

Industry Solutions in Power Electronics Systems

Factory Automation
Process Automation
Social Solutions—Transportation and Radiation Monitoring
Information Solutions



Outlook

Fuji Electric creates competitive components to strengthen and develop systems for the industrial and social infrastructure fields, contributing to various fields through the expansion of these systems in overseas markets.

Factory Automation

For the field of factory automation, we offer components and systems based on our core technologies, such as power electronics, control and measuring equipment.

As for inverters, we have developed the “FRENIC-eFIT” that can be installed alone in harsh environments such as outdoors or in areas susceptible to corrosive gases. Furthermore, fanless cooling structure achieves maintenance free for all capacity models.

For rotating machines, we have developed brake motors compliant with the efficiency regulations of China and the United States. These motors have the same interface dimensions as conventional standard efficient brake motors, encouraging the replacement.

For the automobile industry, we have developed a tire testing machine that is compliant with the Worldwide harmonized Light vehicles Test Procedures (WLTP). By utilizing electric inertia control, it can control loads equivalent to a range of a light vehicle to 4-t truck.

For the field of factory energy saving, we have offered an exhaust-heat based steam generation heat pump that generates 150°C steam by recovering the heat generated by hot wastewater. This product will make it possible to save energy in sterilization and drying processes. Moreover, expanding the functionality of ISO 50006-compliant energy management systems allows customers to reduce the analysis workload and increase the speed of operational efficiency improvement activities that use inverters and exhaust-heat based heat pumps.

For the field of measuring instruments and sensors, we will develop competitive components that can support systems by more clearly specifying application and usage locations. In order to expand applications in the petrochemical industry, we have developed the “FST”

explosion-proof spool piece ultrasonic flowmeter, which achieves the accuracy level equal to Coriolis flowmeters at a more reasonable price.

Process Automation

For process automation field, we offer components and systems that help stabilize production equipment and reduce unit consumption. These products are on the basis of our core technologies, such as drive control, measurement and control, and industrial electric heating for induction furnaces and induction heating equipment.

In the field of steel and non-ferrous metals, we have replaced the large-scale monitoring and control system of a steel plant with the system using the “MICREX-VieW XX.” In overseas markets, we have delivered electrical equipment designed to meet functional safety requirements to a continuous hot-dip galvanizing line.

For the cement industry, we have developed a monitoring and control system package for cement plants as a platform that provides the functionality required in plant control. This package facilitates the engineering activities of partners and users all over the world.

For the industrial electric heating field, we have applied electromagnetic field analysis and thermal analysis technologies to induction heating equipment for sheet metal and intend to use these technologies in new applications.

Social Solutions—Transportation and Radiation Monitoring

In the field of rolling stock, we have delivered door driving systems to Singapore’s Land Transport Authority (LTA). The systems use domestically proven rack-and-pinion door driving systems to improve the reliability and safety of the trains. The New trains using the systems started commercial operations in June 2017.

For the radiation monitoring equipment and systems industry, we have been promoting the development in new fields such as those that can be used in obtaining large projects, reactor decommissioning

measures and new services in Japan. Our new electronic personal dosimeter can simultaneously measure gamma rays and neutron rays with just a single device, thereby raising expectations of its usage in nuclear facilities that generate neutron rays. Furthermore, its communications functions enable it to connect with remote monitoring systems and contribute to reducing worker radiation exposure.

Information Solutions

In the field of information solutions, we are devel-

oping tools and systems that help streamline the operations of local governments and companies. We have developed the “ExchangeUSE” V11, which uses the usage history data stored on transportation IC cards, can reduce the amount of work required in adjusting traveling expenses. We have also developed “Karuwaza Web 7.0,” having multi-language interface, allows non-technical users in administration departments to easily search and total information stored on various databases within the company.

Factory Automation

1 Brake Motors Compliant with Overseas Efficiency Regulations

There has been a continued expansion of efficiency regulations for motors (3-phase induction motors) in various countries and regions to save energy. Brake motors are also subject to the regulations. Fuji Electric has developed brake motors compliant with the efficiency regulations of China and the United States and obtained the following certifications:

- (1) For China [0.75 to 15kW (4-pole, 6-pole rated at 11kW)]
GB18613-2012 GB2 (efficiency class IE3), China RoHS and CCC certification (only applicable models)
- (2) For the United States [0.75 to 15kW (4-pole, 6-pole rated at 11kW)]

NEMA MG1-12-12 NEMA Premium (efficiency class IE3) certification

They have identical frame size and mounting dimensions with existing standard-efficient brake motors, facilitating replacement.

