Transportation Systems

1 Class 97 locomotives fitted with Hitachi's on-board ETCS signalling system

1 SIL 4 Certification for On-board ETCS Signalling System for Main Lines

In November 2013, Hitachi released an on-board signalling system for main line railways that complies with the European Train Control System (ETCS) requirements, satisfies Safety Integrity Level 4 (SIL 4), and delivers the highest levels of safety.

To achieve this certification and demonstrate that the system provides maximum safety levels, Hitachi prepared extensive evidence to demonstrate that the product specifications and all of the processes involved with product development, including design, manufacturing, and testing, complied with European safety requirements. Certification was only gained after a rigorous audit by a third-party European certification agency. In parallel with this, certification of ETCS compliance was also achieved by preparing evidence to demonstrate compliance with all ETCS standards, passing independent functional testing by a European Reference Laboratory, and then passing a final audit carried out by a European Notified Body (NoBo).

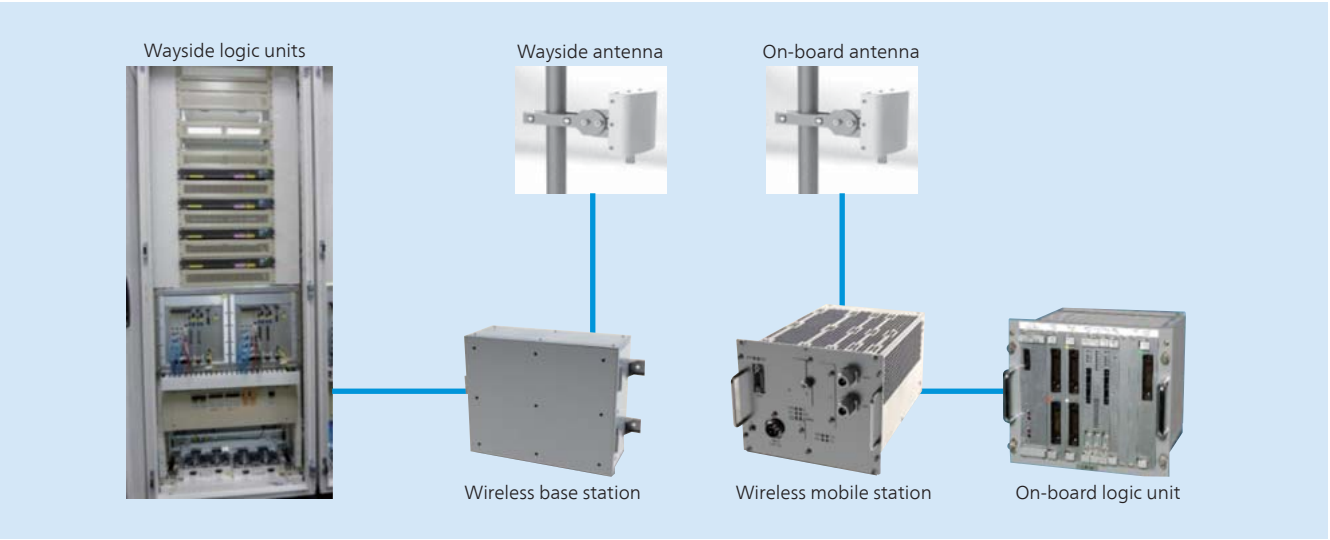
As part of joint development with Network Rail of the UK, Hitachi has also run on-rail trials of Class 97 locomotives fitted with the new system to verify compatibility with wayside ETCS signalling systems from other vendors. While the ETCS standard was formulated to ensure interoperability on European railways, its status as the only standardized signalling system means it is also being adopted in the Middle East and Asia. Hitachi intends to expand sales of the system throughout the world.

2 SIL 4 Certification for Urban Rail CBTC System

The urban railway market is seeing growing use of communication-based train control (CBTC) systems in the construction of new lines and in upgrades to existing signalling systems. Hitachi has gained the highest-level international safety certification (SIL 4) for its CBTC system. SIL 4 certification is an essential prerequisite for entering overseas markets for signalling systems.

The system is based on one that is already in operation and was developed using a "V-model" process that emphasizes traceability and was put in place by Hitachi to satisfy the requirements of the international safety standards. To obtain certification, Hitachi prepared the safety case and other documentation required by the standard for each phase of development; underwent a document audit and a review of its design, testing, and other processes by a European certification agency; and successfully resolved all of the issues that the certification agency identified. This means that Hitachi is now able to place on market its products to overseas urban rail projects that require compliance with international safety standards, including IEEE 1474.

The knowledge gained from this system certification will be useful for other projects that require certification, and will have widespread applications in future overseas signalling system work.



2 Block diagram of CBTC system

3 Tetsuhoku Substation on Namboku Line of Sapporo Municipal Subway Upgrade Using Portable Substation

The Tetsuhoku Substation on the Sapporo Municipal Subway Namboku Line of Sapporo City Transportation Bureau has a key role, not only supplying trains with electric power from the Hokkaido Electric Power Co., Inc., but also supplying power to other substations and electrical rooms. A recent upgrade replaced not only substation equipment that first entered service 41 years ago (excluding extra-high voltage substation facilities), but also the aging substation building itself.

3 Portable substation (top), and power management system and protection interface panels (bottom)

To maintain the supply of electric power during the substation upgrade while the building dismantling and extension work took place, a portable substation housed in an aluminum package and with equivalent functions to the Tetsuhoku Substation itself was installed in free space inside the substation compound. By allowing the Tetsuhoku Substation to be fully shut down, use of the portable substation helped simplify and speed up the upgrade work. After upgrading the substation building was complete, Hitachi went on to install a full set of new substation equipment. The upgraded Tetsuhoku Substation entered service in July 2013 when operation switched over from the portable to the new equipment.

Hitachi intends to use the portable substation in future substation upgrades.

4 Nishi-Nippon Railroad Co., Ltd. Passenger Information System for Tenjin-Omuta Line

As part of an upgrade to the passenger information system for the Tenjin-Omuta Line of Nishi-Nippon Railroad Co., Ltd., its display panel was switched from light-emitting diode (LED) to liquid crystal display (LCD).

Hitachi was responsible for the passenger information equipment including the center and eight station-based systems [Fukuoka (Tenjin), Yakuin, Ohashi, Nishitetsu Futsukaichi, Chikushi, Nishitetsu Kurume, Nishitetsu Yanagawa, and Omuta stations], announcement equipment, and destination displays.

The upgrade added new functions to provide passengers with an intuitive display of any disruption to services, with pictograms being used to indicate the cause of schedule disruption and a track map display indicating which services are affected. Also, the system reduces the control center workload by continued supervision aiming to provide correct information from the train number tracking function about the number of doors and cars in each train and about train movements, even when schedule corrections are not ready in time. To ensure reliability, all critical systems have a redundant configuration.

The location and screen size of destination displays were determined by Design Division of Hitachi, Ltd. based on on-site

4 20-screen multi-display for Fukuoka (Tenjin) station (scheduled to enter service in 2014) and example screens

analysis of passenger movement. The screen designs took account of visibility to users and the screen panel provides upcoming departures and map displays to indicate current train location and the stations at which the train will stop.

The system commenced operation at Nishitetsu Futsukaichi, Chikushi, and Nishitetsu Yanagawa stations in March 2013. The service will be extended to include Fukuoka (Tenjin) and Yakuin stations in 2014, and Ohashi, Nishitetsu Kurume, and Omuta stations in 2015.

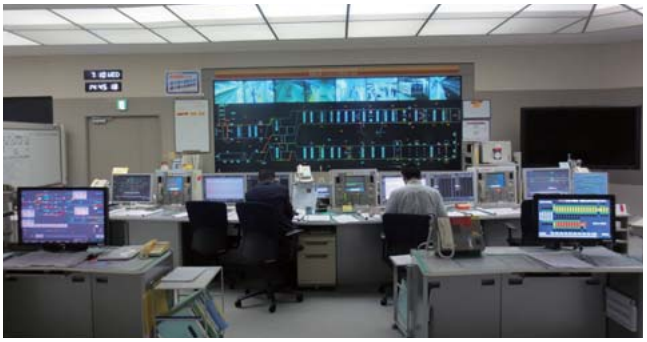
5 Bureau of Transportation of the Tokyo Metropolitan Government Upgrade to Traffic Control Systems for Four Toei Subway Lines

Traffic control systems supplied to the Toei Mita and Asakusa Lines of the Bureau of Transportation, Tokyo Metropolitan Government entered service in February 2013, followed by a system for the Toei Shinjuku Line in November 2013. An upgrade to the Toei Oedo Line is also planned.

In response to the aging of existing equipment, the new system includes upgrades to the central control systems built for individual lines, the traffic control equipment and passenger information displays installed at each station, and the traffic control network. The individual line supervisory staff and center systems will be consolidated at a new central operation control center in the near future. To improve customer service, the upgrades included replacing the passenger displays on the Asakusa Line with full-color screens. A new method of providing supervisory information to train crew and station staff is also to be adopted, involving the installation of new traffic notification units at all stations. In addition to automating train traffic control, the introduction of these systems has helped make traffic supervision more efficient and allowed for a faster response to abnormal situations by consolidating and sharing information about each railway line, while also providing more detailed services to passengers through the use of visual information display.

Hitachi intends to continue working on development of the new operation control center in collaboration with customers to make these subway systems and other important transport arteries in the Tokyo metropolitan area more robust with respect to disasters.

5 Traffic display panels and controller desks that form part of the traffic control systems for four Toei Subway Lines of the Bureau of Transportation, Tokyo Metropolitan Government



6 Control room for Yurakucho Line and Fukutoshin Line traffic management system

6 Traffic Management System for Tokyo Metro Co., Ltd.

Because the Fukutoshin Line of Tokyo Metro Co., Ltd. shares track with the Yurakucho Line, meaning that any schedule disruption to one can cause delays on the other, the traffic management system for the two lines is configured as a single system. With the commencement of mutual through-train operation with the Toyoko Line of Tokyu Corporation in March 2013, the line now carries traffic from five different railway companies. Because this means that any localized schedule disruption will spread to affect a wide area, the traffic management system was upgraded with a particular priority being placed on more efficient command entry and functional enhancements.

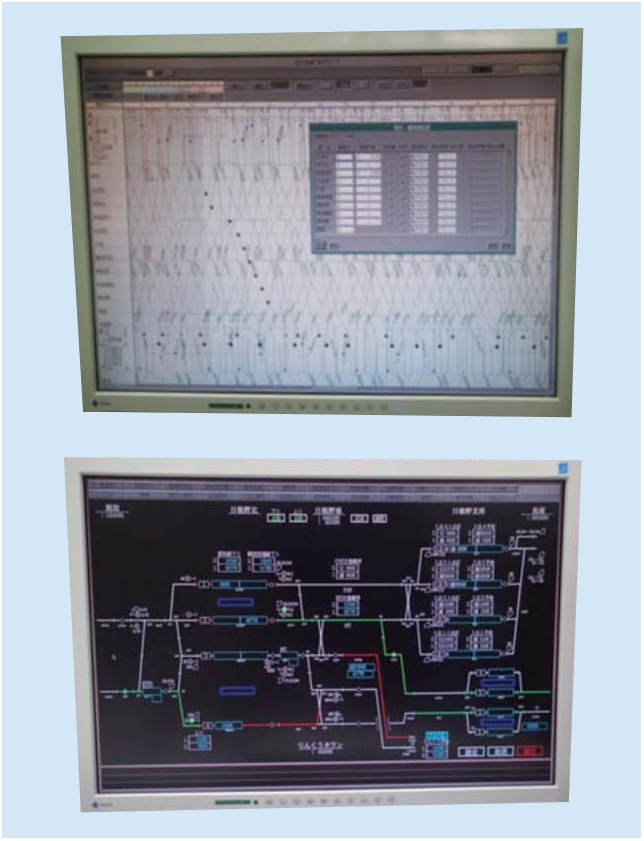
The control servers chosen for use as the core computers for the system feature a high level of reliability and responsiveness. Also, although the controller desks have multiple monitors, the series of tasks from situation assessment to the issuing of commands can be performed more efficiently with a single control unit that can be used for both situation monitoring and the entry of traffic management commands. Furthermore, to facilitate rapid recovery from schedule delays, the system includes manual group control terminals that can send commands such as stop times and operation resumption for multiple selected stations all at once, rather than issuing these commands to trains one at a time via the radio system as in the past, and also a dedicated manual terminal for Kotake-mukaihara Station where the Yurakucho Line, Fukutoshin Line, and Seibu-yurakucho Line of the Seibu Railway Co., Ltd. intersect.

In the future, Hitachi intends to utilize these rescheduling functions on other lines to improve traffic management functions and achieve safe and punctual operation.

7 Upgrade to Traffic Management System for Hanwa Line of West Japan Railway Company

The traffic management system for the Hanwa Line of West Japan Railway Company has been in service for 20 years since it commenced operation in 1993. Recently, to make further improvements in operational quality and the efficiency of traffic management, all equipment at both the center and stations has been upgraded to the latest systems.

Running for 61.3 km from Tennoji Station to Wakayama Station, and including the Kansai Airport Line as a branch line,



7 Operational graphics screens from Hanwa Line traffic management system

the Hanwa Line is an important railway line for the Kansai region. The system controls 26 stations, with station control equipment installed at Wakayama Station where shunting frequently occurs to manage shunted rolling stock at the station. To improve the efficiency of rescheduling when traffic disruptions occur, the system also includes functions for sharing information about the status of related lines. This uses interface equipment for connecting to the traffic management systems for the JR Kyoto and Kobe Lines, the Takarazuka, Tozai, and Gakkentoshi Lines, and the Osaka Loop and Yamatoji Lines, which have already entered service. For line and other maintenance work carried out overnight, the system provides online storage of the procedures for maintenance work planning and for starting and completing work. To cope with trains leaving from different platforms, the system also has enhanced functions for passenger information.

8 Osaka Municipal Transportation Bureau Electric Power Management System

The Osaka Municipal Transportation Bureau's power management system performs centralized monitoring and remote control of substations and other equipment for its eight subway lines and the medium-capacity Nanko Port Town Line.

Hitachi recently undertook an equipment manufacturing and upgrading project that covered the substations and other electrical facilities for Lines 1 to 7 and the Nanko Port Town Line, and also the power management systems at the electrical power control center and Nanko transportation control center. The project provides centralized management and control, with connections to existing systems that include the Line 8 remote

8 Electrical power control center after switchover to the new system

monitoring and control equipment and other equipment management systems. The system consists of a monitoring and control computer, remote monitoring and control equipment, and various support functions. These latter include a simulator, support functions for electric power management work, power use data display, and receiving and distribution of disaster and weather information.

Operation of the new system commenced in March 2013 with switchover to a temporary installation to allow for construction work. Work on the full system, including relocation and demolition, was completed in December. The electrical power control center handles centralized monitoring and control, and this was its first upgrade in the 22 years since it first entered service in April 1991.

9 Osaka Municipal Transportation Bureau Integrated Supervisory System for Sennichimae Line

The supervisory system (traffic management system) for the Sennichimae Line of the Osaka Municipal Transportation Bureau was the final line to be included in an operation control center consolidation project in which the separate operation control centers for each of the bureau's subway lines (Lines 1 to 8) were combined into a single operation control center as part of an upgrade of their traffic management systems. The Sennichimae Line (Line 5) serves 14 stations and runs for 12.6 km between Nodahanshin and Minami-Tatsumi stations.

As is the case for the other lines, the configuration of the newly commissioned system is designed for continuous operation, including backup for traffic management functions to ensure that passenger information services continue even if traffic management shuts down. The operation control center equipment includes two 70-inch LCD projection screens that are used as traffic display panels and have the same specifications as the units used for the other lines. The top halves of the display panels show six surveillance camera images for operational supervision, while the bottom halves show a representation of the entire Sennichimae Line. The controller desk on the new system uses mouse-based operation. This method is common to all lines and is designed to be easier for staff to use, replacing the lever and push-button controls used in the past. Inputs for functions such as traffic management, manual train movement instructions, and passenger information can be entered from the same terminal for all six units. For consistency, the training equipment uses the same traffic display panel and desk configuration as the actual lines.

