

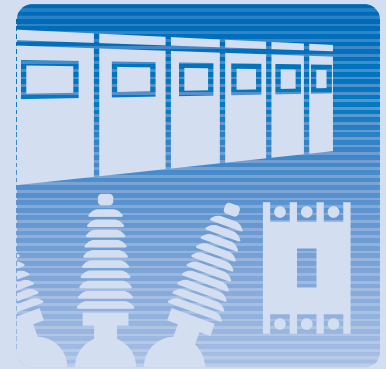
Power Electronics Energy

Energy Management

Transmission and Distribution Systems

Power Supply and Facility Systems

Electric Distribution, Switching and Control Devices



In the power electronics energy segment, Fuji Electric is committed to power electronics, substation, and energy monitoring and control technologies. Based on these core technologies, Fuji Electric offers components such as switchgear, transformers, protection relays, uninterruptible power systems (UPSs), power conditioning systems (PCSs), switchgears and controlgears, as well as energy solutions that incorporate these products. We provide one-stop solutions ranging from system building to maintenance services for power companies, material plants, and data centers in order to contribute to the construction of infrastructure that provides a stable supply of energy.

Energy Management

To achieve carbon neutrality, we offer solutions to expand the adoption of renewable energy and systems to stabilize power supply.

In the field of power transmission and distribution, we have developed a distribution automation system in consideration of business continuity plans (BCPs) that enables restoration of operations from power failures over a wide area. We also delivered a power supply system that stabilizes power supply by linking grid control functions with supply-demand functions. To accommodate the expansion of the supply demand adjustment market, we have provided control systems for storage battery PCSs that work in conjunction with higher-level planning systems. To accommodate the expansion of the adoption of renewable energy, we received an order for electric power storage battery system equipment for Japan's largest-scale self-consumption solar power generation plant. We have also developed a demonstration equipment for M-G sets [equipment for storing power generated from renewable energy in storage batteries and using the power to rotate a motor (M) that drives a synchronous generator (G) equipped with storage batteries]. This equipment is a countermeasure against the decline in power system stability due to factors such as reduced inertia caused by a decrease in the proportion of synchronous generators in the system.

Transmission and Distribution Systems

We provide our solutions business for the electric power, industrial, and transportation sectors to improve reliability, efficiency, and environmental friendliness through substation equipment and power electronics equipment.

In the field of substation equipment, we delivered a special 3-phase transformer that uses an innovative tank structure to reduce the installation footprint by 20% compared to conventional transformers. In the field of power monitoring equipment, we renewed our product offering according to customer needs and have been providing electric power remote monitoring equipment that features improved monitoring visibility and utilizes an open communication protocol that makes it easy to connect with customer-side systems. In the field of railway electrical equipment, we provided electrical equipment for stations on a Shinkansen line that improve reliability by distributing control devices to both primary and stand-by systems, adopting duplex configuration for general control equipment and using emergency generators to provide backup circuits that can supply electrical power even during power outages.

Power Supply and Facility Systems

Data centers and semiconductor plants in Japan and overseas not only require power supply systems that provide a highly reliable and stable power supply, but also space saving and shorter construction times. To meet these needs, Fuji Electric can provide high-voltage substation equipment, emergency power generation equipment, and UPSs that contribute to optimizing systems, reducing installation footprints and shortening construction periods.

For a data center, we provided high-capacity UPS systems that can supply up to 3,600 kVA by connecting UPSs in parallel with a single unit capacity of 1,200 kVA. This system has improved reliability by adopting duplex output buses and facilitates maintenance and inspections. For transformers, we developed and delivered FR3[®] transformers that use natural ester oil to meet the requirements of advanced data center operators to reduce the environmental load. Natural ester

oil is highly biodegradable and non-toxic and is capable of reducing the impact on the environment in the unlikely event of an oil spill. Its high flash point also simplifies auxiliary equipment such as fire extinguishing equipment and contributes to lowering entire installation costs.

For the computer and communications equipment at banking facilities and government offices, we have developed a 3-phase 200-V high-capacity UPS that improves operability, including start, stop and mode switching, while simplifying equipment renewal by allowing existing wiring to be reused.