Fig.1 Brake motor with class GB2 certification for China



2 “FIP Series” DC Backup Power Supply for Industrial Equipment

There has been an increased investment in IoT in industrial fields worldwide and rising demand for automated manufacturing lines, especially in China, and these economic conditions are driving the market for manufacturing equipment such as semiconductor manufacturing equipment and industrial robots. AC-DC power supplies are often used for the operation and control of these types of equipment and are required to deal with requirements on an individual basis because the specifications, such as dimensions and outputs, of each piece of equipment differ. Fuji Electric has thus developed a DC backup power supply for industrial equipment that flexibly meets customer specifications by combining functional blocks. It has up to 4 outputs (output voltage: 5 to 48V) and can optionally provide communications and battery backup functions. This architecture enables samples to be provided to customers in one month in the fastest (one sixth the period of conventional custom power supplies), thereby greatly contributing to reduction in the development time and development cost of equipment for customers.

Fig.2 “FIP Series”



Factory Automation

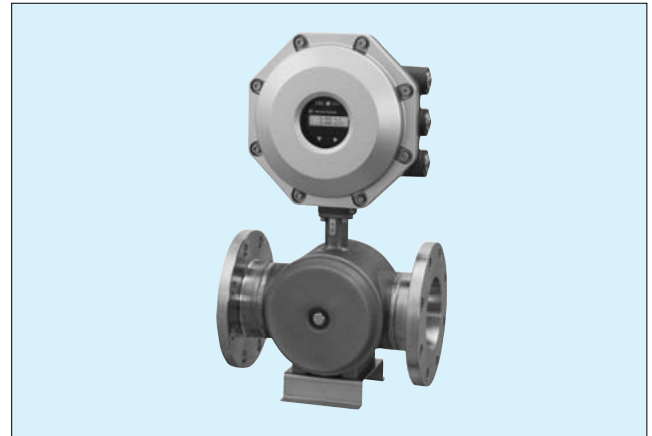
3 Acquisition of Explosion Proof Certification for “FST” Spool Piece Ultrasonic Flowmeters

Fuji Electric has acquired explosion proof certification for the “FST” spool piece ultrasonic flowmeter, offered in 2016, to further increase their marketability.

The FST has a high level of accuracy within $\pm 0.2\%$, which compares with that of Coriolis flowmeters, by using a 3 parallel measuring path system (measurement via 3 pairs of ultrasonic sensors) and proprietary processing algorithm. Furthermore, it is particularly advantageous in that it produces no pressure loss and is reasonably priced.

By acquiring explosion proof certification, the “FST” can replace widely-used Coriolis flowmeters in the petroleum and chemical fields. Moreover, it can also measure non-conductive fluids such as oil and pure water, unlike widely-used electromagnetic flowmeters. We are thus marketing the FST as a replacement for electromagnetic flowmeters. The acquired explosion proof certifications are those of Japan, IECEx, ATEX and NEPSI.

Fig.3 “FST” (explosion proof type)



4 High-Temperature Heat Pump Technology Capable of Generating 150°C Steam Using Low GWP Refrigerant

There has been increasing demand for heat pumps, which are used for saving electric power and heating energy while reducing CO₂ emissions in factories. There is also worldwide demand for the practical use of refrigerants with a low GWP that can replace alternative fluorocarbon refrigerants. Fuji Electric has offered a heat pump that recovers heat from heated wastewater that has low utility-value and generates high utility-value steam. We have made use of NEDO's Research Grant Program to develop a high-temperature heat pump technology capable of generating steam at the industry's top level of 150°C by using a new refrigerant that has a low GWP and complete its prototype testing.

- (1) Development of a high-efficiency refrigerant compression technology using new refrigerants
- (2) Development of high-efficiency, low-cost refrigerant circuit and refrigerant control technology

We will perform the verification testing to develop and improve the reliability of follow-up control of heat load fluctuations.

