Control Technology

EMS Technology
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System Control Technology

Outlook

EMS Technology

As smart community demonstration projects are being advanced throughout the world, Fuji Electric is developing and demonstrating various types of energy management system (EMS) technologies while also participating in such projects as the Kitakyushu Smart Community Creation Project and the Keihanna Eco-City Next-Generation Energy and Social Systems Demonstration Project. Fuji Electric has developed a factory energy management system (FEMS) and building and energy management system (BEMS) that are provided with functions for performing optimized control of multiple energy sources (electric and thermal power) and demand response. In addition, Fuji Electric has developed a power storage control simulator for verifying the optimality of the control system and its capacity, and that supports supply and demand control and planning with a grid, as well as a full-scale microgrid demonstration facility that performs energy optimization operation and grid connection with distributed power supplies and electric power storage systems. Furthermore, in accordance with the replacement demand for smart meters with built-in communication functionality, Fuji Electric is actively engaged in developing such products for major power companies.

In terms of power system distribution, Fuji Electric has contributed to the stable supply of electric power through continuing to deliver grid connection systems and centralized electric power generation supervisory and control systems for public utilities. Fuji Electric is also advancing the development of technology for international standardization and voltage control technology for distribution systems, and is working toward next-generation power system operation.

Measurement and Sensor Technology

In the field of measurement and sensors, Fuji Electric is advancing technical development to meet the need for more sophisticated flow and energy measuring instruments for the purpose of saving energy, environmental measuring instruments for the purpose of enhancing environmental protection and preservation, and monitoring instruments for the purpose of ensuring the safety and security of people's lives.

In the field of flow measuring instruments, Fuji Electric has developed a general-purpose type ultrasonic flowmeter for liquids that has a significantly improved tolerance to bubbles, and has also developed an advanced function type that adds 2-path system measurement and thermal energy computation functions. Additionally, Fuji Electric has developed a Foundation Fieldbus (FF) -compliant pressure/differential pressure transmitter and a combined sensor for mass flow rate measurement. As energy measuring equipment, Fuji Electric developed a clamp type electric power monitor that uses 920 MHz-band specified low power radio waves and that facilitates the construction of an electric power monitoring system.

For environmental measuring instruments, Fuji Electric has realized a laser-type gas analyzer able to measure multiple components, such as being able to measure carbon monoxide and oxygen at the same time, and has developed products that employ an instrumentation air purge system to improve their resistance to dust.

For monitoring equipment, Fuji Electric has developed an inexpensive and ultra sensitive vibration sensor that uses micro electro mechanical systems (MEMS) technology, and to demonstrate its effectiveness, has applied this sensor to a structural health monitoring system for assessing the soundness of buildings, bridges, and the like.

System Control Technology

In the field of system control, because equipment is deteriorating with age at various plants, distributed control systems (DCSs) and computer systems are being renewed and updated, one after another, in order to realize stable operation, improve manufacturing efficiency and expand capacity. Systems are required to make full use of existing hardware and software assets, and to be capable of responding flexibly to the facility operation conditions at minimum cost. For steel plants and waste incineration plants, Fuji Electric has

a proven track record of having delivered many systems for DCS updating and the like, and through the effective use of existing software assets, has realized improved quality assurance and shorter changeover times. In the updating of computer systems for control applications, virtualization technology is used to port the systems to new hardware without having to update the existing facilities, thereby enabling more efficient development and testing, and assuring quality. For the wide-area monitoring and control of city gas, Fuji Electric has constructed an IP telemetry system that flexibly supports differences in the installation location and communication means.

A controller is a common component that plays a central role in control systems and is being used in an increasingly wider range of applications. Fuji Electric's "MICREX-SX SPH3000MG" features Gigabit Ethernet networking functionality and is provided with a standard package for controlling multiple drive devices, enabling a maximum of 200 drive devices and their related I/O to be controlled via a network. The resulting reduction in the number of required engineering man-hours and the wire savings leads to a significant reduction in construction costs. The high-performance "SPH3000PN" with built-in PROFINET RT functionality can be connected directly to the PROFINET and supports global standards. For measurement systems, Fuji Electric plans to offer a high reliability control for monitoring and control systems before the end of FY2013.

For the purpose of environmental improvement, energy savings and crisis management for roads, Fuji Electric delivered tunnel remote control systems and SA/PA information terminals for the Shin-Tomei Expressway in FY2012. In addition, as cloud computing advances, Fuji Electric intends to accelerate cloud-based shared use across prefectural boundaries to reduce further the cost of local government systems.

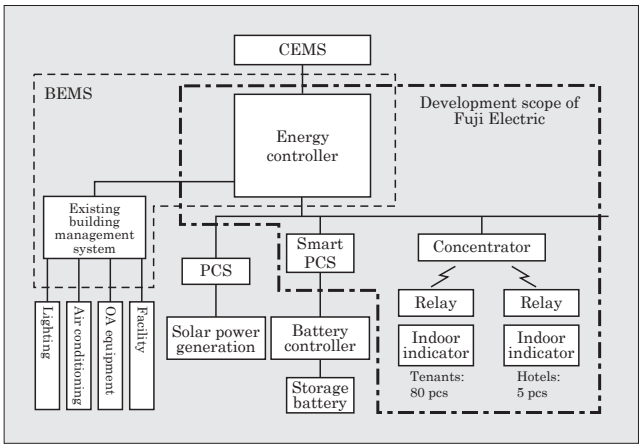
EMS Technology

1 Keihanna BEMS Demonstration Project

Fuji Electric is in charge of a building energy management system (BEMS) for Keihanna Plaza in the "Keihanna Eco City Next-Generation Energy and Social systems Demonstration Project" promoted by the Ministry of Economy, Trade and Industry and initiated the demonstration test in FY2012.

With the developed and delivered energy controller, information is gathered by linking to the existing building management system, and demand forecast from the weather information and energy usage performance, and solar power generation forecast are conducted, and an optimal operation plan for facilities is drawn up. The BEMS contributes to optimize regional energy balance in cooperation with a community energy management system (CEMS) with (1) demand response applied to building tenants and hotels and (2) smoothing demand in buildings with batteries. This demonstration project aims to reduce CO_2 emissions by 10% through energy management.