In addition, we provided the power supply equipment of a semiconductor plant with high-speed circuit breakers that enable switching from commercial power to in-house power generation in one-half cycles in the event of a power outage or instantaneous voltage drop.

Electric Distribution, Switching and Control Devices

We offer power distribution equipment and switching devices to ensure the efficient and safe use of electric power in renewable energy-related facilities, electric equipment for buildings and facilities, and control systems for plant production lines, as well as control equip-

ment to automate and optimize production equipment and machinery.

In the field of control devices, we have renewed our lineup of operating and indicating devices. To meet the needs of the machine tool market, these devices adopt a thin and stylish design with minimal product protrusion from the surface of the panel. The surface of the push button is shaped to fit the operator's fingertip, improving not only the design aesthetics but also the feel of operation.

For switching devices, we have developed an AC contactor for elevator control panels that is suitable for the dynamic brake control circuits required by latest international standards for injection molding machinery and elevators. It contributes to enhancing the safety of equipment that uses electric motors.

In order to meet the growing environmental needs of the power distribution equipment market, we have developed a load break switch (LBS) using resin materials that are easily disposable and recyclable.

Moving forward, we will continue to contribute to society by releasing components to the market for electric distribution, switching, and control devices that meet the needs of the times.

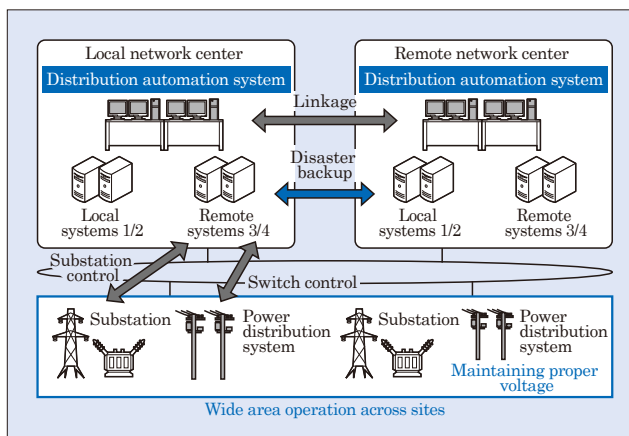
Energy Management

1 Distribution Automation System for Chugoku Electric Power Transmission & Distribution Company, Incorporated

Fuji Electric has replaced the distribution automation system for monitoring and controlling 6-kV and 22-kV power systems for Chugoku Electric Power Transmission & Distribution Company, Incorporated. The system has the ability to automatically restore accidental outage and generate data on equipment information at changing equipment. The main features are as follows:

- (1) By deploying a backup system at a location remote from the business site in consideration of the business continuity plan (BCP), the system can continue to operate even if the business site is damaged by a disaster.
- (2) The wide-area operation function provides a wide-area system diagram on a single screen and enables restoration operations after power outages that span across business sites.
- (3) For power distribution systems, which are becoming increasingly complex due to the expanded deployment of decentralized power supplies, it supports the optimization of power distribution system voltages through highly accurate system condition calculations that take into account small-scale power generation facilities and actual power generation.

Fig.1 System configuration diagram



Energy Management

2 Replacement of Power Supply System for Sumitomo Joint Electric Power Co., Ltd.

Fuji Electric has delivered a power supply system to Sumitomo Joint Electric Power Co., Ltd. designed to provide a stable supply of electric power to Sumitomo Group companies and to enhance power supply control. The main features are as follows:

- (1) It integrates grid functions for monitoring and controlling power systems and power plants with supply-demand functions for preparing and submitting power generation and demand plans and for trading on the wholesale power market into a single system to improve operability.
- (2) It prevents erroneous operations and reduces the burden on operators by automating procedures and accident restoration for grid functions, supply-demand balance planning and intraday market trading for supply-demand functions, and simultaneous supply-demand balancing control that links both grid and supply-demand functions.
- (3) By using the power industry's first multi-window system that supports one client and four monitors, it allows operators to register screen and button layouts to improve workability and usability.

