of demand response and negawatt trading and for energy management systems (EMSs) that support efficient use of energy.

In FY2014, which is the last year of large-scale demonstration projects (in Kitakyushu City and Keihanna Science City), Fuji Electric completed testing the demand control technology, system stabilization technology and optimum facility operation technology for introducing large amounts of renewable energy. This demonstration has enabled us to construct a new form of cluster energy management before others. We have achieved results with the cluster energy management system (CEMS) developed in the Kitakyushu Smart Community Project. Based on this, we are preparing to offer the “new power supply and demand control system” as a cloud-based service for the purpose of contributing to power retail liberalization, which starts in April 2016.

In the power system reform expected to progress in the future, utilization of efficient and economical renewable energy is necessary. Fuji Electric is moving ahead with the development of new technologies and their application to operational systems.

We are actively rolling out systems overseas and have delivered a micro-grid system for the Kingdom of Tonga, photovoltaic power generation system for the Republic of Kiribati and large-capacity power conditioning sub-system (PCS) for Zhoushan marine science and technology demonstration island, a project in which we have participated from the demonstration phase.

Regarding development, we developed a hybrid power system analysis simulator for Chubu Electric Power Co., Inc. to evaluate the effect of introducing a large amount of renewable energy on the system, verify smart-grid control and study operation and control for stable power supply. For Tohoku Electric Power Co., Inc., we developed a distribution static var compensator (SVC) for overcoming the problem of voltage rise due to introduction of a large amount of photovoltaic power generation into the distribution system.

Furthermore, we have conducted research jointly with the Institute of Physical and Chemical Research (RIKEN) and verified the possibility of reducing fuel and lighting costs by having optimum facility operation for K computer.

In the future, we intend to make use of our accumulated technology and know-how to realize stable supply of electric power and roll out new EMS capable of addressing global environmental issues not only in Japan but also overseas.

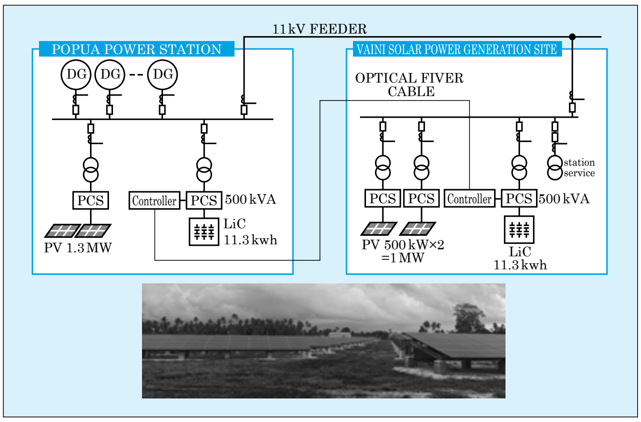
In the social environment field, there is a demand for a reduction of operation cost (life cycle cost) of factories and offices. Fuji Electric has focused on the wastewater treatment facilities, which account for a large portion of the running cost of factories and offices, and developed a technology that reduces the running costs of wastewater treatment facilities. The technology is intended for the food and beverage factories and other fields. It makes it possible to reduce the electric power cost and industrial waste disposal cost by introducing bacteria of genus Bacillus, which have a high wastewater treatment capability, and an agent (mineral) that maintains their activity as a new solution, in addition to energy-saving proposals including the introduction of conventional high-efficiency electric equipment and inverters. In the future, we intend to expand the fields of application to include persistent wastewater treatment, etc. and meet a wide range of customer needs.

Social Infrastructure

1 Micro-Grid System for the Kingdom of Tonga

Fuji Electric was awarded jointly with NBK Corporation an order by Tonga Power Limited for a micro-grid system based on the "Project for Introduction of a Micro-Grid System under the Grant Aid" for the Kingdom of Tonga. It was delivered to Tongatapu Island in March 2015. This system is composed of 1 MW photovoltaic power generation facilities and two 500 kW power storage systems. It restricts output variation of unstable renewable energy by high-speed charging and discharging of the power storage devices to supply stable power to the island. The power storage systems are installed in a distributed manner in the new photovoltaic power plant and the existing diesel power plant, which are coordinated for control. Because a lithium-ion capacitor has been adopted for the power storage devices, charging and discharging of large currents and a stable cycle life of over four hundred thousand cycles can be expected.