Fig.4 Exhaust-heat based steam generation heat pump capable of generating 150°C steam



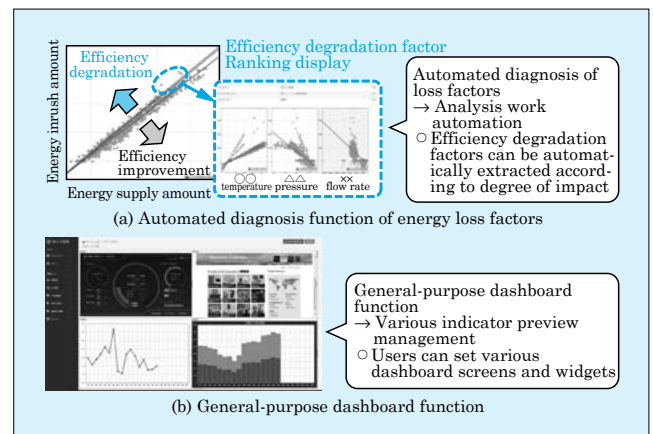
5 Energy Use Efficiency Diagnosis Compliant with ISO 50006

In addition to the energy-saving measures adopted conventionally for individual pieces of equipment, there has recently been increasing demand for equipment efficient operation that corresponds to specific energy demands more accurately. In this regard, Fuji Electric has developed Energy Performance Indicators compliant with the international standard ISO 50006 and new functionality of our energy management systems on the basis of a management framework for managing factors.

- (1) Automated diagnosis of energy loss factors for each energy management unit (organization, production line, facility, etc.)
- (2) General-purpose dashboard function for real-time management of energy efficiency (targets, results) and loss factors (control threshold values)

Using these functions allows customers to reduce the analysis workload and speed up the activities of operational efficiency improvement (PDCA cycle).

Fig.5 Energy use efficiency diagnosis compliant with ISO 50006



Process Automation

1 Steel Plant Standard System Package for Fuji Gemco Private Limited

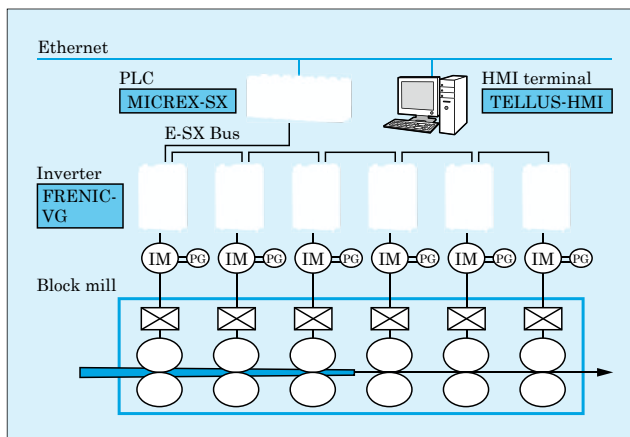
Fuji Electric has developed a steel plant standard system package for Fuji Gemco Private Limited, a company that specializing in steel rolling mill plants in India. The following types of packages are available:

- (1) Standard mill package
- (2) Block mill package
- (3) Shear package

The packages are composed of the know-how of plant system and Fuji Electric components, such as programmable controllers (PLC), human machine interface (HMI) terminals and inverters, which are helping customers achieve an added-high-value plant system.

We plan to expand our business in the steel rolling market in India and Southeast Asia.

Fig.6 Package example (block mill package)

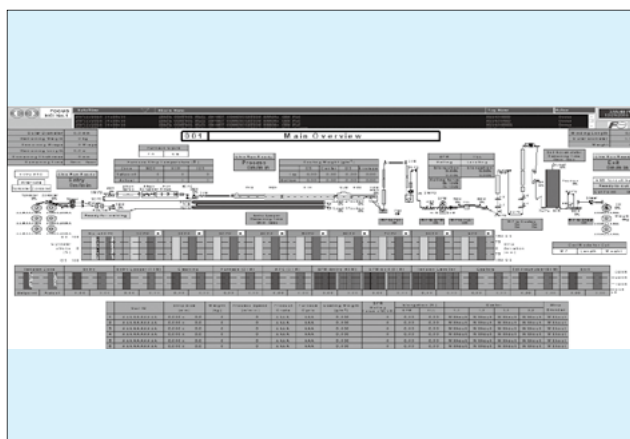


2 Delivery of Electrical Equipment for Continuous Galvanizing Lines

Fuji Electric has been delivered electrical equipment for continuous galvanizing lines to an overseas company. The introduced latest monitoring and control systems improve add-on functions for performance, reliability, maintenance and safety. The main features are as follows:

- (1) The equipment consists of approximately 200 inverters, approximately 250 motors, 11 programmable controllers (PLC), approximately 100 controlboards, control software and a monitoring and control system.
- (2) Each section controller and inverter control controller are networked via SX-net, enabling remote monitoring and fast data collection of several thousands of plant data (1,024 words/1 ms).
- (3) The system is compliant with functional safety standards (IEC 61508).