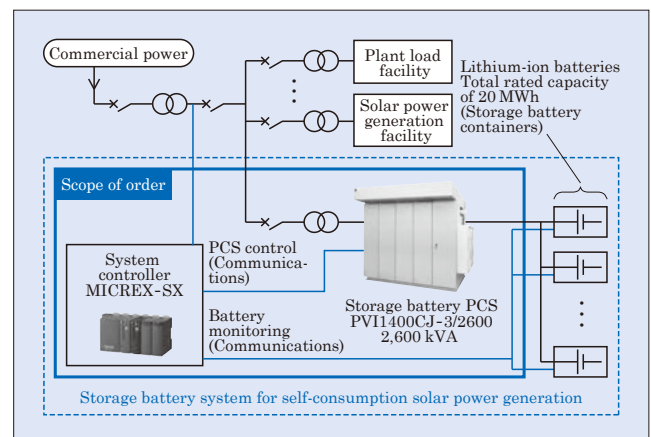
Fig.2 Power supply system



3 Received Order of Equipment for Storage Battery Systems Supporting Self Consumption of Solar Power

Fuji Electric received an order for a storage battery PCS (2,600 kVA), a system controller, and substation equipment from Tokyo Gas Engineering Solutions Corporation. They are used for Japan's largest-scale solar power plant for self-consumption installed in the Kumamoto Factory of Honda Motor Co., Ltd. The equipment will be co-located with a solar power plant (5.8 MW) on the factory premises to support the expansion of self-consumption of solar power by recharging surplus power on factory holidays and discharging it at night and during periods of cloudy or rainy weather. The PCS is designed to accommodate high voltage DC input, allowing the battery system to use high-power, high-capacity storage batteries. This allows the system to have a narrow footprint and flexibly arrange batteries, saving costs for the construction, including foundation work and installation. The system is scheduled to begin operations in April 2024.

Fig.3 Storage battery system

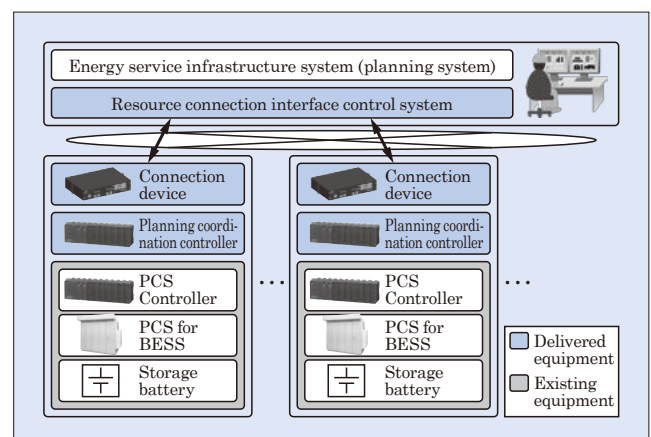


4 Control System of PCSs for BESS used in the Power Exchange Market

Fuji Electric has delivered to Sumitomo Corporation an energy service infrastructure coordination control system that is necessary for making its storage battery system to be used for the power exchange market. This system controls the recharge and discharge of PCSs for battery energy storage system (BESS) using the commands from the energy service infrastructure system as its target values. The main features are as follows:

- (1) The energy service infrastructure system and storage battery systems owned by customers can be easily associated by adding a resource connection system on the energy service infrastructure system and by providing a connection device and a planning coordination controller between them.
- (2) It uses an open communication protocol (OpenADR2.0b) that makes it easy to connect the existing electric power storage battery system to the energy service infrastructure system.