Relocation of the operation control center for the Sennichimae Line was completed in March 2013, marking the completion of the traffic management facility.

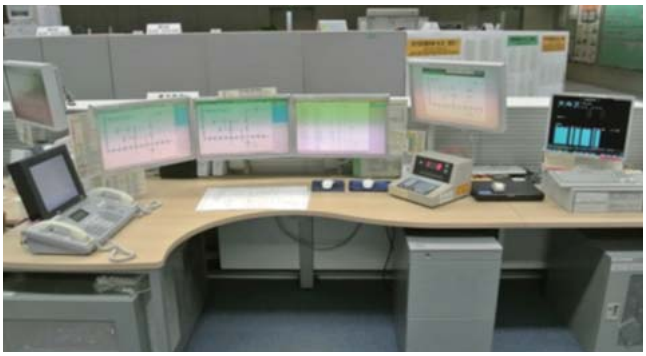
10 Enhancements to Power Management Supervision in ATOS Maintenance Work Management System

The Autonomous Decentralized Transport Operation Control System (ATOS) for the Tokyo region was installed in 1996. The objectives of the system included making the supervision of the railway system more efficient and improving the safety of maintenance work. Similarly, a power supervision system was installed in 1995 to automate the supply and control of the electric power required by the region's railway services and improve the efficiency of power management supervision. ATOS handles transportation supervision and the power supervision system handles power management. The two systems are linked through communication between the supervisory staff who operate them.

As part of the replacement of the aging power supervision system, systems have been introduced to electronically handle tasks (checks performed prior to scheduled electrical outages or reconnections) performed though cooperation between the transportation and electrical supervisory staff. Specifically, these were a function in which the system automatically coordinates train schedules with the very large numbers of scheduled electrical outages and reconnections, and a function for sharing the latest information on, for example, the location of the final train of the day and the sections of track on which maintenance work is prohibited. These functions were added to the maintenance work management system in ATOS.

The system entered service in November 2013. It is delivering further enhancements in the automation and efficiency of tasks handled by cooperation between supervisory staff.

9 Traffic display panel and controller desk for Sennichimae Line



10 Control room and desk for new power supervision system

Public Sector Systems

1 Central control room of integrated water management system of Osaka City Waterworks Bureau

1 Osaka City Waterworks Bureau Integrated Water Management System

The integrated water management system of the Osaka City Waterworks Bureau has commenced operation, providing a central system for managing the water treatment facilities that serve the entire city. The system connects to the various central monitoring and control systems that perform distributed management of water treatment facilities (at three sites) and water distribution infrastructure (divided into 12 blocks) located around the city, managing information on flow rates, pressures, water quality, pumping station operation, and power consumption in realtime. To improve overall work efficiency, demand forecasting and reporting functions that were previously handled by the central monitoring and control systems have also been transferred to the integrated water management system.

The main features of the system are as follows.

(1) Scheduling of the water pumps, which are heavy power users, takes account of pump energy efficiency when allocating the water volumes to be carried by the different routes in the water network.

(2) Automation of parameter learning and forecasting error correction for the demand forecasting function allows operators to work more efficiently.

(3) Control settings for maintaining an appropriate concentration of residual chlorine at the point of supply are provided to the water treatment facilities in realtime using an in-pipe consumption model of residual chlorine concentration.

(Commencement of operation: April 2013)

2 Ideura Water Purification Plant Monitoring and Control System

The Ideura Water Purification Plant of the Kitakyushu City Water and Sewer Bureau has the capacity to supply 255,200 m^3/d of treated water, representing 33% of the city's total water supply. It sources water from the Aburagi Reservoir, Masubuchi Water Reservoir, Heisei Ozeki Dam, and Murasaki River, treats it using a rapid settling and rapid-rate filtration method, and then supplies the treated water via the Horikoshi pumping station approximately 4 km away from the plant to the distribution reservoirs that serve the eastern districts of Kitakyushu City.

2 Monitoring and control system at Ideura Water Purification Plant

Hitachi has recently upgraded the central monitoring system to provide a system that performs centralized monitoring and control of the entire system from three operations desks.

The main features are as follows.

(1) Enhanced reliability and scalability achieved by using a client-server system configuration that distributes the functionality and processing load to its servers. In addition to backup servers, the system includes a data server that collects all of the plant data sent from the field control units, remote monitoring and control devices, and other equipment, and an application server that handles functions such as report generation, audible warning output, printing, and data archiving.

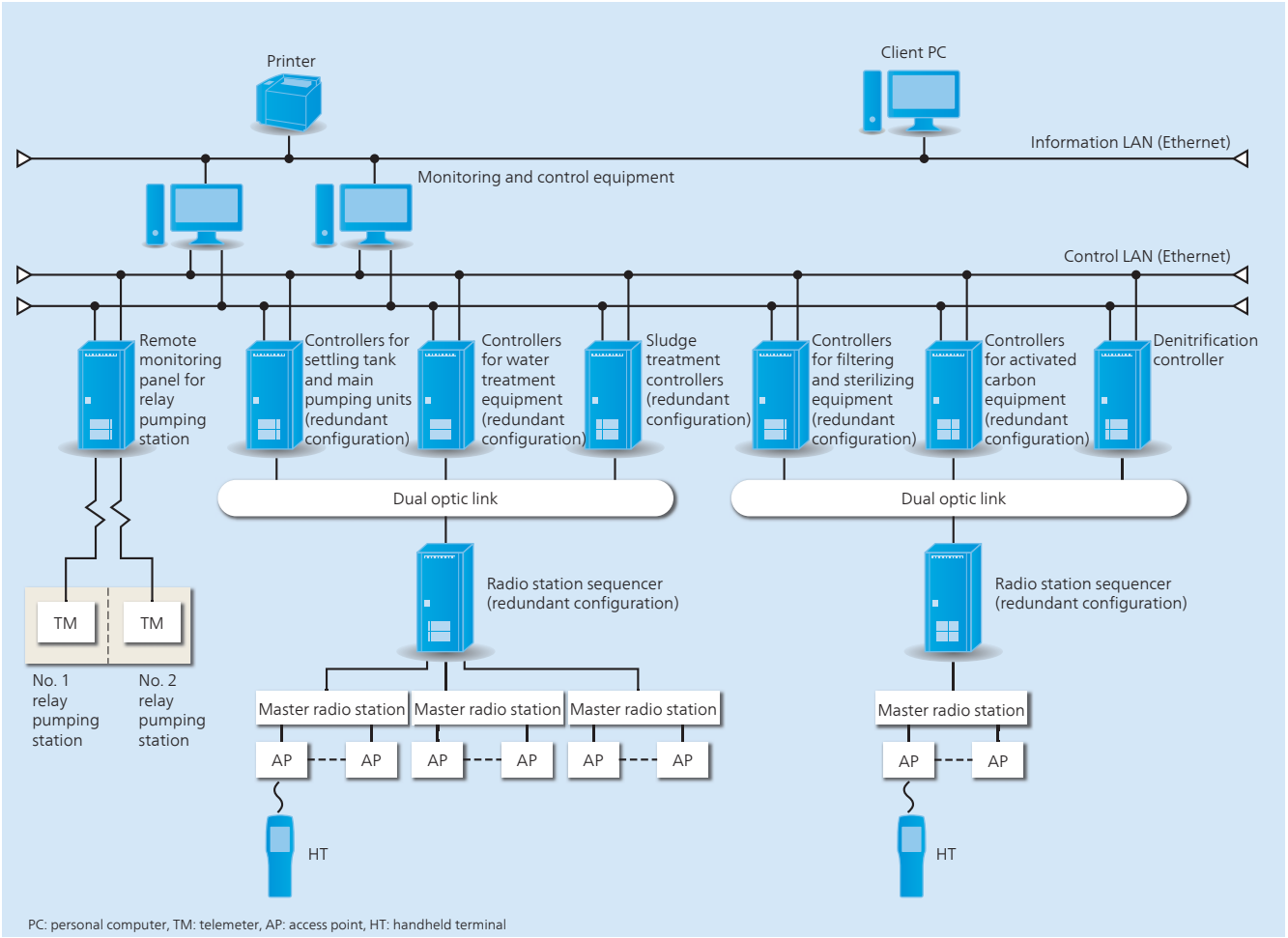
(2) Enhanced reliability achieved by using a redundant configuration with automatic switchover for the telemetry units that provide communications between the water intakes, pumping stations, and treatment plant.

(3) Consolidated monitoring of both equipment located at the facility and remote equipment, with distribution reservoir remote control equipment being connected directly to the control local-area network (LAN).

(Commencement of operation: April 2013)

3 Technoport Fukui Wastewater Purification Center Monitoring and Control System

The Technoport Fukui Wastewater Purification Center in Fukui Prefecture, Japan commenced operation in December 1993, treating industrial wastewater from Technoport Fukui (an indus-



3 Monitoring and control system at Technoport Fukui Wastewater Purification Center

trial complex on the Fukui waterfront). In addition to a conventional wastewater treatment facility, the plant was the first public wastewater plant in Japan to utilize advanced treatment equipment (coagulation sedimentation system, rapid-rate filtration, and activated carbon adsorption system).

The new monitoring and control system supplied by Hitachi was intended to upgrade the central monitoring and control equipment and to enhance its reliability and ease-of-operation.

The main features are as follows.

(1) Enhanced reliability achieved by using a client-server architecture with backup monitoring and control equipment (servers).

(2) Enhanced reliability achieved by using a redundant configuration for the control LAN and for the controllers for key equipment.

(3) Use of wireless handheld terminals for monitoring and operating field equipment to eliminate need for on-site control panels. To improve reliability, the radio station sequencer also has a redundant configuration.

(4) Improved operation achieved by a function in the handheld terminals that displays the relevant operation screen simply by scanning the bar code attached to each device.

(Commencement of operation: April 2013)

4 Eniwa Sewage Treatment Plant Monitoring and Control System

The Eniwa Sewage Treatment Plant in Eniwa City, Hokkaido, Japan commenced operation in 1980 and has a capacity of 47,500 m^3/d. The plant handles all sewage from Eniwa City and operates five streams that use the conventional activated sludge treatment method. In addition to conventional sewage treatment, the plant has installed a facility that accepts raw trash, human waste, and septic tank sludge, and since FY2012 has been mixing it in with sewage sludge.

For the recent center upgrade, Hitachi proposed a system configuration that could operate alongside the existing monitoring system to satisfy the customer's requirement to spread equipment upgrade costs over time.

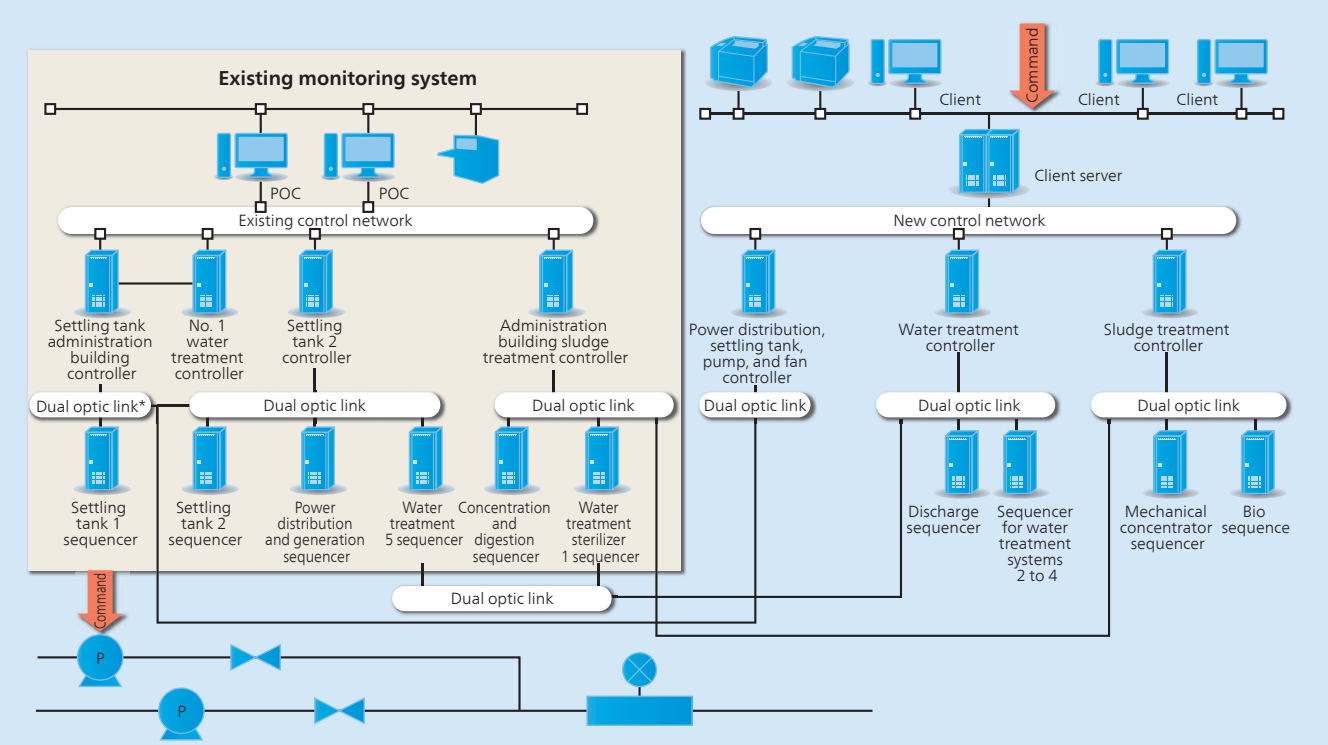
The main features are as follows.

(1) Enhanced maintenance and reliability achieved by using a client-server architecture with a redundant configuration for the network and key equipment such as the monitoring and control equipment (servers).

(2) Ability to use both the new and old monitoring systems, with the new and existing controllers and sequencers both being connected to a dual optic link network. This improves reliability by allowing the old and new systems to operate alongside each other on the same network.

(3) Enhanced reliability achieved by storing the monitoring and control software at four different locations, consisting of two locations for the process operator consoles (POCs) of the existing system and two locations for the (redundant) client servers of the new system.