Fig.7 Example of monitoring and control system's screen



3 Electrical Equipment of Continuous Unloader for Thermal Power Plants

Fuji Electric has delivered electrical equipment for continuous unloaders that handle the raw materials of thermal power plants in Japan and abroad. We have collectively delivered the electrical equipment of continuous unloaders to an overseas thermal power plant. The main features are as follows:

- (1) The drive unit uses a PWM converter and high-performance vector inverter, delivering higher-harmonic suppression and high-precision control.
- (2) The controlboard and motors are designed and manufactured in accordance with IEC standards, achieving safe electrical equipment.

Fig.8 Overall view of continuous unloaders



Process Automation

4 “LEONIC-M700” DC Motor Control Units for Industrial Plants: Expanding Capacity Line-Up of Thyristor Stacks

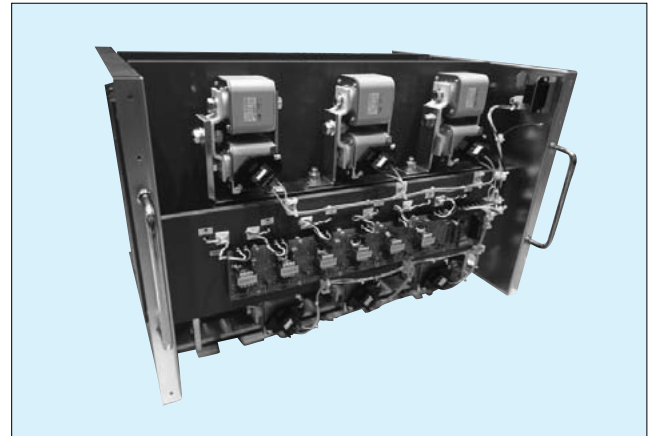
Direct current (DC) motors play a very active role in equipment for various types of industrial plants.

Fuji Electric has expanded the line-up of capacities for the thyristor stack of “LEONIC-M700” DC motor control units for industrial plants. The expanded line-up of capacities is as follows:

- (1) Rated output voltage: Up to 440 V DC; Rated output current: 1,400 A
- (2) Rated output voltage: Up to 750 V DC; Rated output current: 1,500 A
- (3) Rated output voltage: Up to 750 V DC; Rated output current: 2,800 A

We will continue to be committed to the development of thyristor stacks to help extend the service life of industrial plant equipment that uses DC motors.

Fig.9 “LEONIC-M700” thyristor stack

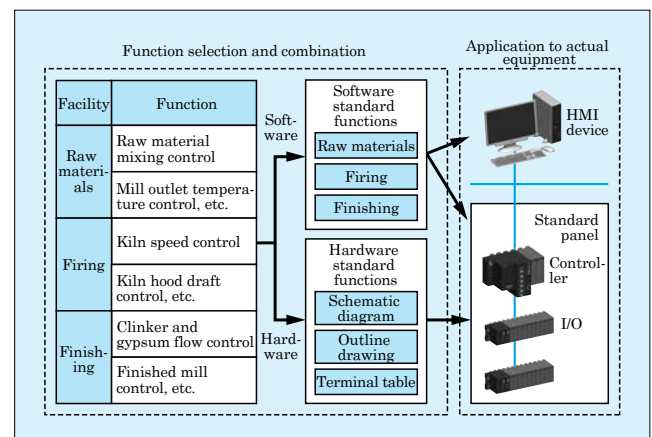


5 Monitoring and Control System Package for Cement Plants

Fuji Electric has delivered many monitoring and control systems to cement plants. We have developed a monitoring and control system package for cement plants that runs on the common platform “MICREX-VieW XX.” It provides the functionality necessary for cement plant control in consideration of customer convenience. The main features are as follows:

- (1) The standard functions of hardware, software and screens are incorporated to one package for each facility of cement plants: raw material, firing and finishing.
- (2) Using the packages, which have been functionally verified, contributes system quality.
- (3) Using the packages allows partners and users in Japan and abroad to facilitate engineering work.