Fig.4 Overview of system configuration



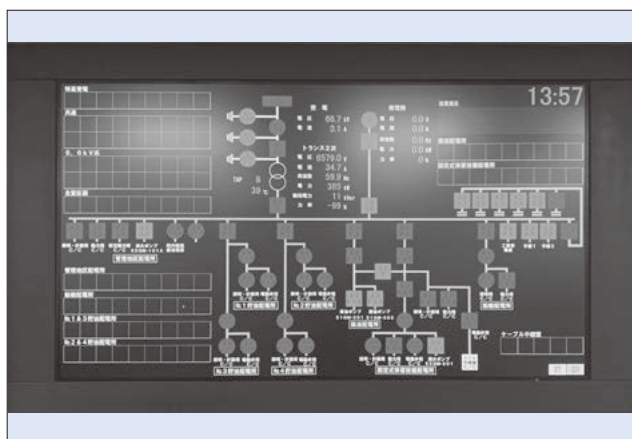
Transmission and Distribution Systems

1 Replacement of Electric Power Remote Monitoring Equipment for Shibushi Oil Storage Company, Ltd.

Fuji Electric replaced the aging electric power remote monitoring equipment for Shibushi Oil Storage Company, Ltd. The Shibushi National Petroleum Stockpiling Base is an important site for national oil storage. As such, it needed to be able to monitor the plant facilities during the replacement period. By replacing the existing system and the newly installed system together in stages, we completed the renewal work without interrupting monitoring activities. The main features are as follows:

- (1) It has greatly improved visibility by replacing the existing mosaic graphic panel with a 98-inch monitor.
- (2) It uses an OPC server to easily connect with customer systems.
- (3) A new operation support function saves labor in daily operation and restoration work when a malfunction occurs.

Fig.5 Electric power remote monitoring equipment



2 Delivery of Electrical Equipment for Stations on the Nishi Kyushu Shinkansen Line

The Nishi Kyushu Shinkansen Line connects Takeo-Onsen Station in Saga Prefecture to Nagasaki Station in Nagasaki Prefecture. It is a 66-km stretch of track that started operations on September 23, 2022. Fuji Electric supplied 7.2-kV enclosed switchboards, main control switchboards, molded transformers, emergency gas turbine generators, and other equipment for four of the five newly constructed stations, including the distributing station at Takeo-Onsen Station. Station electrical facilities are responsible for supplying power to equipment that supports various services at the station as well as to signaling facilities. Therefore, they are required to provide a reliable supply of power. The equipment's main features are as follows:

- (1) It improves reliability by distributing control equipment to both primary and stand-by systems and by adopting a duplex integrating controller system.
- (2) A backup circuit with the emergency generator can start feeding power in case of a power outage.

Fig.6 7.2-kV enclosed switchboards for the distributing station at Takeo-Onsen Station



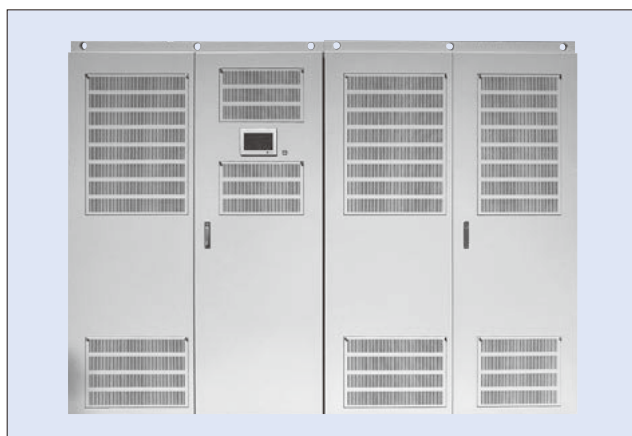
Power Supply and Facility Systems

1 "6000DX Series" 3-Phase 200-V High-Capacity UPS

UPSs with 200-V output are widely used in data centers and in computer and communications equipment at financial institutions and government offices. The power consumption of backup equipment has been increasing due to the increasing amount of data handled. As a result, demand is growing for UPSs with high capacities. To meet this need, Fuji Electric has expanded our 100- to 300-kVA lineup of its "6000DX Series" 3-phase 200-V high-capacity UPSs to include 400/500-kVA models. The main features are as follows:

- (1) It improves operability and maintainability by enabling UPS start and stop, mode switching, and other operations to be performed from the LCD touch screen on the panel.
- (2) It uses the external wiring layout that perfectly matches that of conventional models, enabling the on-site wiring of existing facilities to be reused without modification and also facilitating replacement.

