HITACHI TECHNOLOGY
2008-2009

Social Infrastructure Business

Nuclear Power

Thermal Power

Hydraulic Power

Electric Power Distribution

Environment

Public Facilities

Transportation

Japanese Business Consortium Helping to Meet China's Energy Needs

Shanxi Xilongchi Pumped Storage Power Plant Facilities

With BEIJING 2008 Games of the XXIX Olympiad approaching, energy demand has increased significantly in China, spurred by economic growth, and the construction of energy plants is progressing in a number of regions. As part of a Japanese business consortium with Toshiba and Mitsubishi Electric, Hitachi has accepted an order for the 700-m ultra high head Xilongchi Pumped Storage Power Plant project. Hitachi is currently performing final installation work and field testing work in anticipation of the start of operations in August 2008.

Kensuke Komori (left), Senior Engineer, Hydroelectric Power Engineering Department, Hydroelectric Power Systems Division; Katsuhiro Oshima (right), Department Manager, Hydro Turbine Design Department, Hitachi Works, Power Systems

Accommodating China's Energy Needs

With its abundant water resources, there are exceedingly high expectations for hydraulic power generation in China. A number of large-scale hydraulic power plant projects typified by the Three Gorges project are currently underway. The construction of pumped storage power plants is also progressing in various regions in tandem with nuclear power plants. Pumped storage power generation requires two reservoirs. The power of water falling from the upper to the lower reservoir is used to rotate hydraulic turbine generators, generating electricity to meet high daytime power demand. At night, a motor operating on electricity runs a pump, which raises the water from the lower to the upper reservoir, in preparation for power generation during the day. Nuclear power plants, which maintain constant output over all 24 hours, generate surplus electrical power at night when demand is low. By using this surplus electricity to pump the water at night, pumped storage power plants assume a "storage" function by converting electrical to potential energy. With total output of 1,224,000 kW, the large-scale Xilongchi Pumped Storage Power Plant is widely anticipated in China, where demand for power is increasing rapidly.

Cooperative Structure of Three Japanese Manufacturers

Awarded in September 2004, this project features a three-company cooperative structure, with Hitachi, Ltd. and TOSHIBA CORPORATION (Toshiba) responsible for the pump turbine, Toshiba and Mitsubishi Electric Corporation (Mitsubishi Electric) for the generator motor, and Mitsubishi Electric for other transformer equipment and control facilities. There are four generator-motors and pump turbines, Nos. 1 through 4, each with an output of 306,000 kW. Conventionally, the pump turbine and generator motor are consigned to a single company, or are respectively designed and manufactured by two companies. However, the Xilongchi Pumped Storage project requires pumped storage power equipment for 700-m head, which raised significant technical challenges. For this reason, in this project, a cooperative structure was arranged with horizontal contact between two companies for the design and manufacture of the pump turbine. This has drawn on the strengths of both companies and heightened competitiveness. The pump turbine was designed as a joint venture in a superior/subordinate arrangement. Under a unique production method, Hitachi and Toshiba produced two each of the runners (impellers), the principle components, and the main shaft. Toshiba produced four inlet valve units and the water supply equipment, while Hitachi produced four pump turbine stationary parts, speed governors, the inlet valve control cubicles, and the compressed air supply systems.
During its 1999 technical demonstration (showcase) period, Hitachi achieved a world's first by producing an ultra high head large-capacity pump turbine for the Tokyo Electric Power Company's Kazunogawa Power Plant. This equipment offered an effective head of 728 m and an output of 412,000 kW. In contrast, the largest pumped storage power plant in China to date featured a head of 500 m and output of 300,000 kW. In terms of pump turbines, the design of the head is a crucial element, requiring both sufficient performance and reliability. For this reason, Hitachi's performance record and the performance record of the Japanese business consortium were factors in winning this order.

The Next Generation of Pumped Storage Power Plant Technologies

The Xilongchi Pumped Storage Power Plant is China's first pumped storage power plant project with Japanese manufacturers as primary contractors. If pumped storage power plant construction accelerates in China, demand is unlikely to be met solely by Chinese businesses. The feats achieved as part of this project will be used as exemplars to win projects from other clients, ideally generating various proposals for technological cooperation and the receipt of orders. This new project is also significant as a challenge and educational opportunity for the next generation of engineers.
It has been nearly 50 years since Japan's first pumped storage power plant in 1959, a reversible type that subsequently became the mainstream technology. The repair and renewal of existing facilities have become major issues, involving not just maintenance and repairs, but upgrades in efficiency and performance, among other goals, by replacing equipment with new runners based on the latest hydraulic designs. Such new value-added technological proposals have become essential. Another goal is to capture significant markets outside of China in regions like India, Southeast Asia, and Brazil, where a number of new hydraulic power plant facilities are being planned, drawing on technological expertise gained in the current projects and newly-trained engineers.