(Commencement of operation: March 2013)



P: pump
* Dual optical link for central processing units (CPUs) of programmable logic controllers (PLCs) using high-level data link control (HDLC)

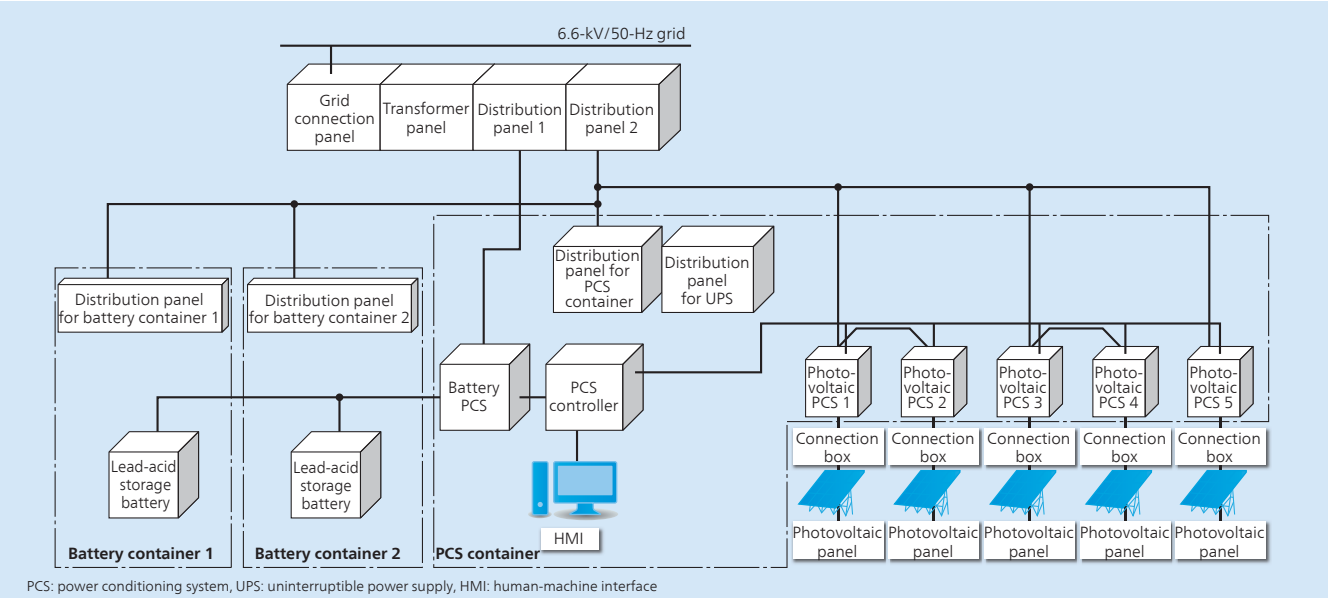
4 Monitoring and control system for Eniwa Sewage Treatment Plant

5 Participation in Joint Project of Ministry of the Environment and Ministry of Land, Infrastructure, Transport and Tourism

Hitachi has installed photovoltaic panels (50 kVA), power conditioners, power distribution equipment, and storage batteries (500 kVA) at the north public wharf at the port of Kashima in Ibaraki Prefecture, Japan as part of "FY2012 Project for Effective Low-carbon Measures for Ports that are Also Applicable During Disasters or Other Emergencies," a joint demonstration project run by the Ministry of the Environment and Ministry of Land, Infrastructure, Transport and Tourism aimed at reducing greenhouse gas emissions and providing emergency power supplies at ports that play a central role in maritime and land transportation. The equipment will be used for the following trials, the objectives of which are to assess the viability and profitability of the system by calculating its costs and benefits during routine operation and quantifying the benefits it provides in times of emergency. The suitability of the system for use at other ports of a similar size will also be assessed.

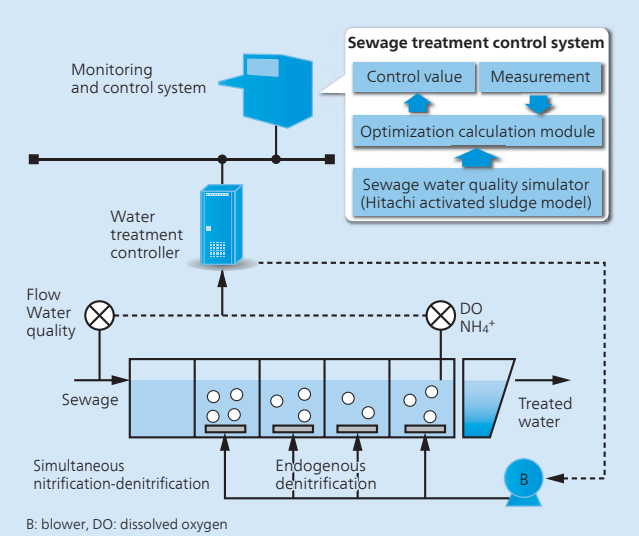
(1) Supply of electric power for lighting and administration facilities
(2) Supply of electric power to gantry cranes
(3) Operation of a system that uses equipment for generating electric power from renewable energy to augment power supplies
(4) Assessment of reduction in carbon dioxide emissions

This project is being run over a three-year period from FY 2012 to FY2014 as a joint project of the Ministry of the Environment and Ministry of Land, Infrastructure, Transport and Tourism.



PCS: power conditioning system, UPS: uninterruptible power supply, HMI: human-machine interface

5 Configuration of system installed at the north public wharf at the port of Kashima



6 Main components of sewage treatment control system

6 Sewage Treatment Control System Incorporating Water Quality Simulation Technology

The requirements for sewage treatment include reducing the environmental load on public watercourses and operating in an energy-efficient manner. These demands are providing the impetus for the adoption of techniques such as the use of ammonia sensors to control the extent of nitrification (conversion of nitrogen from ammonia to nitrate form), or advanced treatment (or quasi-advanced treatment) techniques that involve improving blower operation at existing sewage treatment facilities that use conventional activated sludge treatment.

Currently, Hitachi is working toward the use of sewage treatment control systems that use water quality simulation technologies that have already been developed. In the case of the nitrification quantitative control technique, feedback from an ammonia sensor is combined with simulation-based feed-forward to optimize blower power consumption and the quality of the treated water. In the case of quasi-advanced treatment, meanwhile, Hitachi is developing technology for improving denitrification performance without using circulation pumps through techniques such as endogenous denitrification and simultaneous nitrification-denitrification involving the use of simulation for control of the air flow from the blowers. Hitachi has expanded the range of blowers that can be used for control, providing higher efficiency and smaller size while simultaneously enhancing control performance. By working on the development of these software and hardware technologies together, Hitachi is improving the energy efficiency performance of the overall system.

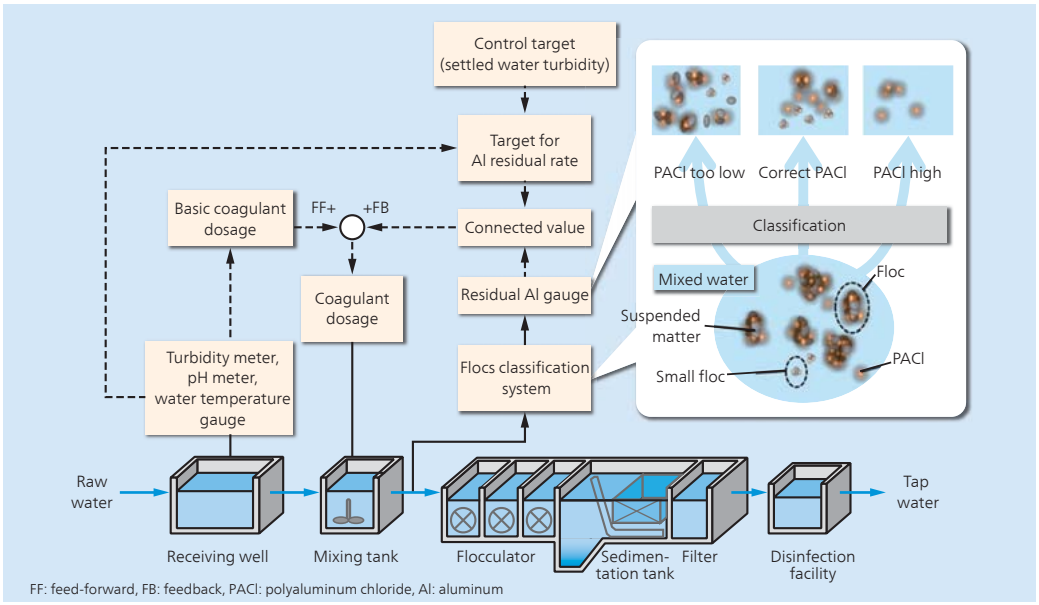
7 Automatic Control Technique for Coagulant Dosage Using Aluminum as Indicator

Adverse natural events such as droughts or heavy rain have been on the increase in recent years. The New Waterworks Vision published by the Ministry of Health, Labour and Welfare, Japan in March 2013 identified risk management that takes account of these events as being important to ensuring a safe water supply.

The quality of raw water is a major risk factor in water quality management, and it is common for experienced staff to intervene manually when adverse natural events occur. As water treatment plants are gradually losing their experienced staff, Hitachi has developed a new control system for automatic coagulant dosage control in response to sudden changes in the quality of raw water.

Flocs (aggregation of coagulant and suspended matter) occur in the water at the outlet of the mixing tank. A feature of the system is that it controls coagulant dosage based on the concentration of aluminum in those small flocks in which the flocculation process has insufficiently advanced. In a demonstration using actual raw water, the system showed that it could shorten the feedback time and prevent deterioration in the quality of the tap water when sudden changes occur in the quality of the raw water. To improve reliability further, work is continuing on collecting data under different conditions, including varying the coagulant and raw water quality.

The new system reduces risks from both natural and human sources and will contribute to realizing the New Waterworks Vision.



7 Flocculant addition control based on aluminum concentration

8 Command center of Shirakawa Fire Department

8 Shirakawa Regional Civil Defense Organization Digital Radio System for Firefighting and Emergencies, and Advanced System for Firefighting Command Center

Hitachi supplied a digital radio system for firefighting and emergencies and advanced system for the firefighting command center of the Shirakawa Regional Civil Defense Organization, which serves Shirakawa City, four nearby towns, and four nearby villages in Fukushima Prefecture, Japan. The systems will help ensure that command and control of the response to fires or other emergencies will be accurate and prompt. The Fire and Disaster Management Agency of the Ministry of Internal Affairs and Communications, Japan has directed that the radio systems used for firefighting and emergencies, which are currently analog-based, be switched to digital systems by May 2016. In addition to satisfying this requirement, the new system included the installation of advanced system at the firefighting command center. This was the first time Hitachi had received an order for both types of new systems.

The main features are as follows.

(1) Operational support functions, including the management and sharing of support information, improved command efficiency through the processes from receiving a 119 call (the emergency phone number in Japan) through to assigning and dispatching the emergency response vehicles or fire engines.

(2) Time-shifting of the transmission of commands from radio base stations is used for radio call-out orders issued during a disaster to eliminate radio dead zones caused by interference.

(3) Automatic selection of the best radio base station for transmitting commands to a vehicle based on the vehicle's position and the base station coverage areas.

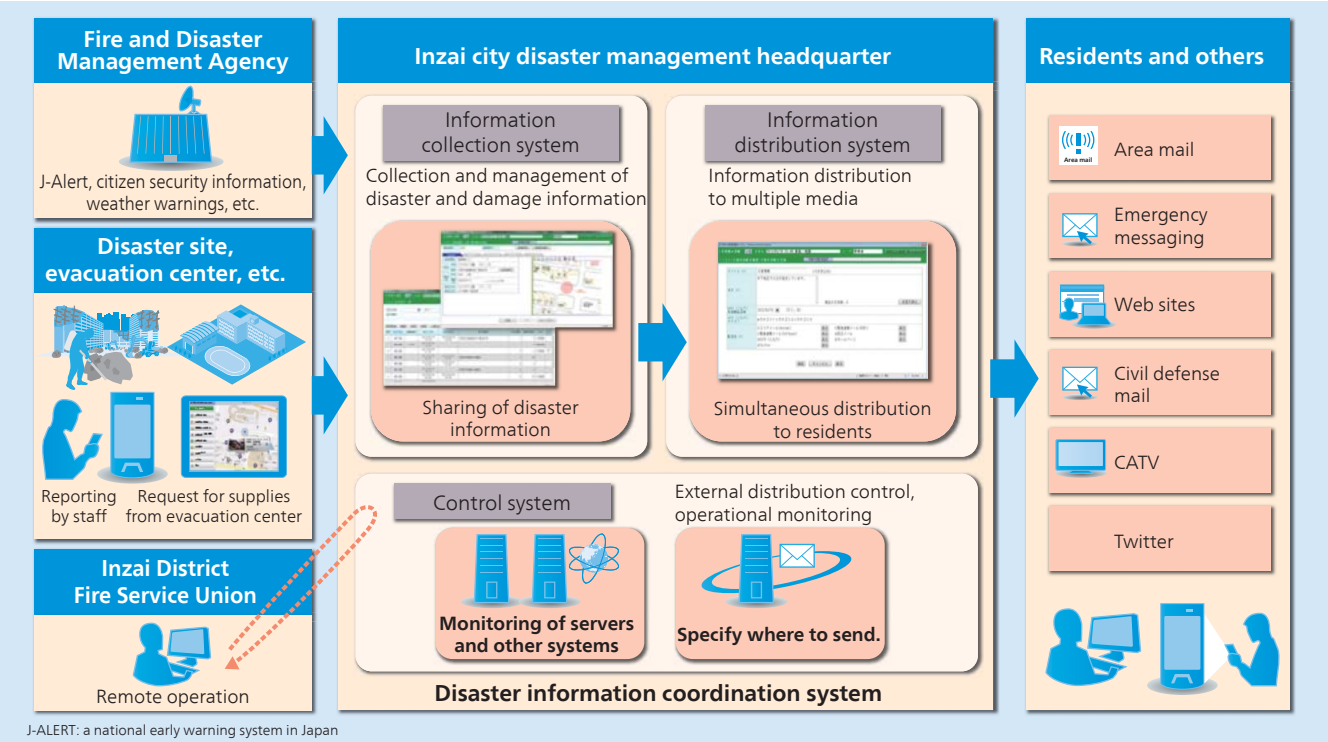
(Date supplied: March 2013)

9 Inzai City Disaster Information Coordination System

Learning from its experience in the Great East Japan Earthquake, Inzai City has introduced a disaster information coordination system that is designed to ensure quick and accurate communication of disaster information by providing multiple, diversified means for its transmission.

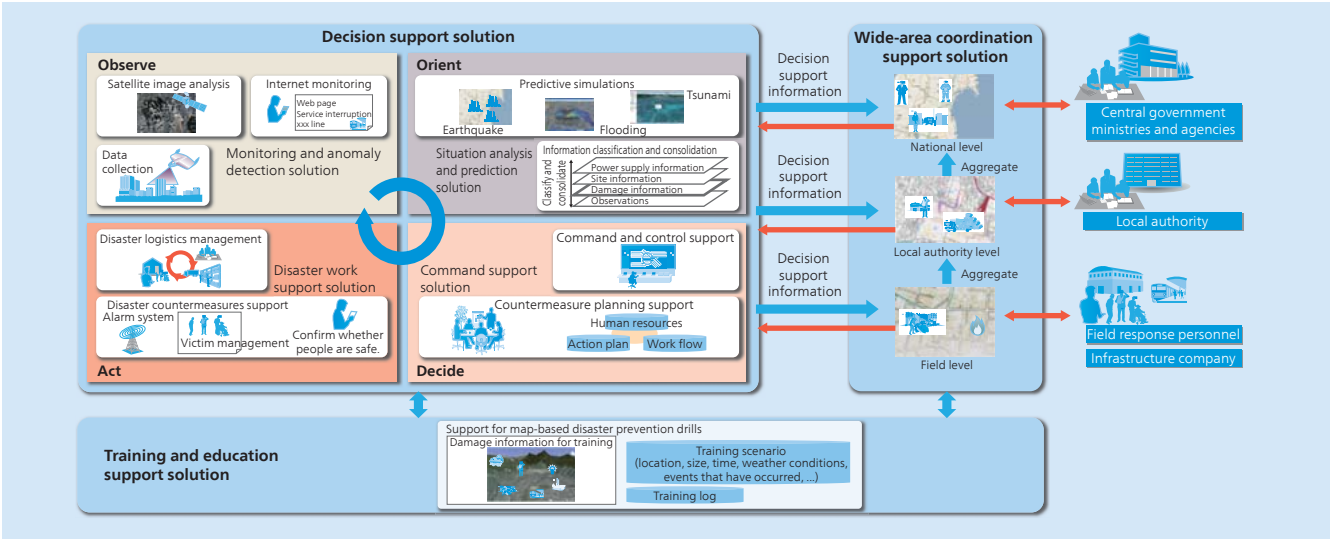
The system helps the city respond to disasters by providing functions such as the prompt collection and sharing of disaster information based on reports from the site of the disaster sent in from mobile terminals and the use of maps for centralized management of the situation. It can also provide residents with timely and accurate disaster information by sending it out across a diverse range of media, including area mail, emergency messaging, web sites, civil defense mail, community access television (CATV), and Twitter.