Fig.10 Package overview



6 Monitoring and Control System for Industry-Owned Thermal Power Plant

Nisshin Steel Co., Ltd. has constructed a new power plant at its Kure Works that uses the by-product gas generated from steel manufacturing facilities as fuel. Fuji Electric has delivered the latest “MICREX-VieW XX” monitoring and control system. Commercial operation started on schedule in November 2017. The power plant at the Kure Works has the following requirements:

- (1) The system can control combustion using various fuels: heavy oil, mixed gas (mixture of blast furnace gas and converter gas) and utility gas.
- (2) Two air feeding systems (3 MPa and 1.4 MPa) of the plant can stably continue even when load rejection occurs.
- (3) Plant air feeding during the operation of the boiler alone can be smoothly followed by the subsequent turbine coordination.

By sufficiently satisfying these requirements and finishing the commissioning even in a short period of time, we contributed to the on-schedule start of commercial operation.

Fig.11 No. 6 boiler and No. 11 turbine generators at Kure Works



Process Automation

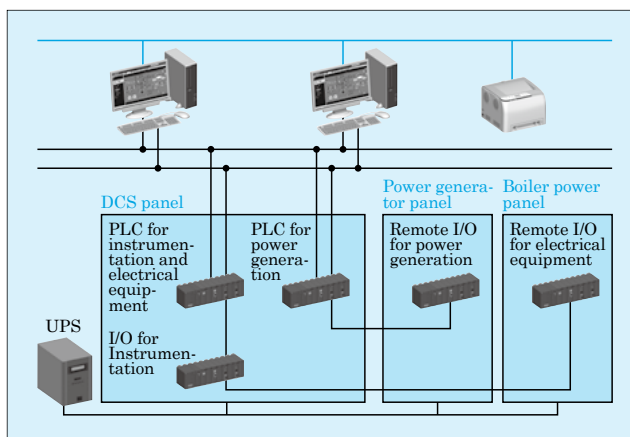
7 Monitoring and Control System for Biomass Power Plants

There has been a boom in the construction of biomass power plants since the start of the “Feed-in Tariff Scheme for Renewable Energy” (FIT). In this regard, small-scale power plants have been attracting attention in recent years particularly from the viewpoint of efficiently securing a source of fuels. In order to respond to these market trends, Fuji Electric has developed a compact and high-functional monitoring and control system. The monitoring and control system has the following main features:

- (1) The monitoring and control system incorporates the control functions of electrical equipment, instrumentation and power generation, allowing a centralized operation.
- (2) Using remote I/O system helps reduce panel size and save wiring labor-hours
- (3) Equipment operation faceplate package automatically generates operation screens and control logic.

This monitoring and control system has contributed to reducing operator workload and improving maintainability.

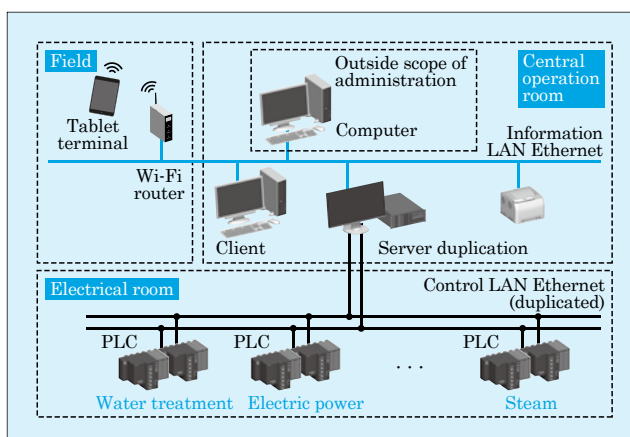
Fig.12 System configuration example



8 Replacing Monitoring and Control System of Food Factory

Fuji Electric has utilized the “MICREX-VieW FOCUS” in replacing the monitoring and control system for the utility and wastewater facilities of a brewing company. The system centralizes the management of energy with client-server configuration. Tablet terminals can serve as client devices, allowing users to reduce on-site operation and maintenance workloads. The existing system intermingled the control of water treatment, electric power and steam, while the renewed system has adopted a configuration that controls facilities by providing each piece of equipment with a separate controller in order to clarify function sharing. This enhancement enables optimum balance control for each utility. Furthermore, restoring accumulated “visualizing” data from the existing system to optimally operate energy, thereby raising expectations with regard to future improvement effects.