Fig.7 "UPS6000DX-T3" (500 kVA)

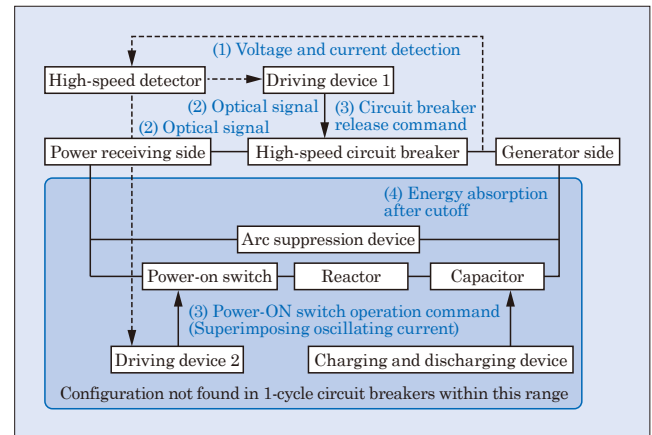


Power Supply and Facility Systems

2 1/2 Cycle High-Speed Circuit Breakers Delivered to Fuji Electric's Yamanashi Factory

In semiconductor factories, instantaneous voltage drops and even slight fluctuations in power supply voltages can cause defective products and manufacturing equipment failures. Therefore, critical equipment must be quickly disconnected from commercial power in the event of a power outage or instantaneous voltage drop. Fuji Electric's Yamanashi Factory operates its in-house power generation equipment in parallel with the commercial power supply at all times. In the event of a power failure or instantaneous voltage drop, critical equipment is disconnected from the commercial power supply and in-house power generation equipment operates independently to continue operations. We delivered circuit breakers that have reduced the break-time to 1/2 cycles (10 ms at 50 Hz), a half that of existing ones. We achieved this high-speed cutoff by combining the high-speed drive technology of 1-cycle circuit breakers with a commutation breaking method that has a proven track record in cutting off DC. This reduces the frequency of stoppages of manufacturing facilities due to instantaneous voltage drops and also helps prevent equipment failures.

Fig.8 Configuration diagram and operation sequence of high-speed cutoff

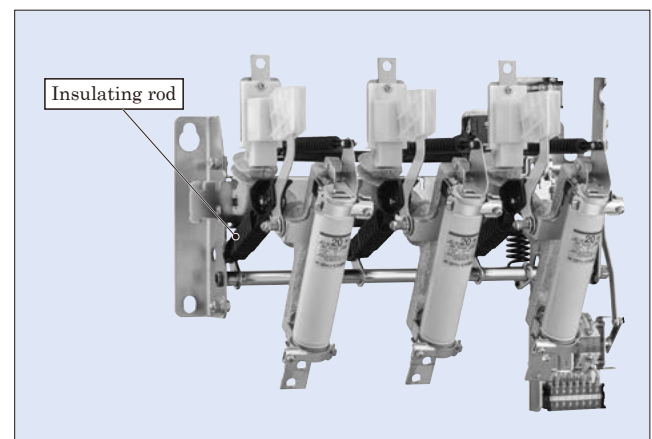


Electric Distribution, Switching and Control Devices

1 Load Break Switches with Improved Environmental Friendliness

In recent years, the "Plastic Resource Circulation Act" and other laws have required the use of resin materials with a low environmental burden in a wide range of fields. For load break switches used in industrial facilities, insulating parts made of difficult-to-recycle thermosetting resins need to be replaced with materials that are easily disposable and recyclable. Against this backdrop, Fuji Electric has developed load break switches with improved environmental friendliness by utilizing thermoplastic resin that can be recycled. We use thermoplastic resin for some of the insulating parts, including the insulating rod connected to the operating handle, by designing the structure after carefully examining the minimum insulation distance required for each material. Furthermore, we eliminated materials containing substances that fall under the RoHS Directive, thereby improving environmental friendliness from the standpoint of hazardous substances.