Amid a shift in requirements away from previous systems that have focused on information collation and sharing and toward systems that emphasize information distribution and delivery, Hitachi is deploying new solutions that support regional safety and security by providing a platform for coordinating information and information delivering.



9 Inzai City disaster information coordination system

Security Technologies for Social Infrastructure



1 Disaster prevention management solution

1 Disaster Prevention Management Solution for National Security

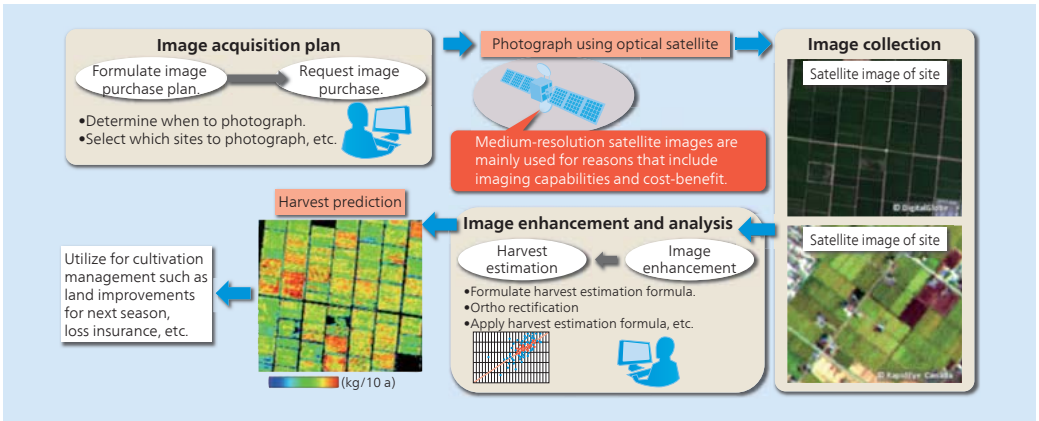
Based on lessons from the Great East Japan Earthquake, there is an urgent need to establish organizations and schemes and provide facilities and systems aimed at mitigating disasters. In particular, in the case of large disasters that affect a wide area and in which the situation changes rapidly with time, it is vital that national and regional agencies, as well as the general public, work together efficiently in order to reduce the amount of damage and speed up the subsequent recovery and reconstruction.

Hitachi already supplies disaster response support systems to central government ministries and agencies as well as local authorities. Currently, Hitachi believes that the best way to ensure national security is by raising awareness through education and training and through wide-area coordination and decision making that takes account of operational concepts in times of emergency. Hitachi is working to expand disaster prevention management solutions intended to achieve this. In the case of large, widespread disasters in particular, a lack of information from the field is an impediment to rapid decision-making. In response to this problem, Hitachi supplies solutions that support ongoing decision-making, including the use of information from sources such as social networking services (SNSs) for rapid situation assessment.

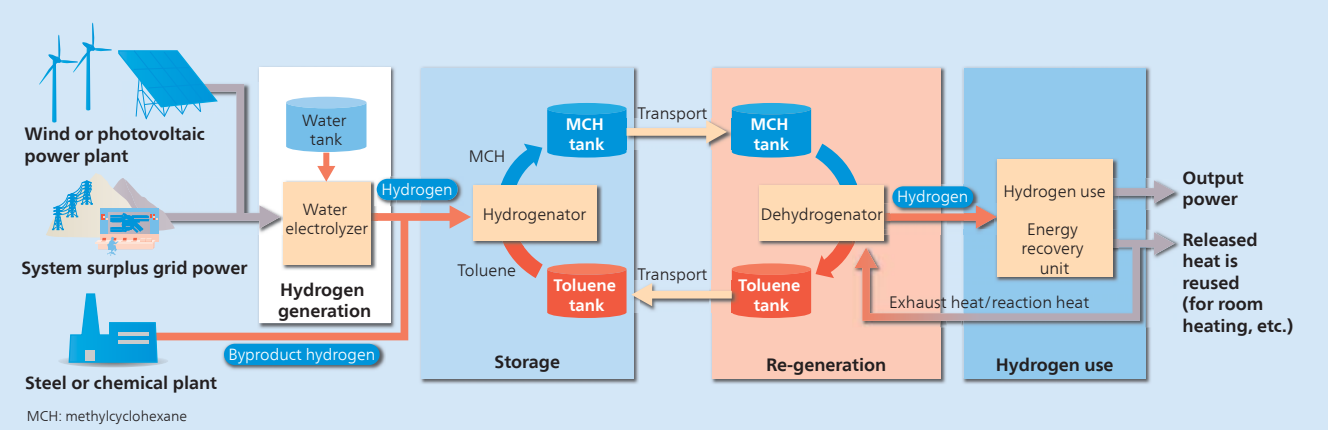
In the future, Hitachi intends to support safety and security in the context of disaster prevention and to contribute to the maintenance of social security through collaborations between national/local authorities, private corporations, and citizens, while also considering the potential for international disaster prevention cooperation.

2 Satellite Imaging Solution for Agriculture

The global population is forecast to peak at more than nine billion



2 Use of satellite images to assess rice harvest volumes



3 Block diagram of carbon-hydride energy storage system

in 2050. Meanwhile, consumption of animal products is also expected to grow, including in emerging economies, and its production requires large amounts of grain feed. For these reasons, the Ministry of Agriculture, Forestry and Fisheries is forecasting a significant increase in global demand for grain.

Images taken by Earth-imaging satellites can be used to monitor large territories, while assessments of harvest volumes for paddy-grown rice made with the benefit of satellite image enhancement and analysis techniques can determine current harvest size. Hitachi is currently looking at introducing such an information service. Hitachi believes that the use of such a service to assist with finding ways to increase rice production will help reduce the imbalance between supply and demand.

In the future, Hitachi intends to use its satellite imaging solutions to help resolve food problems on a global scale.

3 Energy Storage System Using Carbon Hydride

Hydrogen is a difficult fuel to handle. The carbon-hydride energy storage system (CHES) stores hydrogen in the form of the stable liquid methylcyclohexane, thereby making it easy to transport and keep in long-term storage.

To store energy, CHES produces methylcyclohexane by catalytic reaction of hydrogen and toluene, which acts as an energy carrier that is able to be stored and transported. To use the energy, a catalytic reaction splits the methylcyclohexane into hydrogen and toluene, supplying the hydrogen for use as an energy source and allowing the toluene to be reused in future production of methylcyclohexane. As a result, the large-scale long-term storage, transportation, and safe distribution of energy from unstable renewable sources can be achieved by using the electrolysis of water to convert the energy into hydrogen, and then using the hydrogen to make methylcyclohexane.

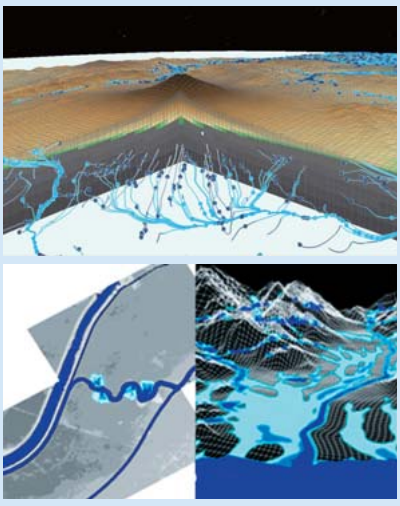
This technology can contribute to wider use of renewable energy, energy self-sufficiency for islands or other remote locations that suffer from high energy supply and transportation costs, improvements in the percentage of Japan's energy supplied domestically, and the realization of a low-carbon society and hydrogen society.

4 Water Cycle Simulation Service

Hitachi is developing a service that assists with water resource management and flood prevention by combining a simulation technique for analysis that fully incorporates both surface water and groundwater with visual representation technology that presents the simulation results quickly and in an easily understood form.

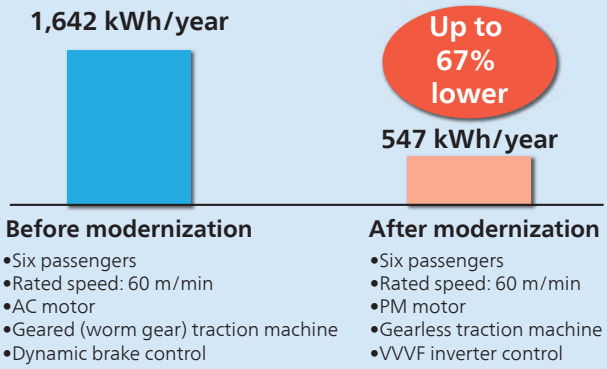
The features of the simulation technique include that it takes account of the interaction between surface water and groundwater, analyzes the movement of contaminants or other material, and supports high-speed computation on a personal computer (PC) cluster. The features of the visual representation technology include highly precise display of large amounts of time-series data on surface and underground conditions, calculation of spatial statistics from the simulation results, and high-speed rendering of data to suit the display scale. By utilizing these features, the service can present situation assessments and highly accurate predictions for water resources or flooding in a form that is easy to understand.

In the future, Hitachi intends to supply the service to help resolve the many global-scale problems associated with obtaining water resources and with flooding.



4 Groundwater flow analysis (top) and flood prediction (bottom) made by water cycle simulation service

Rated load	600 kg	1,000 kg
Rated speed	60 m/min	105 m/min
Rated output	3.7 kW	11 kW
Control system	VVVF inverter control	
Roping	1 : 1	
Traction machine	Gearless traction machine	
Motor	PM motor	
Brakes	Disk brakes	



VVVF: variable voltage variable frequency, AC: alternating current

1 Photograph and specifications of gearless traction machine intended for elevator modernization projects (top), and comparison of power consumption before and after modernization (bottom)

1 Gearless Machine for Elevator Modernization

In response to demand for modernizing the functions and performance of existing elevators that have been in use for many years, and for improving their safety and energy efficiency, Hitachi has adopted a proprietary gearless traction machine which is the key component in Hitachi's Elevator Modernization package.

The main features are as follows.

(1) Enhanced energy saving through the efficiency improvements delivered by use of a permanent magnet (PM) motor and gearless design. Ride comfort has also been improved by using the latest operational control techniques to reduce machine room noise and elevator car vibration.

(2) Unintended car movement protection (UCMP) has become a standard function for improving product safety that works by fitting double brakes on the gearless traction machine.

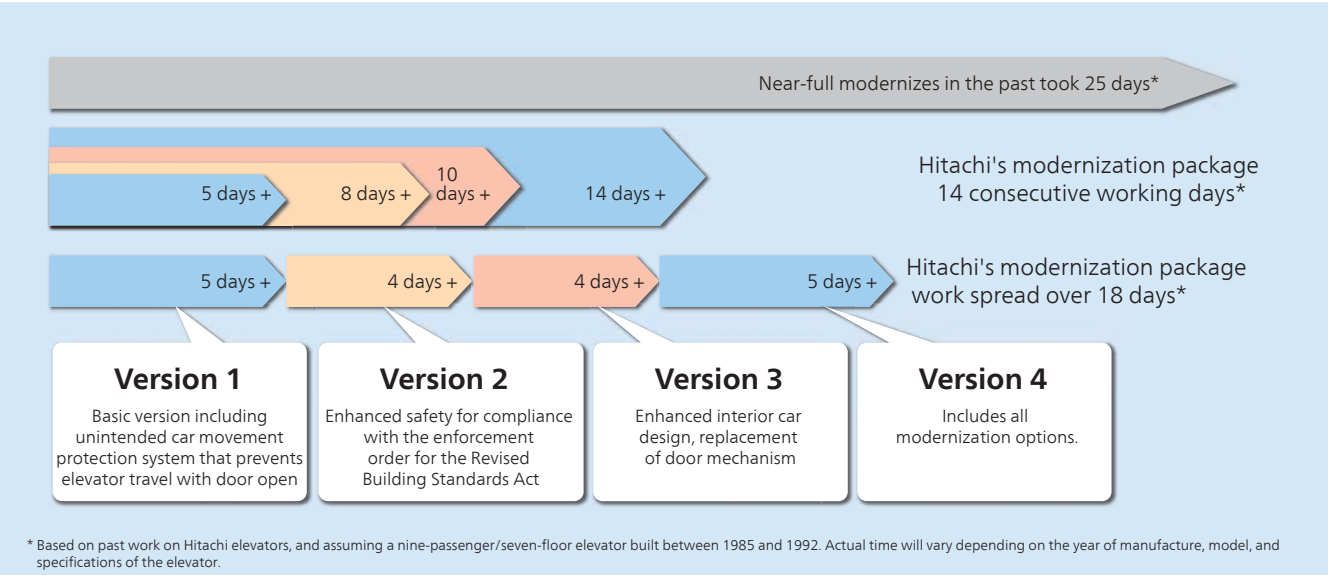
(3) The UCMP system is independent of the main elevator control. The system can quickly detect elevator travel with the door open, even in cases when the drive mechanism or control equipment has failed, and bring the elevator to a halt automatically.

Hitachi intends to continue developing and supplying elevators that keep up with changing requirements.

2 Modernization Package for Compliance with New Elevator Regulations

Hitachi sells a package for modernizing elevators to comply with the new regulations in Japan*. To meet the growing demand for improving the safety of existing elevators, this package uses a highly efficient gearless traction machine and its standard features include an unintended car movement protection system that utilizes the dual-brake design to prevent elevator travel with the door open.

This package is available in four different versions to suit different auxiliary specifications and work schedules. Features supplied by the basic version, version 1, include a function for emergency operation during an earthquake that can detect preliminary tremors, light-emitting diode (LED) lighting, and floor indicators. To comply with the new regulations, version 2 adds earthquake strengthening and a function for automatically



* Based on past work on Hitachi elevators, and assuming a nine-passenger/seven-floor elevator built between 1985 and 1992. Actual time will vary depending on the year of manufacture, model, and specifications of the elevator.

2 Work schedule for a Hitachi's modernization package

landing at the nearest floor in the event of a power outage. Version 3 features enhanced interior design, with ceiling lighting and sheet coverings. Version 4 replaces the entire elevator car with the latest model and is equivalent to a near-full refit.

In terms of work scheduling, version 4 takes 14 consecutive working days to perform a near-full refit, which in the past could take around 25 days. Work can also be split between the different parts of the package to minimize the out-of-service time.

Hitachi also offers the networked building care service for post-modernization maintenance. The service allows the customer to use the internet to change elevator settings or display messages on the liquid crystal displays (LCDs) in the elevator cars.

As demand for elevator modernizes grows, Hitachi intends to continue satisfying diverse customer needs.

(Hitachi Building Systems Co., Ltd.)

(Product release date in Japan: December 2012)

* Compliance with the enforcement order for the Revised Building Standards Act issued in September 2009.

3 Gearless Traction Machine Installation Method

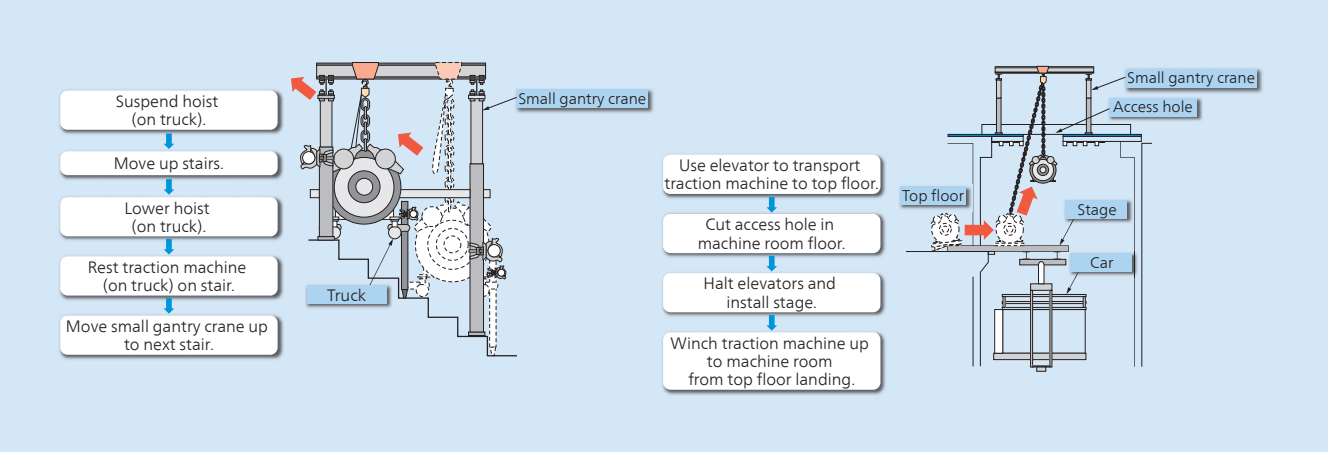
With the brake removed, the gearless traction machine used in a Hitachi's modernization package weighs approximately 450 kg (for the 3.7-kW model). Accordingly, to reduce lifting costs and improve handling, Hitachi has developed two different installation methods to suit different housing conditions.