Fig.13 System configuration example



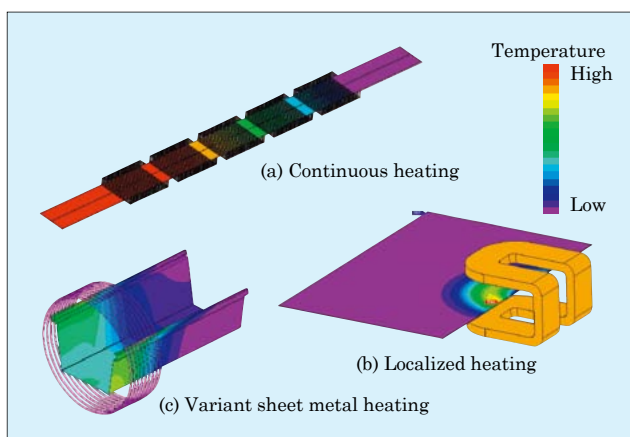
9 Simulation Based Induction Heating Equipment

Productivity improvement and advanced products have brought about increasing demand for improved heating control precision in material processing. Fuji Electric has been using its proprietary magnetic field and thermal simulation technologies to optimally design coils and power supplies. Here are some examples:

- (1) Continuous heating equipment for sheet metal: To improve controllability, 5 pieces of small volume induction heating equipment continuously heat sheet metal to create a uniform temperature rise for the entire sheet.
- (2) Local heating equipment for sheet metal: It selectively heats only the edges of continuously conveyed sheets.
- (3) Variant sheet metal heating equipment: It uniformly heats rectangularly shaped sheet material.

We are providing induction heating for variously shaped materials other than sheet metal also to meet customer requirements.

Fig.14 Example of simulation results



Social Solutions—Transportation and Radiation Monitoring

1 Bulk Delivery of Electronic Products for C151B Trains Operated by Singapore's Land Transport Authority (LTA)

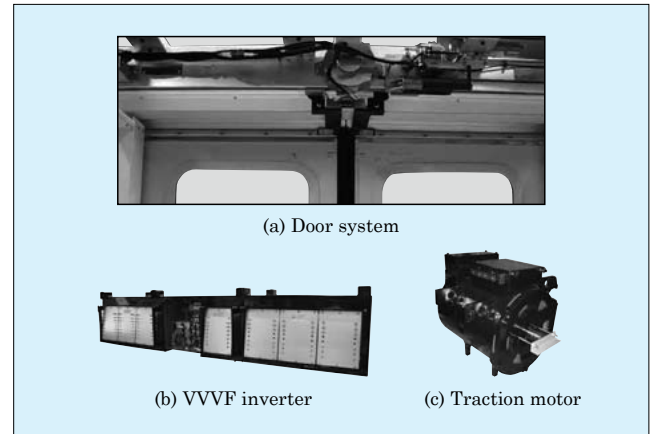
Fuji Electric has been continuously delivering drive equipment (VVVF inverters, traction motors, etc.) and auxiliary power supplies (APS) for rolling stock to Singapore's Land Transport Authority (LTA).

In addition to the above mentioned equipment, we have also delivered door driving systems that use permanent magnet synchronous motors for new C151B trains (45 consists, 270 cars) that started commercial operation in June 2017.

The main features of the door driving system are as follows:

- (1) Using our domestically proven rack-and-pinion mechanism increases reliability and safety.
- (2) A failure diagnosis function facilitates the investigation of failure causes.
- (3) It achieves enhanced safety through improved obstruction-pulling characteristics at times when passengers or luggage is pinched by the doors.

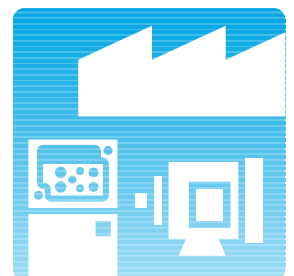
Fig.15 Electronic products for C151B trains operated by Singapore's LTA



2 “NRF51” New Electronic Personal Dosimeter

Fuji Electric has developed the “NRF51” as a new type of electronic personal dosimeter that can simultaneously measure gamma rays and neutron rays. The NRF51 inherits some of the functions of the conventional “NRF50” personal electronic dosimeter, such as a large dot-type LCD, wireless communication module (900-MHz wireless or Wi-Fi) and an emergency call button, while also coming equipped with a neutron ray measuring sensor, enabling it to simultaneously measure gamma rays and neutron rays with just a single device. It is compliant with the IEC 61526 Ed. 3.0 and ANSI N42.20 international dosimeter standards and comes standard with an IP65/67 waterproof rating. Furthermore, it can wirelessly connect with remote monitoring systems in real-time to help reduce worker radiation exposure, contributing to better management of exposure to neutron rays at nuclear power facilities.

Fig.16 “NRF51” new electronic personal dosimeter





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