Fig.1 Keihanna Plaza BEMS overall system configuration



2 Fujitsu Limited Microgrid Demonstration System for Kawasaki Plant

Fuji Electric delivered a microgrid demonstration system to Kawasaki Plant, Fujitsu Limited. This system aims to reduce the receiving electric power and to carry out demonstration tests at the factory. It comprises a solar power generator (45 kW), storage battery system (approx. 80 kWh), power conditioner (50 kW), power distributor and remote operation equipment. This system is to have the following multiple control functions and will be able to conduct various demonstration tests.

(1) Receiving electric power regulating function and adverse current prevention function
(2) Discharge and charge control function
(3) Power stabilization function

Result of these demonstration tests verified to reduce the total amount of power reception by 5% and reduce peak power by 21% on average. Good results are expected for future demonstration tests.

Fig.2 Power conditioner unit

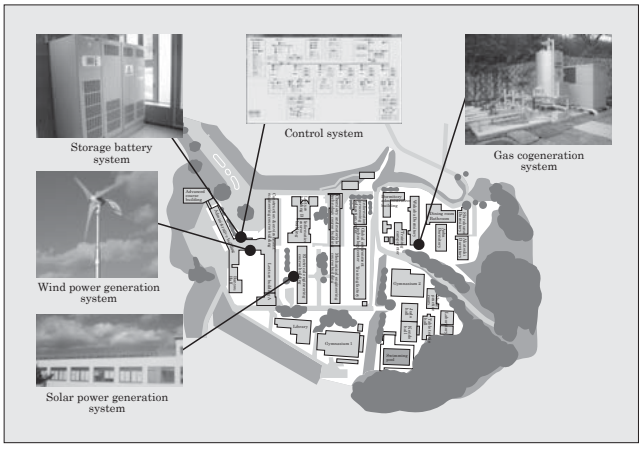
3 Smart Grid Real Scale Experimental Equipment for Fukushima National College of Technology

Smart grid real scale experimental equipment was delivered to Fukushima National College of Technology.

This equipment is experimental and research equipment for the purpose of developing human resources. At the same time, it is used as a routine dispersion type of power source and emergency power supply system in times of disaster.

Integrated control is performed for each system of gas cogeneration, solar power generation (existing), wind power generation, and storage battery. The gas cogeneration system efficiently utilizes waste heat, which is accrued along with power generation, in the hot-water system on campus by using a thermal energy storage technique. In addition, the simulator, which was delivered together with the main equipment, enables real-time simulation of the equipment and control system. A control algorithm such as storage battery control is expected to be developed by using the simulator and verified with the actual equipment.

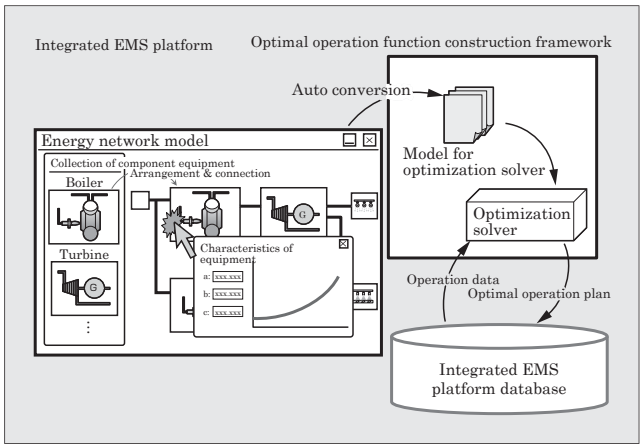
Fig.3 Configuration of smart grid real scale experimental equipment



4 Construction Framework of Integrated EMS Platform for Optimal Operating Function

Fuji Electric developed the optimal operating function as a construction framework for utility equipment such as electric power, heat, and gas equipment. It includes functional expansion of the integrated EMS platform for various industries, such as electric utilities steel, assembly, chemical, food manufacturing and food distribution. By arranging and connecting component equipment on the computer, the created energy network model is converted to the model format, which can be used for optimization solvers, and based on the device properties and operation data, optimization calculation is performed and the optimal operation plan can be drawn up. It is possible to perform maintenance easily when equipment structure or the equipment's characteristics are changed, although it was difficult up to now. The energy network model is installed in the integrated EMS platform and the model is similar to the Common Information Model (CIM) of international standard for power system, IEC61968 /IEC61970. In the future, Fuji Electric will strive to comply further with the standard by means of interconversion.

Fig.4 Optimal operating function construction framework

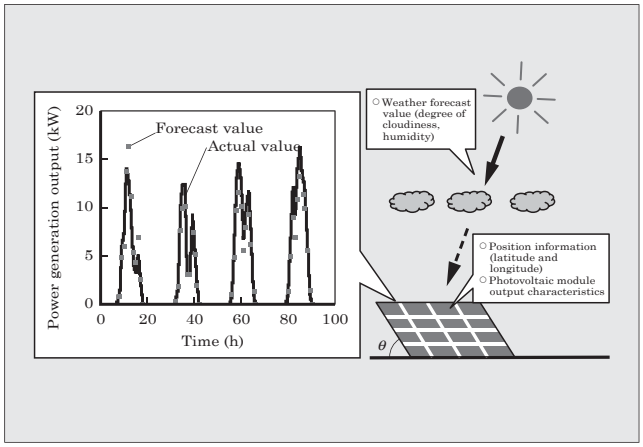


5 Forcasting Technology for Solar Power Generation

As an effort for a low carbon society, introduction of solar power generation systems are being promoted globally. However, the systems have negative effects on a power system because the outputs of them depend on climate. For that reason, technologies to stabilize the output of solar power generation are required. Fuji Electric is working on the development of a forecasting technology for the output as one of these technologies.

The main characteristic of this technology is that it can forecast the output every 30 minutes up to ahead of a few days at any place of the world by using position information of solar power generation facilities and surrounding weather forecast values and by considering output characteristics of photovoltaic modules. The forecast can apply to the supply and demand planning in power companies.