"Installation via stairway" involves transporting the traction machine up the stairs from the top floor to the elevator machine room. The traction machine is transported up the stairs suspended under a specially designed small gantry crane. At each step, the traction machine is temporarily rested on the stair while the small gantry crane is moved up to the next stair. This is repeated until the top of the stairs is reached. The traction machine is shipped from the factory on this truck so that it can easily be pulled along on the way to the installation site.

"Installation via the elevator shaft" lifts the traction machine up through an opening in the shaft. A stage is placed in the elevator shaft at the top floor and the traction machine is lifted up through an access hole in the machine room floor. This method is suitable in cases when carrying the traction machine in by crane or "via stairway" is not practical.

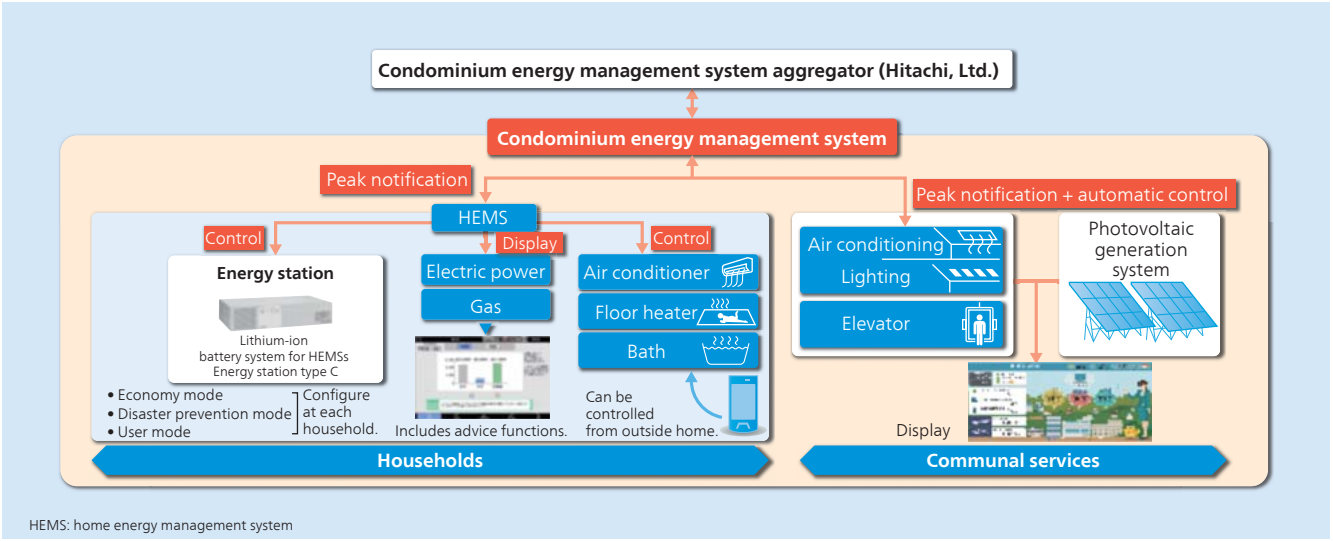
By allowing the work to be performed by elevator installers who do not have specialists such as steeplejacks on hand, these installation methods reduce the cost of lifting the traction machine into place by approximately 30%.

(Hitachi Building Systems Co., Ltd.)



3 Installation via stairway (left) and elevator shaft (right)

Industrial Equipment and Systems



1 Overview of energy management system for condominiums

1 Energy Management System for Condominiums

In addition to providing stress-free ways of saving power at condominiums and other housing complexes, there is also a need to ensure energy supplies during disasters or when electric power is in short supply.

Hitachi has developed a new energy management system for condominiums that uses information and communication technology (ICT) for security and energy saving. In addition to its security functions, the energy management system also presents information on power use and billing. Its control functions cover both communal air conditioning and lighting, and private air conditioners or storage batteries. Hitachi is playing a major role in promoting the adoption of smart condominiums, including being selected, in March 2013, as an aggregator that introduces an energy management system for apartments and provide energy management support services run by the Sustainable Open Innovation Initiative.

In the future, Hitachi plans to expand its condominium energy management system business by drawing on its extensive experience with solutions and systems for condominiums and its cloud-based service platforms.

2 Surveillance Camera Module with New DSP DI-SC221

The DI-SC221 is a full high-definition (FHD) surveillance camera module with a new digital signal processor (DSP). With functions that include ×20 optical zoom and auto-focus, the camera uses

2 Input image (left) and output image enhanced using enhanced intensity (right)

the combination of a new DSP and sensor to deliver crisp images and significantly improve image quality under low lighting condition, a feature for which there is strong market demand.

The camera module also has a new "enhanced intensity" feature. This enhances the brightness of darker parts of the image to produce a bright image even under low lighting condition. Whereas a tendency for bright regions to become over-bright has been a problem with past intensity enhancement techniques, the new function minimizes changes in the intensity of bright regions. Potential applications include urban surveillance and traffic monitoring.

Along with promoting enhanced intensity and the defog function developed and introduced during FY2012 as examples of the image enhancement functions that are a feature of Hitachi surveillance camera modules, Hitachi also intends to continue to develop new functions.

3 Smart Next-generation Factories

As progress is made on improving the energy efficiency of manufacturing plants to help create a low-carbon society, interest is being directed at the use of renewable energy or otherwise unused energy sources. Hitachi is currently working on a variety of developments based on the concept of smart next-generation factories with the aim of making manufacturing plants more advanced, including through energy management practices that use renewable energy.

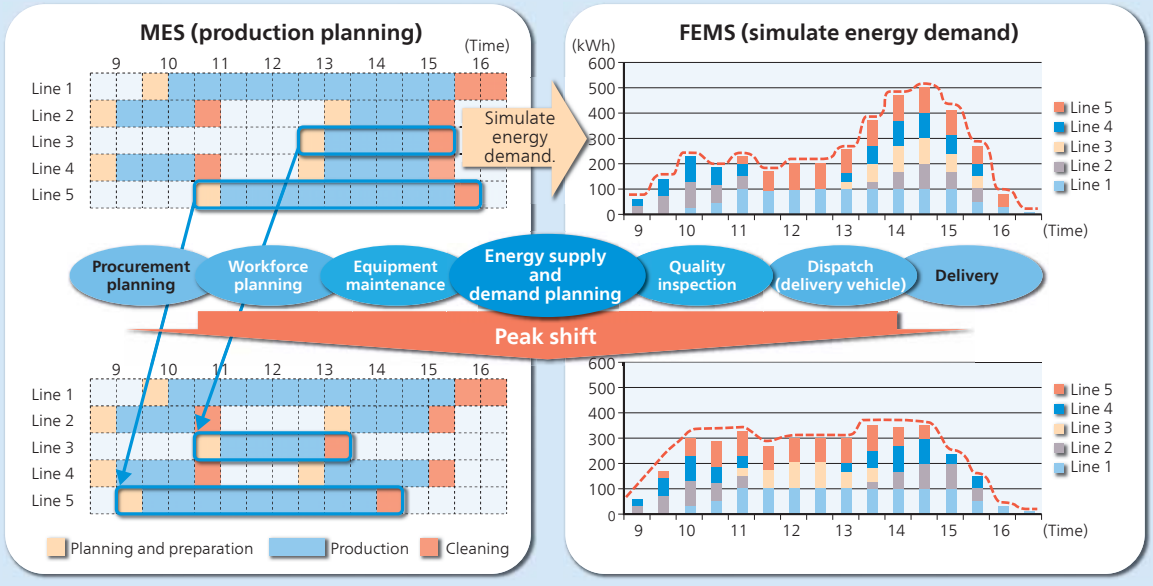
The aim is to make manufacturing systems, such as production equipment and workplaces, highly efficient by seeking to use production information made available through a manufacturing execution system (MES) or other method to eliminate waste. Delivering a high level of energy management in these production processes requires a factory energy management system (FEMS) that can integrate manufacturing systems with utilities such as electric power and heat. Based on the production plans or demand forecast for the manufacturing system, the FEMS controls supply and demand of each type of energy in order to minimize the plant's energy consumption per unit of production. This achieves low-cost operation by saving energy and shifting peak demand.

By integrating and coordinating these production and energy supply plans, Hitachi is seeking to achieve overall optimization of production and energy.

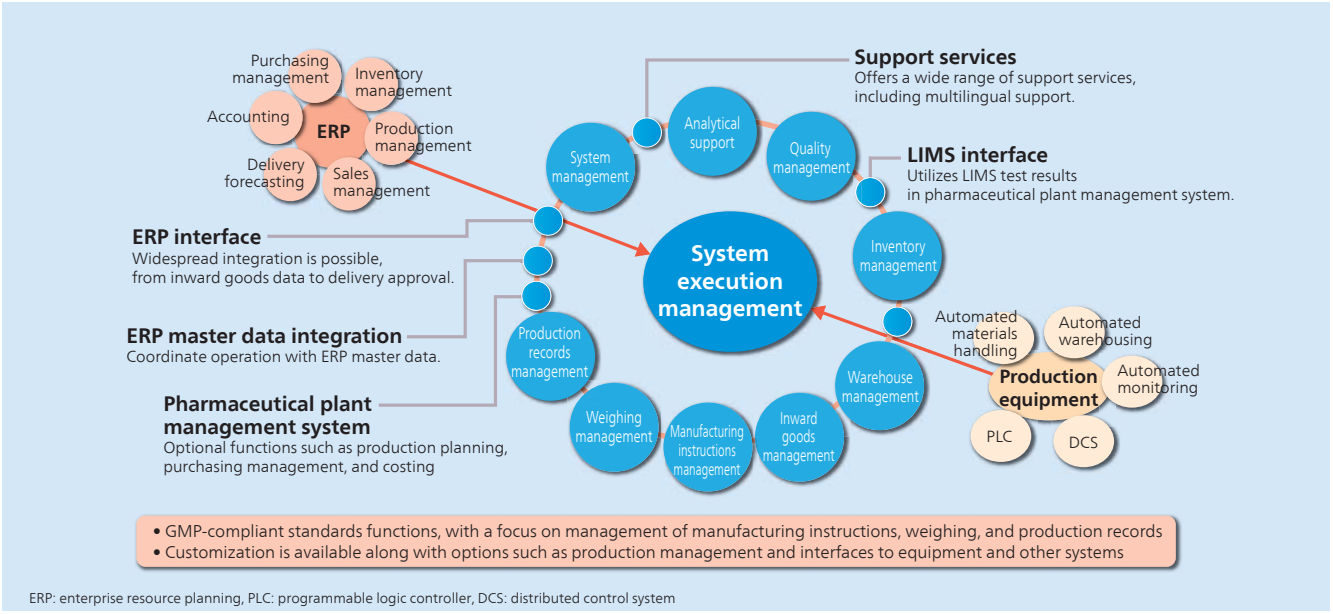
4 Globalization of Pharmaceutical Plant Management System

The pharmaceutical plant management system is an MES package that supports the manufacture of high-quality pharmaceuticals and complies with the good manufacturing practice (GMP) rules demanded by the global market. Since it was first installed in 1994, the system has been recognized as a top class product in Japan, with more than 130 systems having been supplied to approximately 70 companies, and with applications that cover a diverse range of manufacturing processes, including bulk drugs, solid and injectable preparations, and medical equipment.

With recent years having seen numerous instances of adverse drug reactions or sales of counterfeit medicines, particularly in certain emerging economies, there has been an acceleration in measures that treat the safety and security of the pharmaceutical market as a high-priority matter of national policy and seek to restore trust. Furthermore, with overseas companies exerting an increasing presence in the market, business opportunities will increase in the future. Given these circumstances, Hitachi is drawing on its in-house strengths, which include validation consulting, together with the extensive functions of its application packages developed in Japan, and is working in collaboration with local partners to adapt its systems for overseas markets. In the future, Hitachi aims to supply integrated solutions to the pharmaceutical manufacturing industry that are based around this pharmaceutical plant management system but also integrate



3 Peak-shift optimization of electric power through coordination with production planning (MES)



ERP: enterprise resource planning, PLC: programmable logic controller, DCS: distributed control system

4 Functional overview of pharmaceutical plant management system

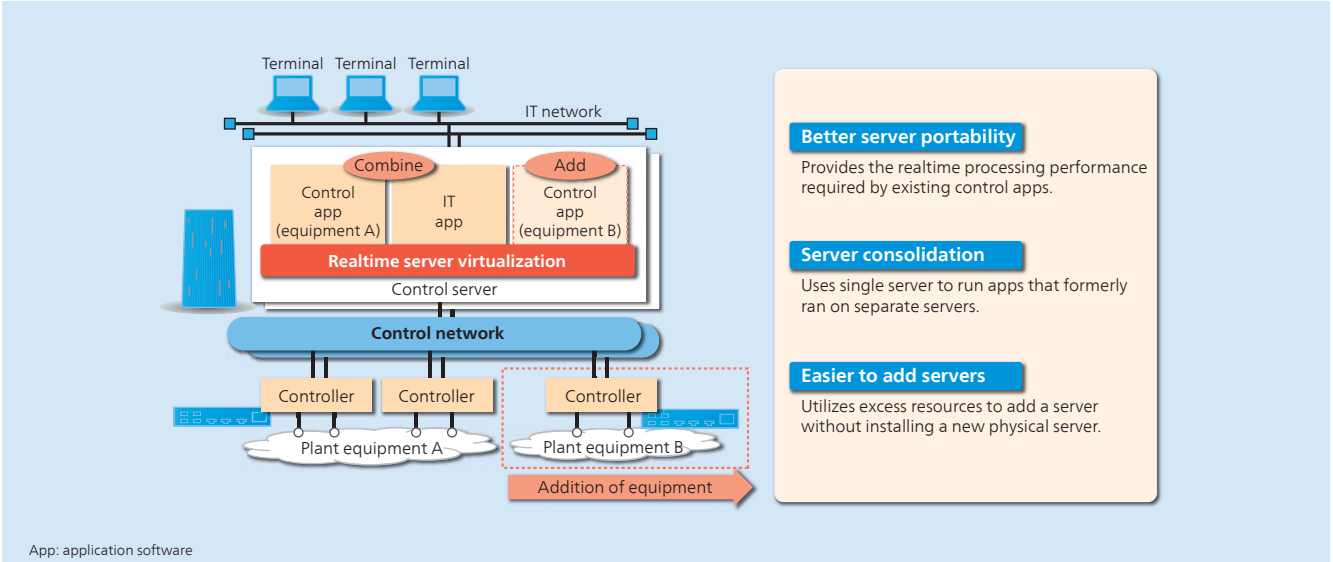
with plant equipment and with the other systems that operate in tandem with an MES, such as laboratory information management systems (LIMSs) and supervisory control and data acquisition (SCADA) systems.