New High-speed Railway Cars Debut on the UK's First High-speed Line, the CTRL

Hitachi, Ltd. has developed a new railway car that runs on both conventional train lines and the UK's first high-speed line, the CTRL. Operation of the new high-speed railway cars, scheduled to commence in 2009, will help significantly expand transport capacity and increase transport speeds, both important issues in the railway field. It is also expected to play a major role in access transport for the London Olympics.

Mitsuo Iwasaki (left), Senior Engineer, CTRL Project; Kentaro Masai (right), General Manager (CTRL Project), Kasado Transportation Systems Product Division, Transportation Systems Division, Industrial Systems

New Railway Car Development Seeks Faster Speeds in Accordance with CTRL Configuration

Construction is currently underway on the CTRL (Channel Tunnel Rail Link: a link line to the channel tunnel at the Straits of Dover), the UK's first high-speed line, which will connect Dover to St Pancras International Station in downtown London (total distance 109 km). The CTRL will also feature the Eurostar, the high-speed intercontinental railway connecting Paris and London.

Hitachi, Ltd. has developed a railway car for high-speed connections between the County of Kent and St Pancras International Station. The cars will run onto the CTRL via conventional peripheral lines. A significant factor in Hitachi winning the order for the new railway cars includes Hitachi's accumulated railway technologies, embodied in the Shinkansen Lines of Japan, as well as Hitachi's track record for high performance and reliability. The UK faces pressing demand for significant improvements in railway transport capacity and speed. Another factor increasing demand for a high-speed railway is the LONDON 2012 Games of the XXX Olympiad. The development of the CTRL-DS (CTRL Domestic Service: railway car for operation within the UK) railway car will help meet these demands.

Clearing International Regulations and Accommodating Two Systems

The CTRL-DS railway cars are part of a high-speed railway system operating at speeds of up to 225 km/h, with specifications based on the UK regulations. The cars also feature premier-class railway car interiors. With respect to specifications, everything from collision absorption configurations to soundproofing and structural configurations, carbody configuration for combustion standards and fire resistance standards, and even the overall system architecture exceed the requirements of the ISO (International Organization for Standardization), the EN (European Norms), the BS (British Standards) and RGS (Railway Group Standards), and the TSI (Technical Specifications for Interoperability).

In order to operate on both the new high-speed line and conventional UK train lines, both AC (alternating current) (25 kV) and DC (direct current) (750 V) have been adopted for the electrical system, as well as three types of signal systems. Compatibility with this complex system represents another significant feature of the CTRL-DS railway cars. Hitachi has made full use of the latest technologies to ensure a comfortable ride, as well as reliability and safety, including the adoption of a high-precision, high-quality doubleskin carbody structure using FSW (friction stir welding), inherited from the original "A-train" concept proposed by Hitachi for the railway system architecture.

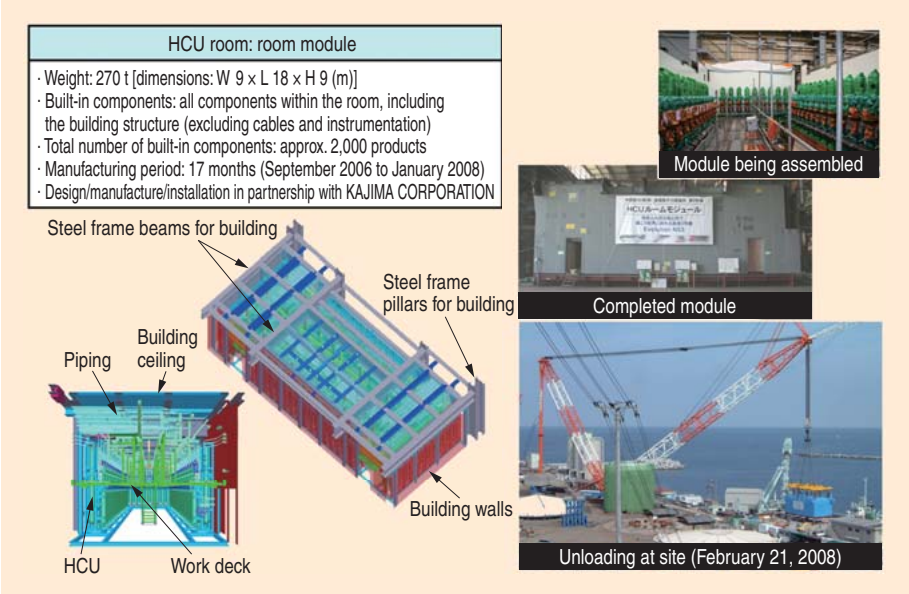
Safety was certified at the design stage. Serial delivery of four prototype sets (one set comprising six cars) is currently underway. Operational tests began on October 1, 2007, and a number of checks are being performed while the railway cars run under actual usage conditions. Operations are expected to commence in December 2009.