Fig.5 Example of the result of forecasting solar power generation

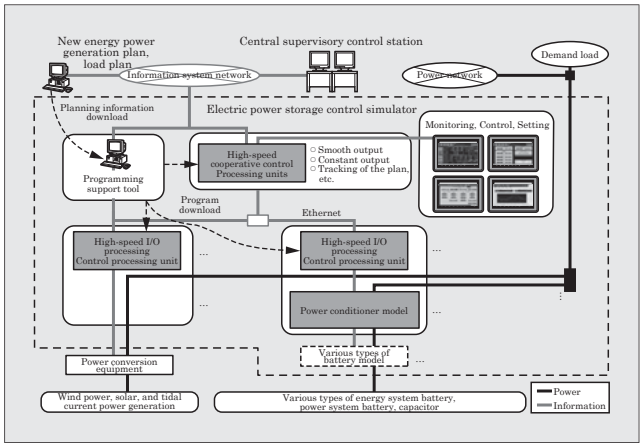


6 Electric Power Storage Control Simulator

Technology to control electric power storage is used to convert various types of large-scale natural energy such as solar power, wind power, and tidal current power to high quality and stable smart energy. This technology is also used to convert microgrids to ensure stable loads on power system. Research on this technology is rapidly progressing. Fuji Electric developed an electric power storage control simulator as an analysis support system based on its long time actual performances.

(1) in order to satisfy the need for power quality at power system interconnection, this simulator provides (a) capacity of electric storage equipment, (b) allocation of each type of electric storage equipment, (c) control algorithm for control system and control equipment, (d) control parameters and (e) data model, (2) support power generation plan and load plan of microgrid for system stabilization and (3) support establishment of optimal control algorithm and suitable parameters.

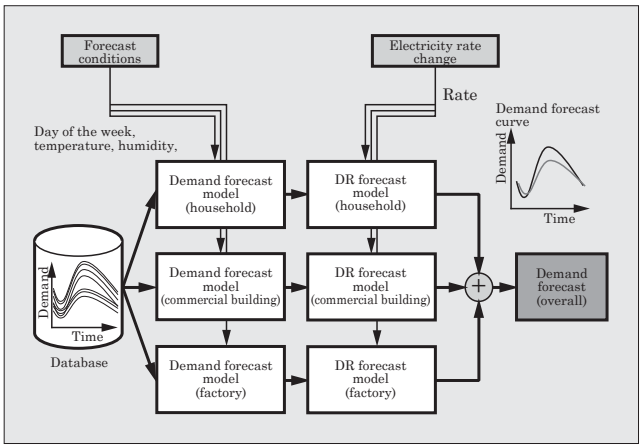
Fig.6 Electric power storage control simulator



7 Technology to Forecast Demand Response

Although adjusting the supply and demand has been performed at the power generation side only, it is becoming important to make adjustments at the demand side as well. By allocating changes in electricity rate and incentive points, demand response (DR), which prompts demand control and peak shift, is attracting attention. In order to integrate DR demand control into the system, it is necessary to forecast the demand change when the electricity rate is changed, and this forecasting technology has been developing. In concrete terms, the demand side is partitioned into several groups such as ordinary households and factories. After demand forecast is performed by using the demand database, the demand variation is corrected as a result of rate change. In the future, we expect to verify the forecast model by using data from a DR demonstration test, which started from FY2012 at the Kitakyushu Smart Community Project.

Fig.7 Configuration of demand response forecast model



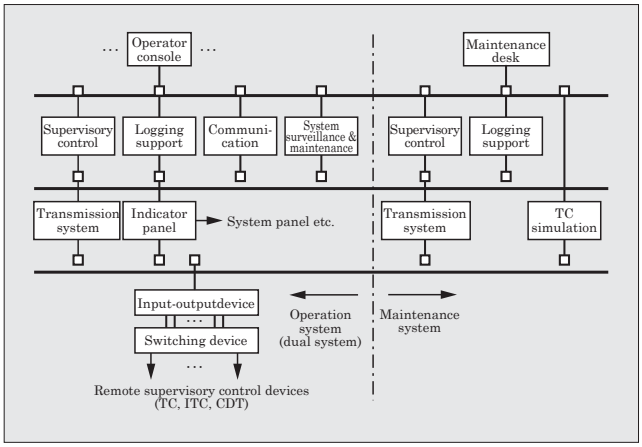
8 Nagano Power Supply Control Station System for Chubu Electric Power Co., Inc.

Full-scale update construction was carried out for the second time since the system was introduced in 1983 at the Nagano power supply station system for Chubu Electric Power Co., Inc. This system performs supervisory control of 128 electric power stations in the northern region of Nagano. The main features are as follows:

(1) As communication work became IP network, PMCN, which is the industrial protocol of The Japan Electrical Manufacturers' Association (JEMA) was introduced for data input and output with remote supervision control devices (TC, ITC and CDT) and there was linkage with a mainstay power supply system, other power supply systems, and power line automation systems.

(2) Operated the application software provided by a customer on the electric power middleware developed by Fuji Electric and achieved streamlining of system architecture.

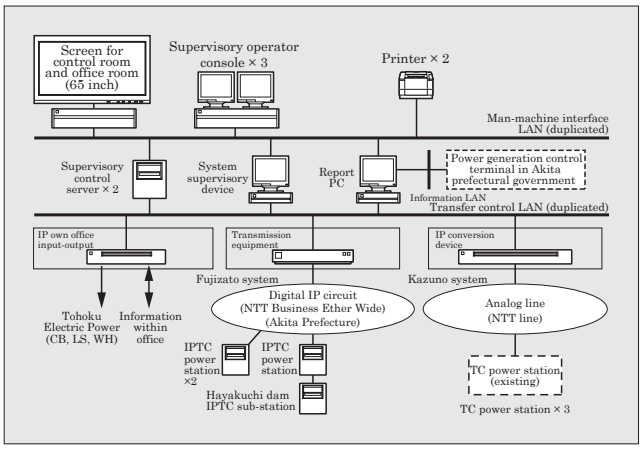
Fig.8 System configuration of Nagano power supply control station system



9 Odate Power Generation Office Centralized Supervisory Control System for Akita Prefecture

Renewal work for the Odate Power Generation Office integrated supervisory control device for Akita Prefecture was conducted. This device is a system to perform centralized supervisory control of six power-generating stations from the Odate Power Generation Office. The main features are as follows: (1) by duplicating the supervisory control server, transmission control LAN and man-machine interface LAN and configuring supervision operator console with three consoles, Fuji Electric achieved a system configuration with enhanced credibility, (2) three power generation stations of the Fujisato system were updated to be telecon compatible with IP (IPTC), and high functionality of infrastructure was achieved, (3) three power generating station of Kazuno system are equipped with an IP conversion device, for which the existing TC was diverted, in the Odate Power Generation Office and prepared for future upgrade to IP and (4) information service to terminals for power generation data control system, which was equipped outside, is achieved via report PC.