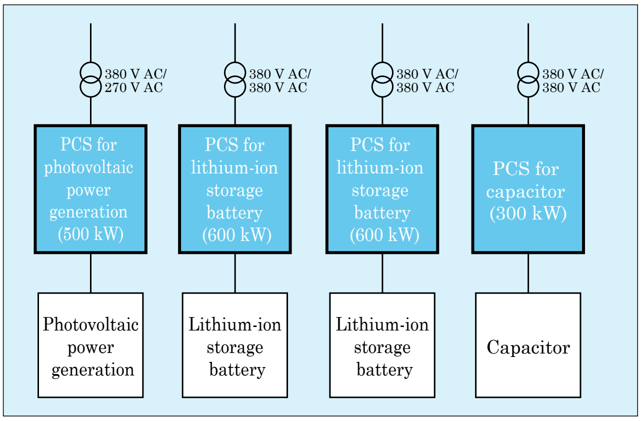
Fig. 1 System configuration and panoramic view of photovoltaic power generation station



2 Large-Capacity PCS for Zhoushan Marine Science and Technology Demonstration Island of Zhejiang University in China

Fuji Electric has participated with Zhejiang University in the new energy micro-grid demonstration on Zhoushan marine science and technology demonstration island of Zhejiang University in China. The project is intended to demonstrate comprehensive new energy usage that makes full use of power generation from large-scale and diverse natural energy sources (wind power, photovoltaic and ocean current) and realizes power stabilization via hybrid power storage control using storage batteries and capacitors. Fuji Electric conducted research on the system and main equipment jointly with Zhejiang University from the planning phase of the project and delivered 500 kW PCS equipment for photovoltaic power generation, 1,200 kW PCS equipment for lithium-ion batteries and 300 kW PCS equipment for capacitors. At the same time, Fuji Electric collaborated with Zhejiang University in studying and developing a PCS that meets the special needs of an isolated island and localized specification of the control system and gradually applied the results to the demonstration project.

Fig. 2 Overview of configuration of new energy micro-grid demonstration



3 Photovoltaic Power Generation System for the Republic of Kiribati

Fuji Electric delivered a 400 kW photovoltaic power generation system for the Republic of Kiribati as a grant aid project by the Pacific Environment Community (PEC) Fund. This system is built as a distributed system mainly including four 100 kW PCSs for photovoltaic power generation systems provided by Fuji Electric. In order to make the most of the limited land, we constructed a roof-type platform and installed photovoltaic modules over existing buildings. In this way, when maximum power is generated during the daytime, the system can supply the power of approximately 12 to 20 % of the overall demand.

In view of rapid variations in the amount of insolation, which is a characteristic of equatorial areas, output restriction control is provided to make it possible to reduce the maximum generated energy. In Kiribati, construction of additional photovoltaic power generation systems is planned and provision of an electric power storage system is being considered for power system stabilization.

For this reason, the system has been configured to make it easy to install a storage battery system.

Fig. 3 Roof-type photovoltaic modules

4 Distribution Static Var Compensator for Tohoku Electric Power Co., Inc.

There is the problem of a voltage rise caused by introducing a large amount of photovoltaic power generation into the distribution system. To solve this, Fuji Electric developed and delivered jointly with Tohoku Electric Power Co., Inc. a distribution static var compensator (SVC) that uses a magnetic flux-controlled variable inductor. The main features are as follows:

(1) The main circuit is equipped with a continuous inductance adjustment function in a simple configuration composed only of windings and iron cores.
(2) The configuration does not include a cooling fan or harmonic filter capacitor and features excellent lifespan and reliability.
(3) It allows control to be performed in view of coordination with other pieces of voltage regulating equipment such as a step voltage regulator (SVR).
(4) The controller is equipped with measuring and monitoring functions to achieve remote monitoring and control.