Fig.9 "LBS-6 A/200F"

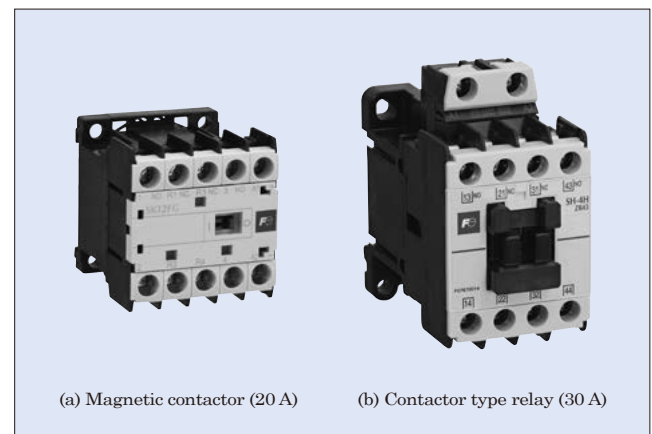


2 AC Contactors for Elevator Control Panels

China's elevating machinery test regulation "TSGT7007-2022" was issued with new H6.11 safety brake circuit (sealed star circuit) requirements added. Fuji Electric has released its AC contactors for elevator control panels that comply with the new requirements, based on an auxiliary relay, which is recognized as highly reliable by the Chinese market. The main features are as follows:

- (1) The configuration of 2A 2B contacts of the main circuit facilitates the formation of a star-closed-circuit, which is required to safely stop an elevator drive motor.
- (2) The lineup comes in rated currents of 20 A and 30 A and can be used for almost all elevator starting motors.
- (3) Applying proven pressure to the contacts as used for dynamic brake applications in Japan ensures high reliability.

Fig.10 2A 2B AC contactors



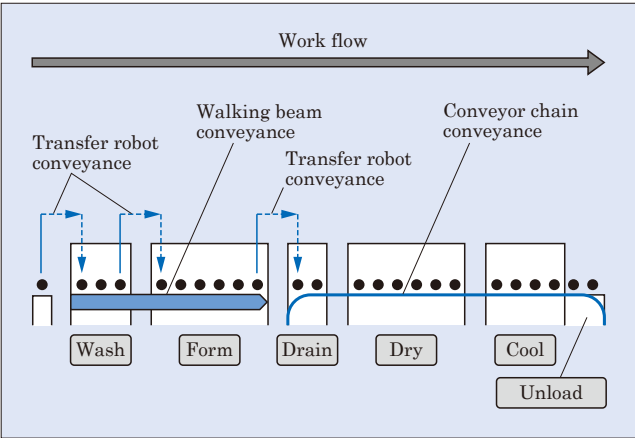
Electric Distribution, Switching and Control Devices

3 Replacement of Iron Core Production Line for Magnetic Switches Compliant with VOC Regulations

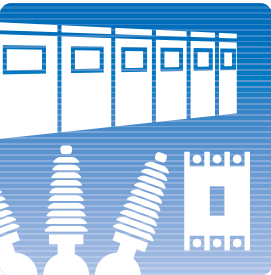
The revision and enforcement of the Air Pollution Control Act has increased the requirements to regulate the emissions of volatile organic compounds (VOCs). This has made it imperative to switch to materials with a lower environmental burden. Fuji Electric's iron cores for its magnetic switches had used VOC, namely dichloromethane, as the main solvent for anti-rust treatment, which needed to be switched over to a compliant anti-rust treatment. Against this backdrop, we have developed a new heat-drying technology that enabled the use of a non-VOC, easy-to-manage water-based treatment solvent. By renewing the production line that applies this new technology for anti-rust treatment, we reduced VOC emissions by 80% from the previous year. Going forward, we plan to apply this newly developed anti-rust treatment equipment to other products to further reduce VOC emissions.

Based on this accomplishment, this product was awarded honorable mention in the FY2023 Japan Electrical Manufacturers' Association Technical Achievement Award.

Fig.11 Configuration of anti-rust treatment equipment



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