Fig.9 System configuration of centralized supervisory control system



⑩ Control Processing System for Maruyama Dam, Chubu Regional Development Bureau

Fuji Electric received an order for control processing system for Maruyama Dam from the Chubu Regional Bureaus of the Ministry of Land, Infrastructure, Transport and Tourism. The system started operation at the end of FY2012.

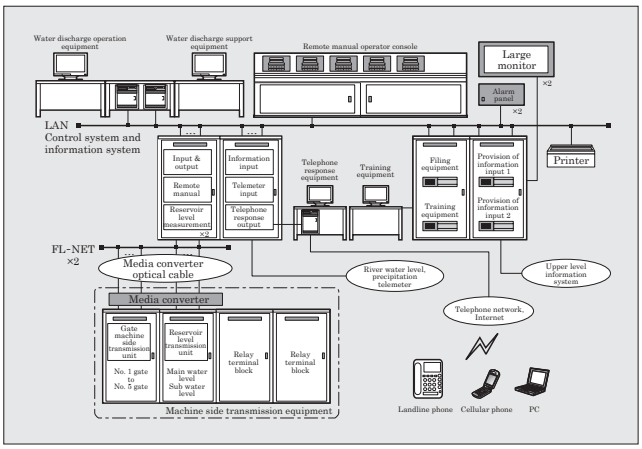
The main features of the equipment are as follows:

(1) In addition to discharge control of five spillway gates of the Maruyama Dam, it is possible to switch to the discharge control of two bypass gates that is built additionally along with the construction of a new Maruyama Dam.

(2) By linking a training equipment and remote manual operator console, it is possible to perform operation training close to the actual operation including operator console.

(3) In addition to response by telephone and reporting function with telephone response equipment, it is possible to send e-mail notifications.

Fig.10 Configuration of control processing equipment for management



⑪ Initiation of Flooding Test for Integrated Development Construction of Kyoto Prefecture Hatagawa Dam

Design, manufacturing and commissioning of main telecommunication equipment for a flood disaster prevention dam, which is built by Kyoto Prefecture, and water supply dam for Kyotamba-cho were completed. The main components of telecommunication equipment includes dam body observation equipment, measurement equipment, telemeter and discharge warning equipment, communication equipment, CCTV equipment, and control processing equipment for dam management.

These components equipment are under centralized management at the dam control office, and have a remote surveillance & control function and dam inflow forecast calculation function based on forecast precipitation from the Meteorological Agency. An energy-saving performance in dam management works and safe operation of the dam are realized.

The final adjustment test was carried out along with a flooding test in cooperation with Kyoto Prefecture, dam body contractor and discharge equipment contractor, and then construction was completed in March 2013.

Fig.11 Telemeter and discharge warning equipment and dam control station

⑫ Unit Type Digital Relay for Hokkaido Electric Power Co., Inc.

Fuji Electric developed the DUJ series of unit digital relays to install into digital relay equipment for power distribution substation of Hokkaido Electric Power Co., Inc. The main features are as follows: (1) reducing the size by about 60% compared to the existing equipment through functional integration by means of improving the CPU processing capability, employment of connectors for external terminal (excluding AC input section) and revising the substrate mounting form, (2) realizing improved accuracy using 16 bit AD converter and improved performance based on 4,800 Hz high-speed sampling, (3) improving maintainability by installing output terminal for testing, (4) by using dot matrix LED letter indicator, operability at stabilizing and visibility at status confirmation were improved and (5) noise-resistance performance conforms to JEC-2500 (2010).

Fig.12 "DUJ Series"

1 Dual Pressure Element (DPE) Sensor

When monitoring pressure and flow in the management of gas and oil wells, it is particularly important to measure the mass flow rate. Consequently, it is necessary to measure the differential pressure at the front and rear of the orifice installed in the piping and pressure (static pressure) in the piping simultaneously.

A DPE sensor consists of a compound sensor part that includes both the differential pressure and static pressure sensors, main body part that makes contact with the fluid, and a circuit part that includes functions for AD conversion and correction calculation.

The compound sensor (capacitance type) is based on MEMS technology and provides high sensitivity as well as superior stability and reproducibility. The pressure receiving unit of the main body part utilizes the same performance-proven structure as the "FCX-A III Series" to make it very reliable. Because the differential pressure and static pressure signals, which are processed by the circuit part, are externally output via serial transmission, the unit can significantly reduce power consumption and provide excellent interface compatibility. DPE sensors with these characteristics can be used in the harsh environments.

Fig.13 DPE sensor

2 Ultrasonic Flow Meter "FLR" and "FSV"

Since releasing its first ultrasonic flow meter in the 1970s, Fuji Electric's ultrasonic flow meters have been accumulating a steady track record in a wide range of fields, especially as related to the water treatment field and the steel and semiconductor industries. We have recently commenced sales of our successfully redeveloped "FLR" compact ultrasonic flow meters and "FSV" small ultrasonic flow meters.

The FLR has achieved an anti-bubble performance of approximately 60 times more than previous products, by adopting the implementation of digital signal processing (utilizing an advanced ABM method). The FSV has renewed its component configuration to include the latest technologies. In addition, it is expected to facilitate the release of high-end FLR models with expanded functionality for a diverse range of applications through future developments and enhancements. In particular, we are expected to add a variety of new functions such as a double measuring line method for 2-line synchronous measurement applications, HART communication for remote maintenance applications, and heat quantity calculation for energy savings applications.

Fig.14 "FLR" and "FSV"

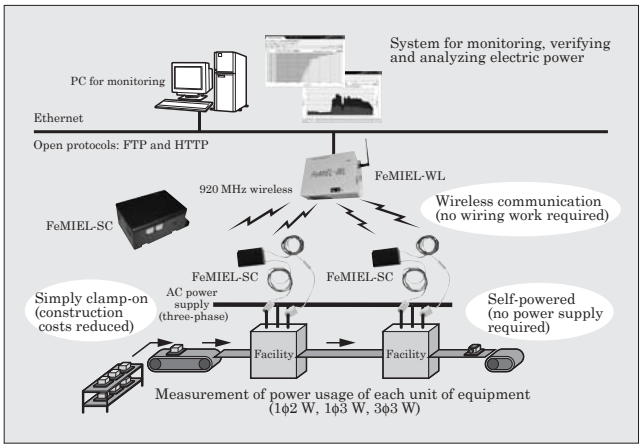
3 Clamp-On Type Power Measurement System

Fuji Electric has developed a clamp-on type power monitoring device and system to enable the easy construction of a power monitoring system.