5 Realtime Server Virtualization

Featuring long-term product availability and high reliability, RS90 series control servers are used in information and control systems in a wide range of industries, including power generation and steel manufacturing. With systems in Japan having become increasingly larger in recent years, the challenge has been to extend the life of software to control maintenance costs and keep up with rapid advances in hardware and operating systems (OSs). In emerging nations and other overseas markets, meanwhile, there is demand for systems that can be installed on a small scale and then progressively expanded. Server virtualization (running a number of virtual servers on one physical server) has been adopted as a response to these needs. This makes software more portable when servers are upgraded and facilitates the adding of additional servers or their consolidation.

Delivering realtime processing performance is a problem for the server virtualization used for conventional information technology (IT) systems, which is prone to delays in software execution due to competition for resources between the multiple virtual servers running concurrently. A new technique for realtime server virtualization developed by Hitachi minimizes execution delays and ensures realtime performance by providing mechanisms for the virtual servers to reserve exclusive access, at the logical level, to the resources they use. In response to the problem whereby the hosting of multiple virtual servers makes fault analysis more complex, Hitachi has added functions such as operational trace and operation monitoring mechanisms that provide a comprehensive assessment of the operation of each virtual server and shorten the time taken from detecting to resolving a fault.

In the future, Hitachi intends to continue expanding the range of applications for this technology by improving its reliability and making it easier to operate and maintain.



App: application software

5 Example application of realtime server virtualization for control servers

6 Battery charging and discharging unit with autonomous output function

6 50-kVA/100-kVA Battery Charging and Discharging Unit with Autonomous Output Function

Energy storage is recognized as an important aspect of smart energy systems. Hitachi's new series of 50-kVA and 100-kVA battery charging and discharging units can be connected to a variety of different storage batteries. Applications include cutting or shifting peak demand for electric power and business continuity planning (BCP).

The main features are as follows.

(1) Charging and discharging is performed in response to commands from a supervisory controller. Flexible systems can be configured for applications such as peak cutting or shifting.

(2) Can be used with a variety of different battery types, including lead-acid and lithium-ion batteries*.

(3) Autonomous operation function suitable for BCP applications (including three-phase three-wire output option)

(4) Complies with grid connection rules [JEAC (The Japan Electric Association) 9701-2010].

This series can play a central role in smart energy systems.

(Hitachi Industrial Equipment Systems Co., Ltd.)

* Requires consultation on battery specifications prior to purchase.

7 Amorphous Transformer

As of April 2014, Hitachi's 6-kV distribution transformers will become "Top Runner 2014 Transformers" that comply with the stage II criteria for "specified equipment" transformers, as defined under Japan's Energy Saving Act (the Act on the Rational Use of Energy). Along with this, Hitachi also plans to use amorphous transformers for some of its standard oil-filled models.

Despite an increase in transformer weight resulting from enlarging the wire cross-section and changing the materials used in order to reduce losses to comply with changes to the criteria, Hitachi has succeeded in reducing the winding size by using heat-resistant paper that allows the permitted windings temperature to rise by 10°C under revisions to the Japanese Industrial Standards. Furthermore, by using an amorphous alloy for the core, Hitachi has reduced no-load losses by approximately 70% and taken advantage of the lower losses to minimize material use. Also, optimization of manufacturing practices to suit the new amorphous alloy*1, which features a high saturation magnetic flux density, has increased the design magnetic flux density by approximately 5% and reduced the size of the core. Together with a compact winding technique with a high resistance to short circuits, changes to the core structure have also made the transformer 15% lighter, making its weight roughly equivalent to current Top Runner transformers*2.

7 Amorphous oil-filled distribution transformer

Hitachi has already expanded its product range to include Scott-type mold transformers, step-up transformers for photovoltaic power generation, and extra-high-voltage transformers. To these, Hitachi has now also added standard 6-kV oil-filled transformers, one of its major product lines, to expand further the applications for amorphous transformers.

(Hitachi Industrial Equipment Systems Co., Ltd.)

(Date of initial production: January 2014)

*1 2605HB1M supplied by Hitachi Metals, Ltd.
*2 For a 1,000-kVA three-phase oil-filled transformer

8 Three-phase Induction Motor that Complies with Top Runner Program

Amid growing demand for energy savings, various nations are adopting efficiency standards to improve the efficiency of electric motors, which are responsible for about 40% of total power consumption. In Japan, electric motors will come under the Top Runner standards from FY2015. This will oblige manufacturer to supply motors that meet the IE3 standard*.

In response, Hitachi has pre-empted the regulations and has been supplying 55-kW and smaller models in its series, which comply with the premium efficiency standard, since January 2013. Through measures that included the use of electromagnetic

8 Three-phase induction motor that complies with Top Runner criteria (3.7 kW, 4P)

9 Inline (left) and end-suction (right) models of pump

field analysis to optimize the design and cooling and structural optimization, Hitachi has produced motors with IE3-equivalent efficiency while maintaining the same mounting dimensions.

By combining these energy efficiency improvements with greater reliability achieved by upgrading the thermal class of the motors, and by offering frame variations to make the motors easier to install, Hitachi is responding to increasingly diverse requirements.

(Hitachi Industrial Equipment Systems Co., Ltd.)

* The premium efficiency class, as defined in the International Electrotechnical Commission (IEC) 60034-30 standard

9 Pump Incorporating PM Motor with Built-in Controller

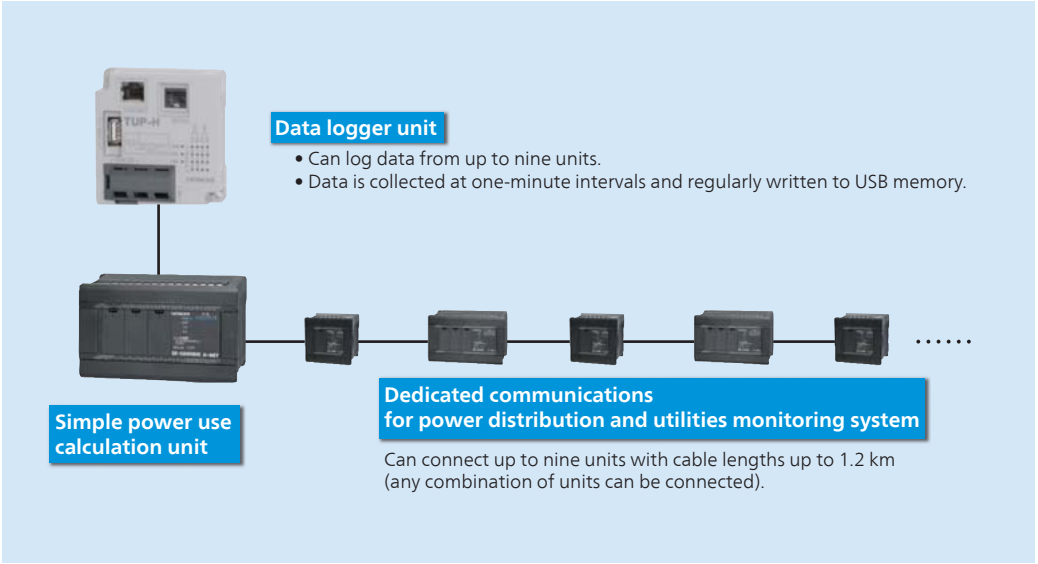
Use of an inverter to control motor speed is an effective technique for improving the energy efficiency of pumps. There is also a trend toward using more efficient permanent magnet (PM) motors in place of induction motors. However, because PM motors are a form of synchronous motor and therefore require a control system, they need both a controller and a control panel to house it.

Designed to satisfy requirements for energy efficiency and small size, the newly developed pump incorporates a PM motor with a built-in controller. The controller is attached to the PM motor housing and includes control panel functions (such as dealing with harmonics and electrical noise). Also, the pump is made as monoblock outdoor installation type to realize more environmentally resilient control and motor parts. To facilitate upgrade projects, the pump unit has dimensions that are compatible with those of previous motors. Incorporating a built-in controller board with input and output terminals and proportional-integral-derivative (PID) control software that is included as a standard feature, pressure signal inputs can be used by the pump to perform constant-pressure control of its own outlet pressure.

(Hitachi Industrial Equipment Systems Co., Ltd.)

10 Simple Energy Monitoring System

Against a background that includes the enactment of the April 2010 revisions to the Energy Saving Act and the power shortages that followed the Great East Japan Earthquake, there is an urgent need for reductions in energy consumption. In particular, small and medium-size enterprises are experiencing growing demand to make devices smaller and to use connections between diverse devices for automatic control of air conditioning, lighting, and



10 Simple energy monitoring system

other appliances.

To support energy efficiency, Hitachi has already developed and released the Hitachi power distribution and utility monitoring system. Along with the addition of the Modbus*/remote terminal unit (RTU) protocol in July 2011 to add support for a common communication standard, Hitachi has now also made the system smaller (37% of previous system) in response to customer needs over recent years. In October 2013, Hitachi went on to release a simple energy monitoring system using a data logger and universal serial bus (USB) memory to allow the configuration of systems that are simpler than Hitachi power distribution and utility monitoring system. The data logger can collect data from up to nine measurement units and periodically store the collected measurements on the USB memory at one-minute intervals. A 4-Gbyte USB memory is capable of storing an year's worth of data.

(Hitachi Industrial Equipment Systems Co., Ltd.)

* See "Trademarks" on page 142.

11 Inverter Designed for Use with PM Motors

Developments such as the revisions to the Energy Saving Act in April 2010 and motor efficiency standards (IEC 60034-30) have resulted in inverters being used as a way of saving energy in a variety of sectors. With the prevention of global warming and the creation of a low-carbon society being a challenge for emerging economies as much as developed ones, demand for energy efficiency measures in emerging economies looks likely to lead to even wider use of inverters. The growth of these needs is behind demand for inverters capable of driving both induction motors (IMs) (the typical type of asynchronous motor) and PM motors (the typical type of synchronous motor).

The high-performance, small-capacity WJ200 series was developed for this purpose and has built a strong reputation since being released in 2010. Hitachi also plans to support PM motor drive in its high-performance SJ700 series and small-capacity/low-cost NE-S1 series models. These inverters will be able to drive the small, lightweight EHM1 series and the EHM2 series PM motors from Hitachi as well as PM motors from other suppliers. The EHM2 series of PM motors are intended as IM motor replacements and have the same housing design.

(Hitachi Industrial Equipment Systems Co., Ltd.)

12 New Oil-free Screw Compressors

With a high priority being placed on environmental and energy efficiency measures throughout the world, Hitachi has an extensive range of new oil-free screw compressors (22 to 240 kW) to meet these needs.

The main features are as follows.

(1) Improved efficiency and reliability through use of a specialty stainless steel with excellent corrosion resistance and durability in the first and second stage rotors of the newly developed air end. A special coating is also used along with precision grinding of the teeth surfaces. The variable speed drive also improves energy efficiency, with features that include a proprietary capacity control mechanism.

(2) The compressed air cleanliness satisfies class zero, the highest class in the ISO8573-1:2010 standard. This means that, in addition to conventional industrial applications in the food, pharmaceutical, or electronics industry, the compressors can be used in applications that require a reduced risk of contamination or environmental load.

(3) Quieter operation achieved through development of a new air end with low noise and high efficiency together with enhanced anti-vibration performance in the air end drive and cooling systems.

(Hitachi Industrial Equipment Systems Co., Ltd.)

NE-S1
(small-capacity,
low-cost model)
Support for PM motors is planned.

WJ200
(small-capacity,
high-performance model)
Already supports PM motors.

SJ700
(medium/high-capacity,
high-performance model)
Support for PM motors is planned.

11 Inverters for PM motors

12 Hitachi's range of new oil-free screw compressors (22 to 240 kW)

13 New Series of PM Motors

With growing demand for energy savings to prevent global warming, there is a particular need for higher efficiency in the motors that account for approximately 40% of all power consumption. This has led to greater standardization, with the JIS C4034-30 efficiency standard for induction motors defining the IE3 premium efficiency standard. There are also plans to add a definition of IE4 super-premium efficiency that will assume the use of PM or other high-efficiency motors.

Hitachi has now developed a series of new PM motors that comply with the IE4 standard (3.7 to 55 kW, 1,500 min^{-1}). Like the existing 1,800-min^{-1} series, the new models are compatible with the induction motor frame numbers and feature smaller external fans and use of electrical steel with low iron loss for higher efficiency.

The main features are as follows.

(1) Complies with IE4 motor efficiency standard.

(2) Compatible with induction motors (same motor frame numbers)

Hitachi is currently working on the development of larger motors and high-efficiency motors with new structural designs that use amorphous alloy.

(Hitachi Industrial Equipment Systems Co., Ltd.)

14 IEC 61131-3 Compliant Compact PLC

The newly developed series are an addition to the existing range of PLCs that include Ethernet ports in their standard features and have earned a strong reputation for their ability to use USB memory for program updates. They also comply with the IEC 61131-3 international standard for PLC programming languages.

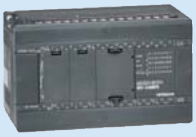
The new PLCs use the CODESYS* integrated development environment as their IEC 61131-3 platform, as do the series of module PLCs currently under development that will also comply with the IEC standard. CODESYS includes extensive editing functions that provide graphical assistance for program coding, and a wide range of debugging functions including sampling trace and offline simulation.

With systems and mechanical equipment becoming larger and more complex due to growing use of PLCs, this is creating a need for higher software productivity to reduce costs and improve quality. Meanwhile, because manufacturers are moving production to overseas sites, PLCs are being used in many different countries and regions and by engineers with varying skill levels from a variety of different industries. This is why the new series offers an internationally standardized programming language that suits different applications and skill levels.

(Hitachi Industrial Equipment Systems Co., Ltd.)

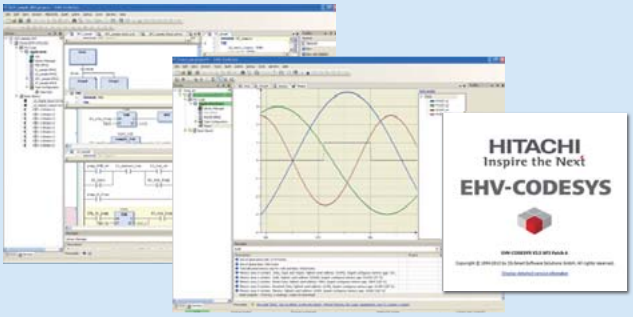
* See "Trademarks" on page 142.

13 New series of PM motors (3.7 to 55 kW, 1,500 min^{-1})



PLCs (40 I/O points)

PLCs (64 I/O points)



Integrated development environment (programming software)

I/O: input/output

14 Series of IEC 61131-3 compliant compact PLCs

15 Wireless Monitor Wireless Temperature Monitoring System

The wireless monitor wireless temperature monitoring system uses platinum (Pt) sensors to record temperatures with high accuracy (±1°C) over a wide range (–200 to 500°C).

Applications such as the processing or storage of pharmaceuticals or food require not only precise temperature management but also management of dust and other interior environmental factors, and this can raise problems when new equipment is installed as part of plant upgrades. With this new system, however, the use of wireless communication simplifies the installation of temperature monitoring systems at sites where this would have been difficult in the past due to the need to run cables. Also, the combined use of the 2.4-GHz low-power band and 429-MHz specified low-power band allows the sensor units to use battery power and extends the transmission range to access points. Wireless monitor is designed with system configuration in mind. In addition to the logging of temperature data, it also has a function to generate an alarm in the event of an abnormal temperature reading.

Along with the development of other products such as 920-MHz wireless devices and analog input interfaces, Hitachi is making it possible to configure wireless network systems suitable for an even wider range of uses.

(Hitachi Industrial Equipment Systems Co., Ltd.)