Fig. 4 Distribution static VAR compensator

5 Optimum Facility Operation for "K Computer"

Fuji Electric has collaborated with the Institute of Physical and Chemical Research (RIKEN) in research and conducted a simulation of optimum heat source operation since FY2014 for the purpose of reducing the operational cost of the "K computer." The annual power consumption of the entire facilities of RIKEN Advanced Institute for Computational Science (AICS), where the "K computer" is installed, is equivalent to that of about 25,000 general households. The cold heat demand that is high throughout the year poses a challenge of reducing the operational cost. In the joint research, Fuji Electric's optimum operation function was used to build an energy model of K to conduct a simulation and identify the minimum cost. As a result, it has been confirmed that improving the facility operations can reduce the fuel and lighting cost by 1.8% annually. In FY2015, we intend to gather field data to verify the effect in actual operation and work on further improving the operational efficiency of the K computer together with RIKEN.

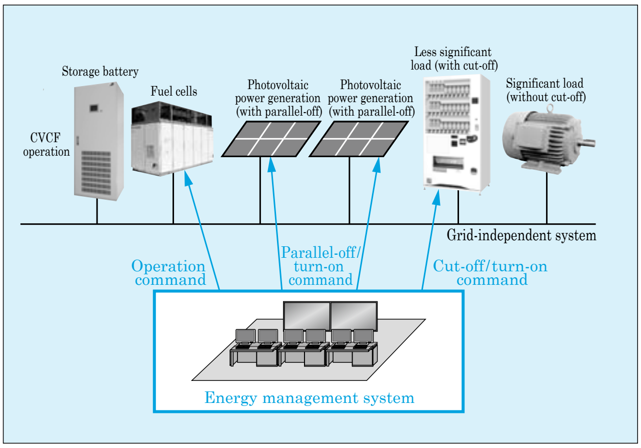
Fig. 5 "K computer," the world's first supercomputer to hit 10 petaflops

6 Technology for Isolated Operation in Disaster Situations Using Photovoltaic Power Generation

Fuji Electric has developed a technology that allows isolated operation even in disaster situations by combining a small-capacity storage battery with photovoltaic power generation, which has unstable output. Photovoltaic power generation is paralleled off when the photovoltaic power generation output is too large, and less significant loads are cut off when the loads are too great. In this way, the supply-and-demand balance can be adjusted to realize isolated operation even with a small-capacity storage battery. This system eliminates the need for expensive large-capacity storage batteries, and an electric power supply system can be constructed at low cost.

Electric power supply systems that make use of this technology can be combined with power generation facilities capable of stable supply such as emergency generators and fuel cells. Accordingly, isolated operation is possible even in the night-time when photovoltaic power generation output cannot be expected and electric power can be supplied continuously throughout the day and night.

Fig. 6 Example of configuration of electric power supply system



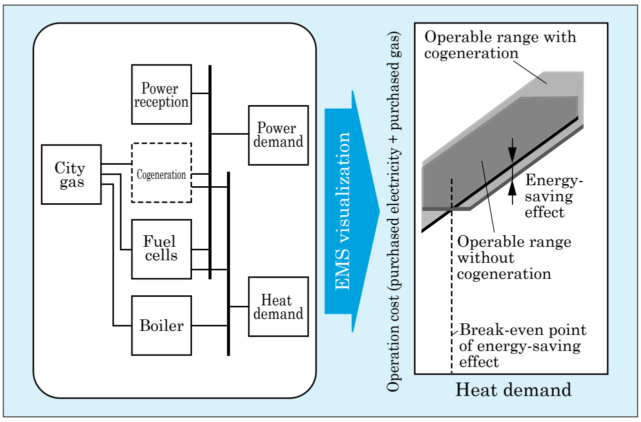
7 Technology to Visualize Energy Operation Optimization Based on Formula Manipulation Technology

As one energy management system (EMS) function that helps optimize energy operation, Fuji Electric has developed a technology for analyzing and visualizing rooms for energy saving from the plant device configuration information.

First, the power consumption characteristics of the individual devices that constitute the plant and various operation restricting conditions are given as formulae. Then, the feasible operation range of the plant can be automatically calculated by a symbolic and algebraic computation algorithm, a cutting-edge formula manipulation technology. The energy saving effect can be visualized by comparing the feasible range of operation both before and after the equipment is installed in the plant.

We intend to make use of this technology for a trial calculation of the effect of installing an EMS and to verify the operational effect of operating an EMS both in Japan and overseas.

Fig. 7 Example of visualization technology (effect of introduction of cogeneration)



Fuji Electric
Innovating Energy Technology