The main features are as follows:

(1) 920 MHz specified low-power radio communication allows for data collection via wireless transmission.
(2) The implementation of a clamp-on current-sensor for measurement makes it unnecessary to have a dedicated power supply and power line (i.e., making it self-powered), since the power of the device is obtained from measured current.
(3) Installation can be made without switching-off the power, and connected simply by clamping to a power line.
(4) By collecting data via an Ethernet LAN (FTP, HTTP, etc.), the system can be combined with more sophisticated systems, enabling it to provide display of trends, reports, groupings, etc.

Fig.15 Clamp-on type power measurement system



4 Large-Scale Production of New Unit Type Electricity Meter

GE Fuji Meter has developed a new unit type electricity meter (rated current of 60 A, for a single-phase 3-wire model and three-phase 3-wire model). Production for the new unit began in July 2012. This meter is the result of the joint research of eight companies including the Kansai Electric Power Co., Inc. and Kyushu Electric Power Company, Incorporated.

A unit type electricity meter is used by combining a measurement unit and case unit. When the certificate expires, the measurement unit can be replaced with leaving the case unit to prevent workers from touching an energized part. Replacement work can, therefore, improve safety and reduce working hours. In addition, by changing the case unit material from glass and steel into plastic, the weight has been reduced by about 50% as compared with the conventional model.

Fig.16 New unit type electricity meter

5 Laser Gas Analyzer ($CO + O_2$)

Fuji Electric has developed a laser gas analyzer that utilizes two built-in laser elements in a single device, which can be used in applications including combustible gas recovery for steel industries and advanced combustion management for garbage incineration and sludge burning plants. The unit was released in June 2013.

By adopting a 2-laser method, we have achieved a significant price reduction on the unit compared with previous products. Some original technical specifications, such as usage of air for purge gas and improved anti-dust performance based on an automatic amplification-factor control function, are added to the unit. Since the laser elements can be changed according to application and measurement range, in the future it will be possible to make 2-components or 3-components measurements with all of the measuring devices in our product lineup.

We have acquired ATEX and NEPSI explosion-proof certification in FY2013 so that we can expand sales to overseas oil and petrochemical markets.

Fig.17 Laser gas analyzer ($CO + O_2$)

6 Radioactive Contamination Inspection System for Monitoring Foodstuff

Fuji Electric has developed a radioactive contamination inspection system for monitoring foodstuff that is capable of high-speed 100% inspection of large-quantities of rice-bags. The system is compliant with the new radioactive cesium standard for foodstuff. The system improves sensitivity through increasing the number of high sensitivity gamma-ray detectors, and also implements ambient radiation (i.e., BG radiation) shielding using a shadow-shield structure. This has resulted in measurement processing times significantly faster than previous systems (60 seconds inspection has reduced to 10 seconds). Its main features are as follows:

(1) Measurement performance: Determination can be made at a precision of 99% for standard values of less than 100 Bq/kg (Measurement lower limit: 25 Bq/kg or less; Screening level: 50 Bq/kg)
(2) Processing capacity: For 30 kg rice bags, inspection can be made of 360 bags per hour (when BG is 0.1 μSv/h)

In the future, inspection of general foodstuff will also be possible by changing software, further helping to achieve food safety and security.

Fig.18 Radioactive contamination inspection system for monitoring foodstuff

Measurement and Sensor Technology

7 New Gas and CO Alarm Annunciator for City Gas Consumers

Fuji Electric has developed a newly designed gas and CO alarm annunciator for city gas consumers that is approximately 20% thinner and realizes about a 40% reduction in power consumption compared with previous models.

In order to improve the visibility of the display lamp, we have newly adopted a prism that can suitably diffuse the light of the lamp. For the alarm tone, we have adopted a sweep tone to enable tone changes from low to high frequencies. By revising the lamp and tone of the alarm, we have enhanced the hazard perception capability to users, which is the primary role of alarm annunciator. In addition, we have also been able to improve alarm reliability in the following ways: implementation of gas detection employing newly developed decision logic, improvement in suppression of false alarms for various gases other than city gas and carbon monoxide, and enhancement of failure diagnosis functions.

This product contributes to help for gas utilities to "achieve their goal of realizing a safe and secure society."

Fig.19 New gas and CO alarm annunciator for city gas consumers

8 "PXE" Low-Cost Compact Temperature Controller

Fuji Electric's temperature controllers, especially high-quality and low-cost "PXR Series," have acquired support from large amount of users throughout the world, with over three million units being sold in China, Southeast Asia, the United States, and Europe.

In recent years, there has been increasing demand for low-cost units in the Chinese and Southeast Asian markets. To meet this demand, Fuji Electric has recently released the low-cost "PXE" temperature controller, which has achieved a significant reduction in size while maintaining the market-proven high-quality of previously sold products. Its main features are as follows:

(1) the unit contributes to miniaturization with a front face thickness of 1.6 mm (80% reduction from previous units) and a depth of 61 mm (24% reduction from previous units), (2) developed as a product line of low-cost models with the same basic performance as previous products, (3) since the unit can be powered by a PC, parameter settings can be easily carried out via a single cable connection and (4) long warranty period (3-year product warranty).

Fig.20 "PXE"

9 Foundation Fieldbus (FF) Transmitter

The Foundation Fieldbus communication protocol has been popular in Europe and the United States in the measurement and control fields as a means of communication control that supports bi-directional communication. It enables direct connection of control monitoring systems with measurement and control equipment. In recent years, an increasing number of utilizations of the protocol have been adopted in some of the world's largest class plants in Southeast Asia, the Middle East, South America, etc.

Based on these trends, Fuji Electric has added an FF communication function to its "FCX-A III Series" of transmitters, which have a reputation for high-precision, high-reliability, and low power consumption. The lineup also meets customer requirements, incorporating specifications that include resistance to hydrogen permeation as well as corrosion-resistant material. In addition, since the lineup enables to bring out explosion-proof and intrinsic safety, it can be applied to a wide range of fields such as the petroleum, petrochemical and natural gas fields, which often require the adoption of FF specifications.