15 Remote unit with temperature sensor (left) and access point (right) for wireless monitor wireless temperature monitoring system

16 New Multi-function Coding Verification Machine

The inspection of date of production, use by date, and lot number labeling is becoming increasingly important in food, pharmaceutical, and other manufacturing industries for reasons of legal compliance and traceability. Hitachi supplies coding verification machines to meet future market requirements.

The newly developed MC-20S is a multi-function coding verification machine that extends Hitachi's existing lineup. It includes the adjustable matching function provided for inspection of inkjet printing.

The main features are as follows.

(1) Includes support for color cameras and has a built-in standard white light-emitting diode (LED) strobe, with standard functions that are suitable for inspecting text printed on surfaces such as the paper or plastic packaging widely used in the food and pharmaceutical industries.

(2) Supports user configuration of settings for the products to be inspected, with simple adjustment, recommended setting, and focusing and aperture adjustment functions.

(3) Suitable for user-specific environments, with standard position, rotating inspection, and identification of tilted text.

(4) Multi-lingual support (further languages to be added) and designed for export.

(Hitachi Industrial Equipment Systems Co., Ltd.)

16 MC-20SJ coding verification machine

17 New ADV series servo amp (with EtherCAT support)

17 New ADV Series of Servo Amps

The ADV series are a new range of servo amps that meet market demand for even higher performance in machine tools, industrial robots, semiconductor production equipment, and other machinery. They achieve a speed control response frequency of 2.2 kHz through use of a high-speed microcontroller and new dedicated current controller integrated circuit (IC) that allow cycle times for speed control and current control that are approximately 50% shorter than previous models from Hitachi. The newly released products are a 200-V-class model for applications up to 750 W and a 100-V-class model for up to 400 W.

The main features are as follows.

(1) More compact dimensions for mounting in control panels due to a thin-profile design that can be installed side-by-side without a gap between amps.

(2) Shortening high-speed positioning times is made easier by improvements to the auto-tuning function for determining control parameters and the moment of inertia of the load.

(3) Incorporates a safe torque-off (STO) function that complies with European Norm (EN)/ISO 13849-1 Cat. 3 PL d and EN 61800-5-2 safety integrity level (SIL) 2 functional safety requirements to facilitate the certification of machines that use the servo amp under European machinery ordinances.

(4) Multi-axis motion systems can be configured using models that support the EtherCAT* open network standard that allows high-speed synchronized control.

(Hitachi Industrial Equipment Systems Co., Ltd.)

* See "Trademarks" on page 142.

18 Hitachi Positioning System for Mobile Robots

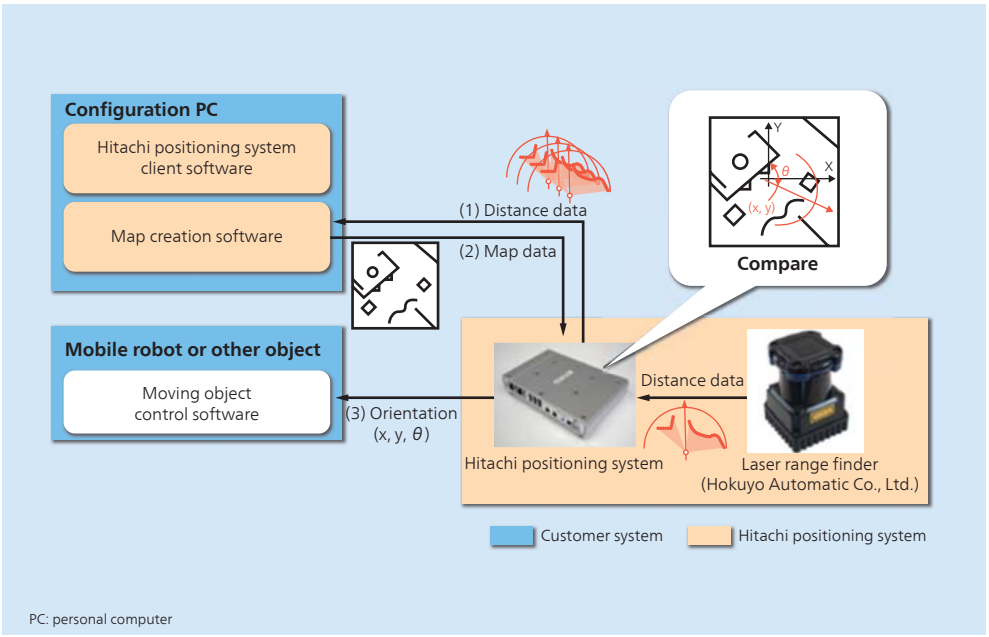
The image collecting Hitachi data acquisition system uses laser range finder to detect the position of a moving object. It can generate maps both indoors and outdoors, and then perform positioning (detect the position and orientation of the sensor on the map).

The first step is to generate the map. This uses a log of the distance data collected by the laser range finder. Because these distances are the only data that the system requires, the user can survey a route simply by moving along it using a hand trolley or similar. The map creation software in the positioning system then transforms this collected data into a map. As a result, the time taken to map a region of 50 m × 50 m, for example, to an accuracy of about 2 cm is a mere 30 minutes from surveying to map creation.

Next, map and distance data are compared to determine the position and orientation of the moving object. While considerable computation is required for accurate positioning, Hitachi has developed an algorithm that can perform precise map matching with a reduced computational complexity. It achieves an accuracy of ±50 mm and ±3° with an output cycle time of 25 ms.

In addition to positioning for moving objects such as autonomous mobile robot, the system is also suitable for map-based applications.

(Hitachi Industrial Equipment Systems Co., Ltd.)



18 Block diagram of Hitachi positioning system

OLED production system

Film assembly equipment

Micro-ball printing system for semiconductor packaging

19 Production equipment for advanced electronic components

19 Production Equipment for Advanced Electronic Components

Recently, smartphones and tablets have grown so rapidly to almost replace PCs. This growth is mainly due to the progress of the production equipment technology, which has realized the high-resolution thinner display, and high-density component mounting for higher performance of the device.

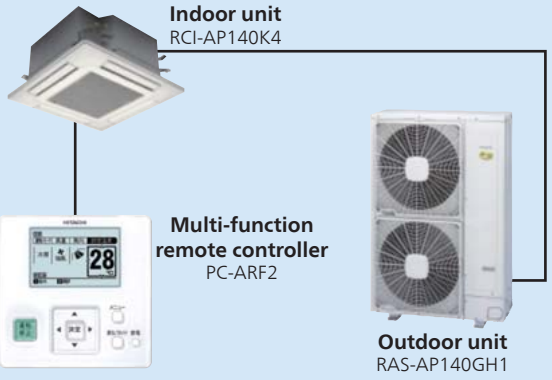
As the production equipment for the mobile devices is required to have the advanced performance and the solutions for the further progress, Hitachi has recently developed precision printing technology, and film assembly technology for flexible devices, such as organic light emitting diodes (OLED) display and lighting, and semiconductor packaging.

From now on, Hitachi will continue to develop high productivity production equipment to contribute to the progress of the advanced electronic devices.

20 Energy-efficient Premium Series of Highly Efficient Packaged Air Conditioners for Shops and Offices

For the updated model range of its energy-efficient premium series of highly efficient packaged air conditioners for shops and offices, Hitachi has simultaneously developed a new outdoor unit, 4-way cassetted type indoor unit, and multi-function remote controller.

In addition to optimizing the over-compression regulator, Hitachi also developed a new compressor with enhanced



20 14.0-kW model of energy-efficient premium series of highly efficient packaged air conditioners for shops and offices

mid-range performance, and a new propeller fan with improved efficiency achieved by using computational fluid dynamics (CFD) to optimize the blade shape. As a result, when used in conjunction with 4-way cassetted type indoor units, the models ranging from 4.0 kW to 28.0 kW satisfy the 2015 standards specified in Japan's Energy Conservation Law, which are defined in terms of the annual performance factor (APF) energy efficiency rating. The new system reduces annual energy consumption by approximately 50% compared to Hitachi's previous fixed capacity model released about a decade ago (comparison based on 14.0-kW model). A variety of new functions have been added to help save power, including controlling the capacity of the outdoor unit, and the power saving modes can be selected and configured easily from the multi-function remote controller. The multi-function remote controller also presents information on energy savings by displaying graphs and tables on its screen that show indicative values of parameters such as power consumption and carbon dioxide (CO_2) emissions, and that provide comparisons with past data such as the previous day.

(Hitachi Appliances, Inc.)

21 Spot Cooling System for Data Centers

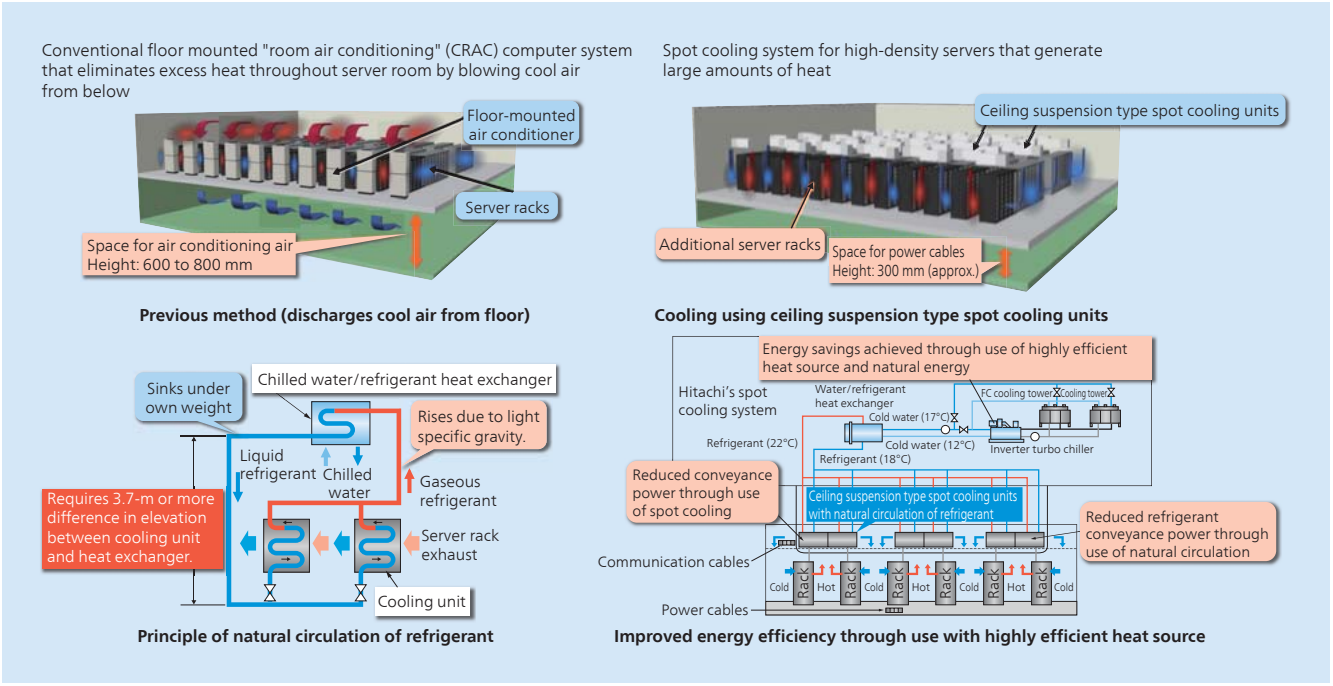
Compared to past computer room air conditioners* (CRACs), Hitachi's spot cooling system for data centers delivers significant energy savings, provides more room for server racks, and minimizes under-floor space requirements.

Conventional systems have installed air conditioners on both sides of server racks, cooling them by discharging the cool air supplied by the air conditioners from under the floor. In contrast, Hitachi's system uses spot cooling units that are suspended from the ceiling above the servers. This provides the following benefits.

(1) The shorter path for cool air circulation reduces pressure loss and allows a fan with a significantly lower power to be used.

(2) Provides room for more server racks to be installed using the space that was previously taken up by underfloor air conditioning units.

(3) Height of underfloor space can be made smaller because, unlike previous systems, Hitachi's spot cooling system does not pass cool air under the floor.



21 Hitachi's spot cooling system

It also uses a cooling system with naturally circulated refrigerant. This works by the liquefied refrigerant being heated and then vaporized in the cooling units by the heat from the servers, causing it to flow up the riser pipe due to its lower specific gravity until it reaches the chilled water/refrigerant heat exchanger. The refrigerant is then cooled and condensed by the chilled water in the heat exchanger, after which its higher specific gravity causes it to return to the cooling unit by gravity. This results in the natural circulation of refrigerant without the need for a pump or other external driving force.

When combined with highly efficient heat sources such as inverter turbo chillers or free cooling (FC), the spot cooling system can save up to 60% of total system energy consumption.

* An air conditioning method that cools the entire server room by discharging cool air from the floor.

22 Hyper Hydrogen Compressor for Hydrogen Refueling Station

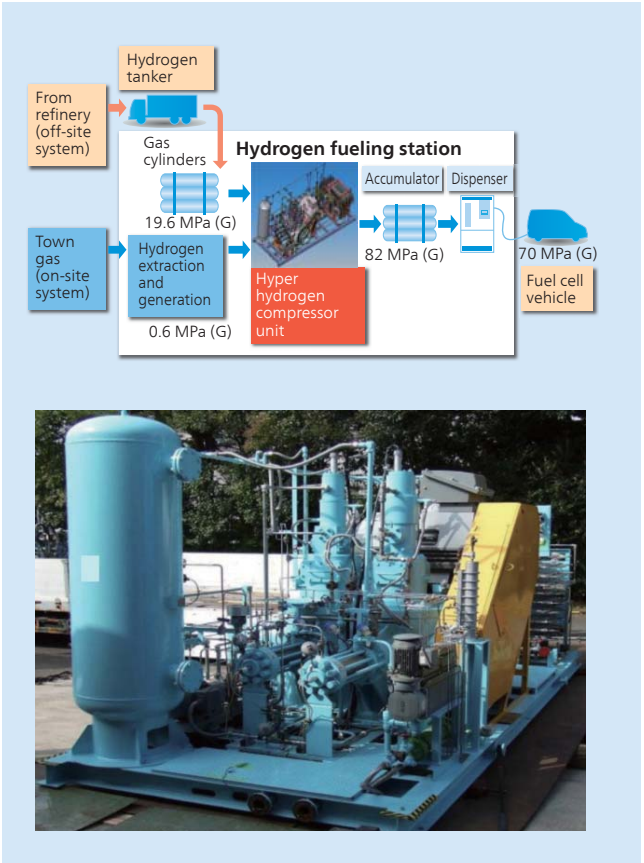
Hitachi has delivered hyper hydrogen compressors to JX Nippon Oil & Energy Corporation for use in hydrogen refueling stations.

To help prevent global warming, fuel cell vehicles, which do not emit carbon dioxide gas (CO_2), are anticipated to enter widespread use worldwide. Fuel cell vehicles run on hydrogen gas, making them an alternative to fossil fuel. In Japan, automotive manufacturers have targeted 2015 as the date for commencing sales of fuel cell vehicles to the public. In order to promote use of fuel cell vehicles, the Japanese government plans to construct 100 hydrogen fuel gas stations in Japan by 2015. At these stations, compressors that handle flammable pure hydrogen and discharge hydrogen at hyper pressure (82 MPa) will be installed to supply the fuel gas to vehicles.

The most reliable and safe machines are essential for this application. Hitachi has been supplying medium-large hyper compressors with a delivery pressure of 343 MPa of ethylene for over 40 years. Based on this hyper compressor technology, Hitachi has also been developing state-of-the-art hyper hydrogen compressors for several years with the assistance of government funding.

The special features of the hyper hydrogen compressors are as follows.

(1) Sliding parts that achieve high reliability and long life through the injection of lubricant into the compressor. The quality of discharged hydrogen gas is guaranteed to satisfy the ISO-14687



22 Process flowchart for hydrogen fueling station (top) and hyper hydrogen compressor (bottom)

standard.