Fig.21 FF Transmitter

Measurement and Sensor Technology

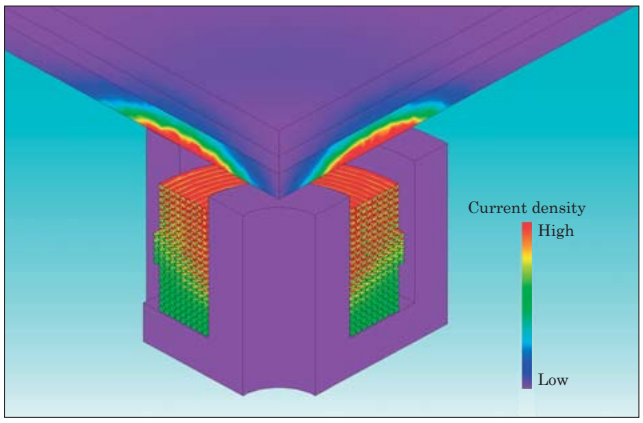
⑩ Enhanced-Precision of Electromagnetic Behavior Analysis in High Frequency Regions Used for Coin Identification

Eddy current sensors, which utilize coils, are used in a wide range of applications such as the verification of metallic material. In recent years, there has been a tendency that the verification target is diversified into a composite material consisting of multiple metal layers, and as a result, there is increasing demand for high-performance material verification capabilities.

Fuji Electric has developed a metallic material verification sensor to meet these needs, utilizing the difference in depth of penetration of the magnetic flux in high frequency regions. By combining the compensation acquired through equivalent circuit analysis with an electromagnetic field analysis technique, which has conventionally been based on the finite element method, we have been able to establish an analytical method that takes into account the amount of stray capacitance, which has induced problems during high-frequency excitation (500 kHz and up). This has enabled to greatly improve analysis precision.

In the future, we will continue to apply this analysis technology with our optimized design technology in order to develop techniques for carrying out material discrimination in composite materials that have a complex layer composition as well as for identifying foreign coins that are composed of composite materials.

Fig.22 Example of current density distribution analysis of the coil sensor (1/4 model)



System Control Technology

① "MICREX-SX SPH3000MG" Controller with Gigabit Ethernet

The "MICREX-SX SPH3000MG" is a high-performance and large-capacity controller equipped with the "SX-Net," which is a gigabit Ethernet-based control level network. Its main features are as follows:

(1) SX-Net has 128 K words of common memory area, which consists of broadcast transfer areas of maximum 64 K words per controller. The updating capability of the data is 8 K words per ms, which provides high-efficiency and large-capacity communication.
(2) The SPH3000MG also has the "E-SX Bus" and allows high-speed I/O updating, application execution and the SX-Net high-precision synchronous data exchange within 1 ms (minimum) cycle. Thus even between distributed multiple controllers, it is easy to build a high-precision synchronous control system.
(3) SPH3000MG is also equipped with a general purpose Ethernet port as in the Fuji's existing controllers and is flexibly applicable to various system configurations.

Fig. 23 "MICREX-SX SPH3000MG"

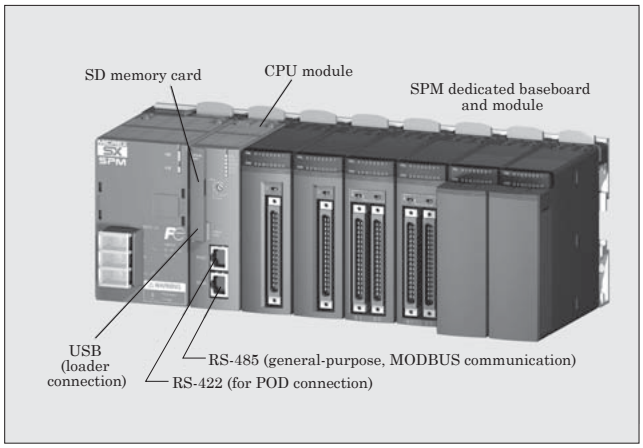
② "MICREX-SX SPM Series" of Programmable Controllers for Asian Markets

Fuji Electric added the "MICREX-SX SPM Series" to its lineup of programmable controllers for sale in Asian markets.

In the field of small-scale machine control, when performance is short with an existing small programmable controller, a conventional model of the "MICREX-SX SPH Series" makes a system more expensive and higher performance than required. However, the development of the SPM Series has helped to achieve a competitively priced product by filtering out certain functions, maintaining the same exact computing power as the SPH Series. Its main features are as follows:

(1) The SPM Series has the same programming tools as the SPH Series, ensuring the compatibility and reuse of software assets.
(2) Non-volatile RAM is utilized for data retention memory (no battery required).
(3) The CPU module is equipped with an RS-485 port, allowing for easy connection with the "ALPHA5 Smart."

Fig.24 Eight slot-based "MICREX-SX SPM" system



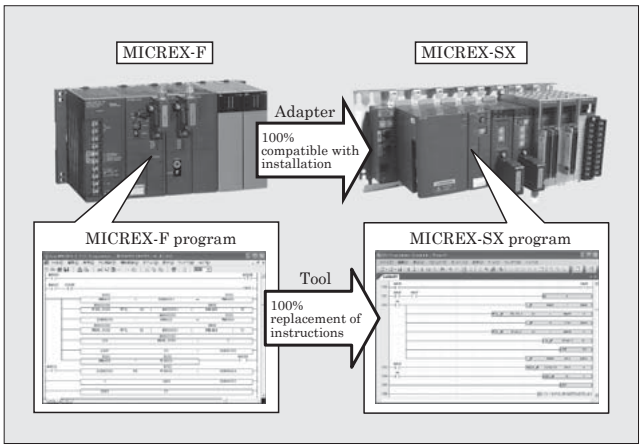
3 Replacement Tools and Adapter for "MICREX-SX"

A tool that completely converts application instructions of older "MICREX-F Series" models into those of the "MICREX-SX Series" of main controllers has been developed and released to the market. By developing a function to convert between differently represented instructions, migration can now be made from the MICREX-F Series to the MICREX-SX Series. This tool has allowed customers to smoothly transfer software assets and significantly reduced the design costs for the migration.

In conjunction with this tool, an adapter has also been developed to absorb differences between hardware externalities. Conventional I/O terminals can be reused as is, and since removal and rewiring of I/O signal lines is not required, the amount of time required for wiring work can be reduced dramatically.

Fuji Electric's replacement tool and adapter meet the demands of today's market, which requires effective utilization of customer assets as well as enhancement of functionality or replacement of long-term-use devices.