(2) Compact frame construction achieved by the development of a special crank mechanism. The same technology is utilized in the hyper ethylene compressor.

(3) High level of safety and reliability achieved by the adoption of materials to comply with Japan's latest High Pressure Gas Safety Law. This law specifies which materials are to be used to avoid hydrogen embrittlement based on joint research by government authorities and relevant universities.

(4) High reliability was demonstrated by a full load test that involved repeated loading and unloading of gas under actual conditions.

Hitachi intends to work actively on developing hydrogen compressors in anticipation of growing requirements for infrastructure to encourage wider use of fuel cell vehicles.

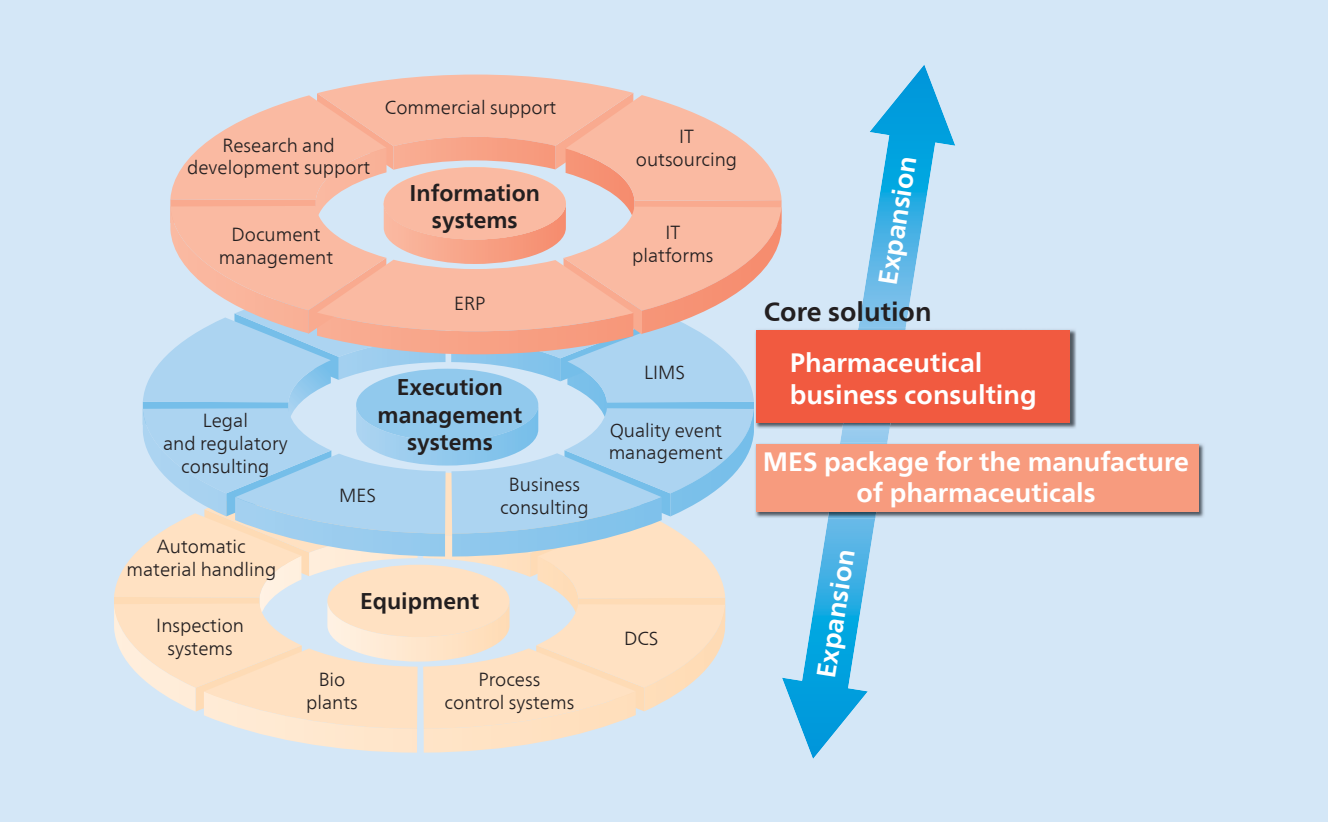
23 Pharmaceutical Manufacturing Solution for China and India

Since the 1990s, Hitachi has been helping pharmaceutical manufacturers ensure high quality and improve business efficiency through the provision of business improvement consulting and by building manufacturing equipment and systems. In particular, Hitachi has released its MES package software and supplied more than 130 installations to about 70 companies, mainly in Japan.

Asia currently has a high profile in the pharmaceutical manufacturing market, with China and India in particular experiencing rapid annual growth of 10% or more. It is anticipated that the size of these two markets will be the second and seventh largest respectively in the global market by 2015*. Hitachi is proceeding with the establishment of its own business by utilizing its extensive industry experience with MESs and its business improvement consulting to gain a foothold in these growth markets. It has had dedicated teams stationed in China (Beijing) and India (New Delhi) since 2012, and has commenced engineering work in partnership with local companies.

In the future, Hitachi intends to extend its solutions beyond control systems and manufacturing equipment for pharmaceutical product manufacturing processes to also include information systems, and to expand the services it offers progressively from consulting to system configuration and after-sales support.

* Source: IMS Market Prognosis (May 2012)



23 Solutions for pharmaceutical industry

Plant and Factory Equipment

1 Pickling line and tandem cold mill at Ternium Mexico S.A de C.V

1 Ternium Mexico S.A de C.V Pickling Line and Tandem Cold Mill

The pickling line and tandem cold mill (PL-TCM) supplied to Ternium Mexico S.A de C.V of the United Mexican States has commenced commercial operation and is operating. In addition to its main purpose of producing automotive sheet steel, the plant is also capable of producing a wide range of other steel grades, including electrical and high strength steels.

The plant control system includes Hitachi's plant controller capable of high-speed computing, insulated-gate bipolar transistor (IGBT) drives with high performance and capacity, and process input/output (I/O) equipment and small and medium-capacity drives supplied by a North American vendor. During site commissioning, Hitachi's system integration capabilities and past experience and know-how ensured that product quality requirements were met along the entire strip length, and helped commence commercial operation ahead of schedule. Hitachi also utilized local electrical suppliers in the commissioning work so that they could act as a local point of contact after the plant entered operation and to ensure comprehensive after-sales service.

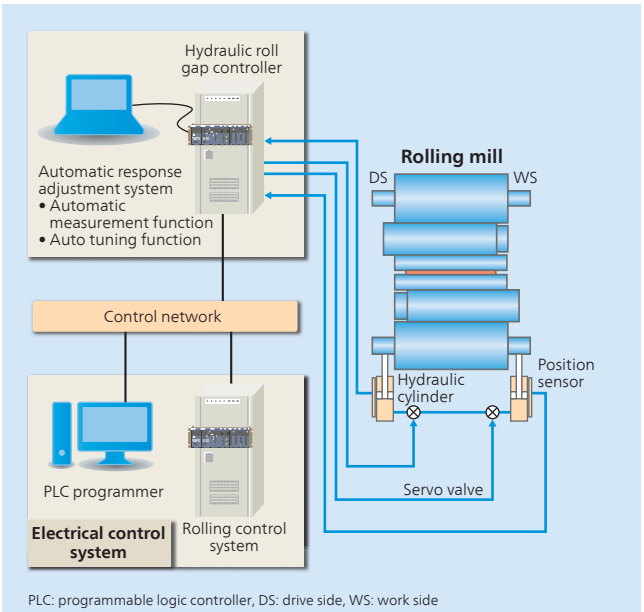
In the future, Hitachi intends to undertake further work in the Central and South American markets.
(Commencement of commercial operation: August 2013)

2 Automatic Response Adjustment System for Hydraulic Roll Gap Controller

Improving strip thickness accuracy and maintaining stable operation are key challenges for rolling mills, and adjusting the response of their hydraulic roll gap controller is a critical aspect of their maintenance. In the past, maintenance staff have made ongoing adjustments to the control gain based on response measurements to achieve the desired performance. As a result, this response adjustment work has taken up considerable time and effort during rolling mill maintenance shutdowns.

Hitachi's newly developed automatic response adjustment system consists of an automatic preset measurement function that performs measurements for a number of preset control gains, and an auto tuning function that searches the control gain that achieves the desired response performance. The new system also significantly improves the efficiency of maintenance work by introducing a new single frequency waveform measurement method in place of the sweep frequency waveform measurement used previously, reducing the measurement time from 30 s to only 5 s.

Operating in conjunction with the electrical control system, the new system can also perform rapid adjustment of the response prior to rolling to ensure that the mill is set up appropriately for



PLC: programmable logic controller, DS: drive side, WS: work side

2 Standard configuration of automatic response adjustment system for hydraulic roll gap controller

actual rolling conditions when the mill response changes, such as the roll position change and the roll exchange.

In the future, Hitachi intends to expand applications for the new system as part of its electrical control systems.

3 3.3-kV IGBT Inverter (Second Generation)

Hitachi has contributed to the new construction or upgrading of numerous steel manufacturing plants in Japan, China, South Korea, and other Asian countries by supplying 3.3-kV IGBT inverter drives. It has now developed a second generation of 3.3-kV IGBT inverter drives for rolling mills that have been designed to meet user needs throughout the world. To this end, they include comprehensive changes to device dimensions and available drive capacities, while still maintaining the features of previous models.

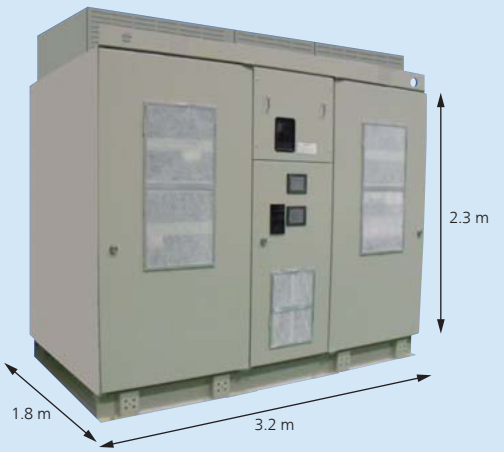
Three key features of these drives are listed below.

(1) Use of globally standard 3.3-kV/1.5-kA (3.0-kAp) IGBTs to increase output capacity and ensure long-term product availability.

(2) Smaller drive size due to simplified circuit design. The new drive is 55% smaller (panel width dimension) than the equivalent earlier model (for a 10.4-MVA drive).

(3) A range of different capacities are available, meaning that the best drive system can be selected to suit user requirements. This is achieved by using a configuration in which main circuits are connected in parallel. Maximum capacity is 13.0 MVA (or 26.0 MVA in a two-bank configuration).

(Commencement of production: September 2013)

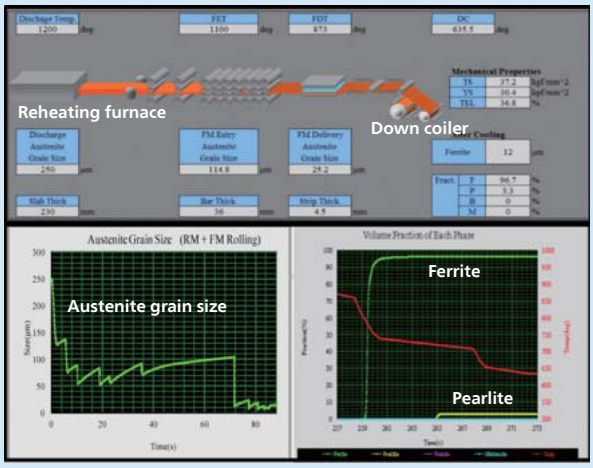


13.0-MVA converter/inverter

Parameter	Specification					
Circuit type	Three-level NPC inverter					
Motor type	Three-terminal				Six-terminal	
No. of converter panels	1				1 × 2 banks	
No. of cell unit rows	1	2	3	4	2 × 3 rows	2 × 4 rows
Rated output (MVA)	3.8	7.0	10.1	13.0	20.2	26.0
Rated output voltage (Vrms)	2,250					
Cooling	Water cooled (purified water)					
Overload	150% for 1 min					
Conversion efficiency	98% or higher (converter + inverter)					

NPC: neutral point clamped

3 Second-generation 3.3-kV IGBT inverter and its specifications



4 Example results screen for material properties simulation system for hot rolling
[Summary screen (top) and graphs of changes in grain size and microstructure fractions (bottom)]

4 Material Properties Simulation System for Hot Rolling

In addition to dimensional control of strip thickness and width, hot rolling also needs to meet targets for material properties such as steel strength and formability. To meet this requirement, Hitachi has developed a simulation system for predicting the material properties of hot rolled steel strip.

Using actual data on strip temperature and rolling conditions collected from the hot rolling process, this system can estimate the metallurgical properties of the steel (including grain size, volume fraction of different microstructures, and dislocation density) from the time the slab is inserted into the reheating furnace until it is coiled by the down coiler and predict the mechanical properties (including strength, hardness, and elongation) of the coiled strip. In addition, the system can simulate how the mechanical properties will change for a designated strip [specified using a human-machine interface (HMI)] in response to changes in its temperature history, reduction at each stand, and chemical composition. It also has a learning function that adjusts the prediction parameters to correct for any error between the actual and predicted mechanical properties.

Having delivered the first implementation in May 2013, Hitachi anticipates that the new system will be used for purposes such as the management of hot rolled strip quality and to help design optimal rolling schedules.

5 PBS Production Plant at PTT MCC Biochem Co., Ltd.

Hitachi has extensive experience in supplying equipment and constructing plants for production of polycondensation polymer as engineering plastics in the world. In particular, it is notable that Hitachi has own high-performance special polymerization processors that are designed and produced by being based on simulation of the polymerization reaction. In February 2013,

5 High-performance special polymerization processor

Hitachi made a full turnkey agreement for production plant of polybutylene succinate (PBS), a biodegradable plastic with its capacity of 20,000 t per year with PTT MCC Biochem Co., Ltd., a joint venture between PTT Public Co., Ltd. of the Kingdom of Thailand and Mitsubishi Chemical Corporation.

Among chemically synthesized biodegradable plastics, PBS is classified as a plastic with particularly good degradability. It is seen as a viable alternative to polyethylene, polyvinyl chloride, and polypropylene whose applications are such as degradable plastic bags or multi-wall agricultural plastic sheet. Moreover, PTT MCC Biochem plans to build the Succinic Acid and 1,4-Butanediol plants as feed stocks of PBS plant. By achieving the above plans, PTT MCC Biochem will realize production of environmentally sustainable plastics that do not depend on fossil fuel resources.

(Commencement of operation: April 2015)

6 Pandemic Influenza Vaccine Production Facility for Kitasato Daiichi Sankyo Vaccine Co., Ltd.

A pandemic influenza vaccine production facility that uses a mammalian cell culture system supplied by Hitachi to Kitasato Daiichi Sankyo Vaccine Co., Ltd. was constructed as the second stage of Ministry of Health, Labor and Welfare project for establishing production capabilities for pandemic influenza preparedness. Were a pandemic to occur, the facility would produce and supply sufficient vaccine for 40 million of Japan's roughly 130 million people within half a year.

The scope of the contract includes the cell culture, virus propagation, virus recovery and concentration, and purification processes, as well as culture medium and buffer preparation systems. Those systems include equipment, electrical instrumentation, and monitoring and control systems. In addition, on-site construction work, commissioning, and validation services were supplied by Hitachi. Features of the new plant include optimal design for large-scale cell culture using sophisticated culture process simulations, and automation of almost all processes including cleaning, sterilizing and process operations. Following trial production by the customer and auditing of the equipment by the supervisory authority, the plant is scheduled to receive drug manufacturing approval during FY2013.

Technologies such as process automation and the scale-up of bioreactors acquired through this plant construction will be able to be deployed in other plants for antibody drugs or vaccines productions using mammalian cell culture.

6 Virus production room in pandemic influenza vaccine production facility