Fig.25 Example of replacement using the tools and adapter



4 "MICREX-SX SPH3000PN" Controller with Built-In PROFINET

Fuji Electric has developed a high-performance "MICREX-SX SPH3000PN" controller with built-in PROFINET RT, which is a global open network. The main features are as follows:

(1) Uniqueness of data is ensured and construction of high-speed control system is enabled by executing applications and synchronizing I/O data refreshing time among PROFINET I/O slave modules.
(2) I/O data of 4,096 words, connection of 128 slave stations, I/O communication at a rate of 2 to 512 ms for I/O data refreshing, and communication among controllers via general-purpose Ethernet overlapping are enabled.
(3) The support tools enable to reduce engineering efforts, allowing programs to be written in conjunction with the label name of the PROFINET I/O slave station.

Fig.26 "MICREX-SX SPH3000PN"

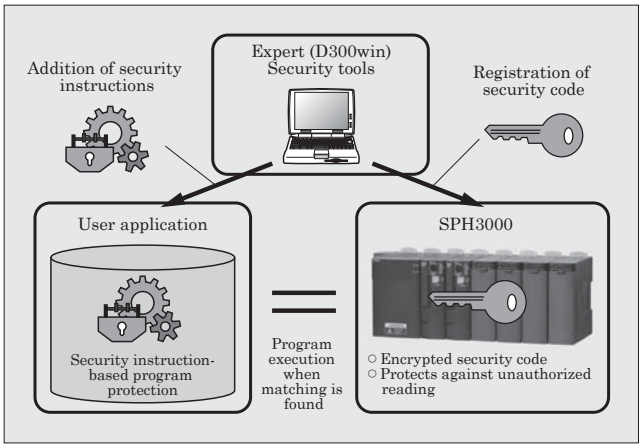
5 User Application Protection Installed in "MICREX-SX SPH3000"

A user application protection function was added to the "MICREX-SX SPH3000" in order to prevent unauthorized use of application programs. A security code, which is managed by the user, creates an association between programs and the controllers used to execute the programs, allowing a program to be executed only when this associative combination matches. By adding this restriction, unauthorized copying of programs and replication of the user's system can be prevented.

This protection function can be used in combination with traditional password-based functions used to prevent the display and reading of programs, and as a result, users can protect applications in a more robust manner.

The protection function also provides the ability to set an execution period for the program, ranging from 1 hour to 365 days, and enables to respond to the provisional operation and sample deployment of user system.

Fig.27 User application protection



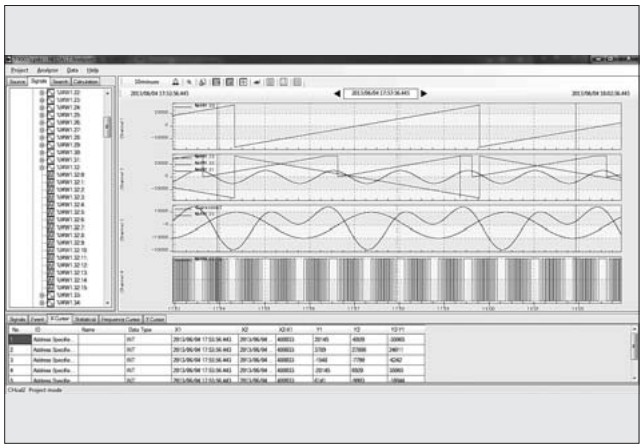
6 "f(s) NISDAS7" Package Software Supporting Data Collection and Analysis

In order to meet the need for predictive maintenance including the stabilization of equipment operation, high efficiency operation, and lifespan prediction, Fuji Electric developed the "f(s) NISDAS" support package software for data collection and analysis in 2002, and since then, we have supplied approximately 250 sets of the software to our customers. Recently, we have released "f(s) NISDAS7" as a new version of the software, incorporating many functional enhancements and providing compatibility with the latest personal computer environments. The main features are as follows:

(1) New functions: Newly added features include an innovative display and operating method, data management capabilities, panoramic display, and cursor function for statistical value
(2) Improved convenience through software enhancements

Chart comments, chart cursor function, data calculation function, Boolean display function, and data collection capabilities have been integrated into the software.

Fig.28 Example of chart from "f(s) NISDAS7"



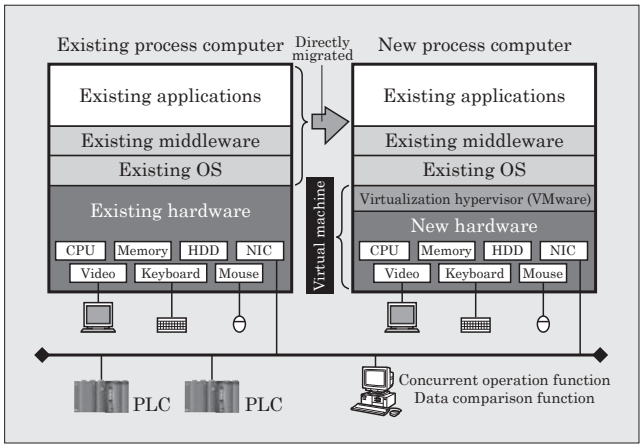
7 Replacing Process Computers by Using Virtualization Technology

The process computers (control computers) used in industrial fields need to be replaced periodically due to hardware degradation and expansion difficulties. Replacing to the latest hardware, operating system and middleware is very expensive due to costs associated with the conversion and operation test involved in the migration of existing applications.

Fuji Electric has utilized virtualization technology to develop a system that can be installed on new hardware without the need to change the existing system. This system ensures high quality, and also reduces development cost and time. It has the following features, which facilitate operation test and contribute to higher efficiency.

(1) Simultaneous operation of the old and new computer (concurrent operation)
(2) Efficient comparison of the output results of the old and new computer

Fig.29 Configuration of virtualization system



8 Administrative Cloud Mall for Citizen Information Services

With the growing interest in cloud computing implementations in local governments, Fuji Electric has developed an administrative cloud mall for resident information services as a new cloud service for local governments.

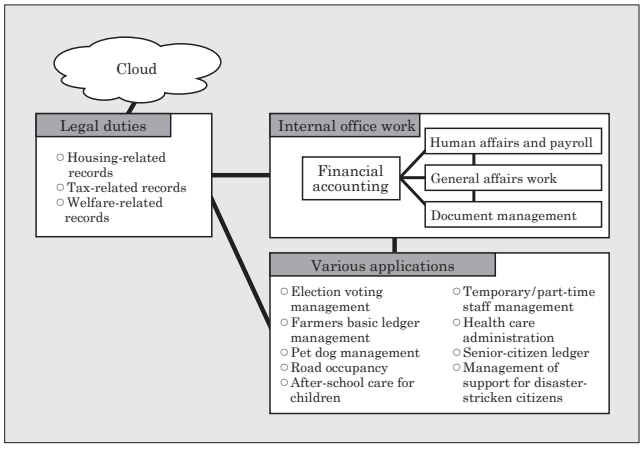
This service provides a cloud-based service that allows sharing of resident information packages, which previously needed to be installed individually, among multiple local governments and municipalities.

The main features are as follows:

(1) Housing-related records: Management of resident records
(2) Tax-related records: Management of local taxes
(3) Welfare-related records: Management of national health insurance, etc.

In addition, greater coordination can be made between various applications and the functions of internal office work, for which document management services have already been in operation.

Fig.30 Outline of administrative cloud mall for citizen information services

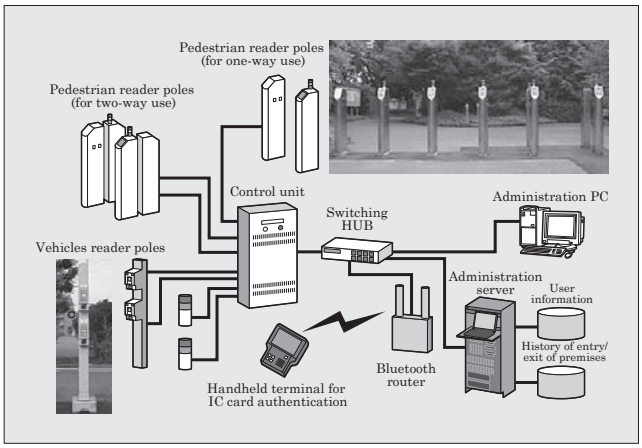


9 Entry/Exit Management System Capable of Counting Occupants

In the aftermath of the Great East Japan Earthquake, there has been growing demand for a system that can immediately discern the number of occupants on premises. Fuji Electric has developed this entry/exit management system to meet these needs. This system can immediately discern when people enter the premises of a building and also count the number of occupants on the premises. The system works by keeping track of when people (including pedestrians and vehicles) enter or exit the premises of a building by making real-time verification of the IC card data of company employees, etc. by using non-contact card readers or handheld terminals.

The control device is composed of an MPU and general-purpose remote PIO device for use in a remote monitoring and control system (telecontrol) to authenticate by checking the user information managed with server and information read from the card reader. We have also developed software to be used with the server for managing (registration, recording, storage and reference) the information of people who enter or exit a premises, resulting in an entry/exit management system that can easily count the number of occupants on a premises.

Fig.31 Configuration of entry/exit management system



10 New Tomei Expressway Remote Monitoring and Control System

In March 2012, Fuji Electric supplied the Tokyo Branch Office of the Central Nippon Expressway Company Limited with a remote monitoring and control system. This system consists of two types of equipment: (1) intelligent substations (intelligent slave station for Internet protocols) installed in the tunnels of the New Tomei Expressway opened in April 2012, (2) highway information terminal (including an earthquake early warning system) installed at service areas and parking areas.

The Intelligent substation incorporates a function for displaying the information recorded inside the slave station. The expressway information terminal equipment provides information regarding expressway traffic jams, etc. as well as URL information that can be accessed via a communication function in mobile phones that use FeliCa. The system also links to earthquake early warnings and displays earthquake magnitude information on its terminal screen for service area and parking area users. In addition, it is also possible to provide the information to public-address systems for notification by loudspeakers.

Fig.32 Intelligent substation and expressway information terminal equipment

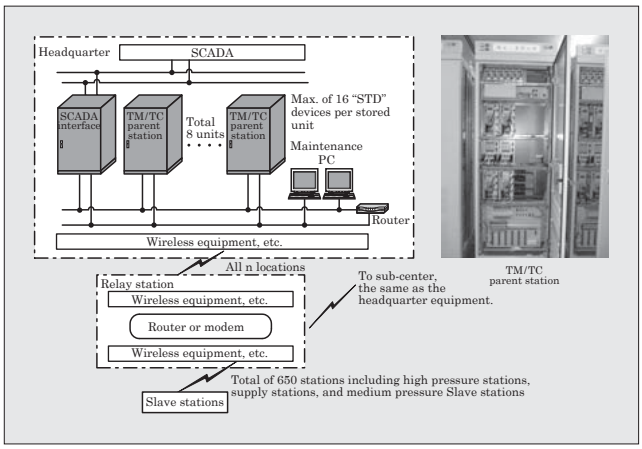
11 TM/TC Wide-Area Monitoring and Control System for Osaka Gas Co., Ltd.

Fuji Electric has supplied Osaka Gas Co., Ltd. with a TM/TC wide-area monitoring and control system. The system utilizes IP Telemeter "STD" hardware, which has a proven track record at power companies. We have also developed software used in the system, taking into consideration the differences in installation locations such as central monitoring rooms, radio relay stations and slave stations, as well as the differences that exist in communication methods such as those that use satellite channel, terrestrial radio channel and NTT digital circuit.

The system is a critical communication system for approximately 600 locations including high and medium pressure governor stations located throughout the supply areas of Osaka Gas Co., Ltd. The system is based on performing remote monitoring and control via a SCADA system in the central monitoring rooms (in both main and sub centers).

We have completed the delivery and testing of the system and are currently in the process of migrating from analog to digital lines.

Fig.33 System configuration diagram



System Control Technology

12 Renewal of Blast Furnace Blower Control System for Ironworks

Fuji Electric has renewed the blast furnace blower control system at an ironworks.

The renewal work of the control system required to complete within the short intervals of the furnace shutdown. This was accomplished by repeating detailed preliminary surveys as well as by repeatedly replacing and restoring signal branch board installations and switchover of old and new control systems.

The system's main features are as follows:

(1) Highly-reliable system meeting the blasting demands of the blast furnaces of integrated ironworks. The system achieves stable blowing through the combined control of multiple turbine blowers.

(2) The control system can flexibly respond to operations at times of periodic maintenance of each facility and device, blast intervals, inspections, etc. by carrying out operation though variously combining the blast furnace, blower and control system.

Fig.34 Blast furnace blower control system