A Step Toward Penetrating the European Market

When the CTRL-DS railway car was first delivered to the UK, The Guardian and other media expressed significant interest. The consensus anticipated a "made in Japan" style railway. It would not be going too far to say that the CTRL on which this new high-speed railway car will debut in the UK, the birthplace of rail travel, represents a European showcase for Hitachi. Following delivery of the prototype, various efforts are expected to address issues associated with mass production. The delivery should be seen as a first step toward expanding business into both the UK and continental European markets.

Hitachi Advanced Construction Methods Applied to Unit 3 at the Shimane Nuclear Power Station of The Chugoku Electric Power Co., Inc.

Based on more than 30 years of Hitachi experience with construction, Hitachi-GE Nuclear Energy, Ltd. (HGNE) has established various new construction methods intended to improve construction safety and quality control, reduce process times, and increase economy. The methods consist of four primary techniques: modularization, the open-top method, parallel construction, and an integrated construction management system. These methods have been applied to the current construction of Unit 3 (Shimane No. 3) at the Shimane Nuclear Power Station of The Chugoku Electric Power Co., Inc. The new methods applied at Shimane No. 3 with respect to modularization and the integrated construction management system are described below.



Overview of room module for the HCU room

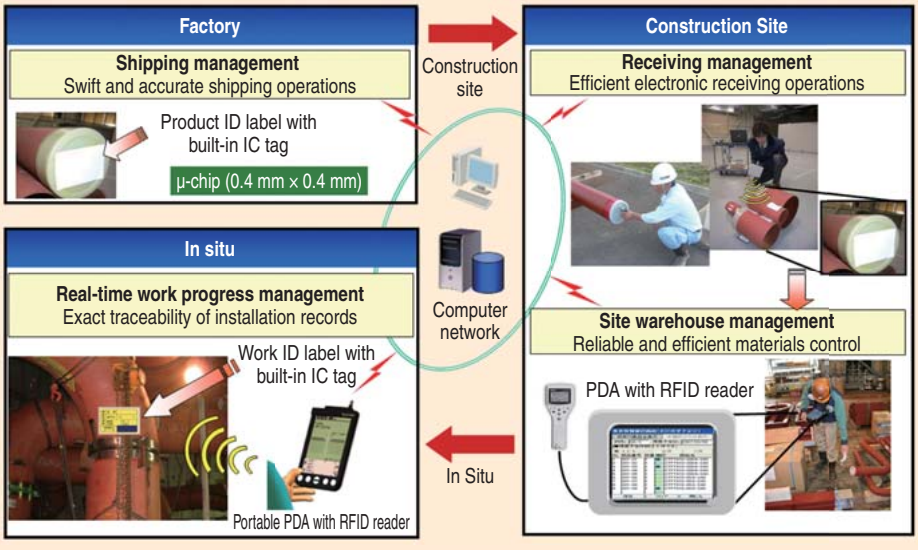
Modularization applies a "room module" approach to creating the HCU (hydraulic control unit) room, with the goal of minimizing the amount of onsite work required. As the phrase implies, "room module" refers to the prefabrication of all equipment (excluding instrumentation and cables) to be included in the room. This includes not just HCU, piping, and other mechanical and electric products, but the floor, walls, ceiling, and other building structures that form the room. This makes the cooperation of the construction company responsible for design and onsite construction of building structures essential. In the case of Shimane No. 3, design, manufacturing, and onsite installation were performed jointly with KAJIMA CORPORATION. The HCU room module was constructed at the HGNE Futo module factory. Onsite installation was completed without incident in February 2008.

The integrated construction management system seeks to digitize onsite construction management work to provide high-quality project design and management and to heighten the efficiency of indirect work. During this development process, members involved have made vigorous efforts with respect to project systemization, use of 3D (three-dimensional) CAD (computer-aided design) and other design information, expansion of the scope for system applications, and work process innovations. The scope of application now includes a thorough integration of construction management, covering everything from the design of a large-scale nuclear power plant to the installation process and even commissioning.

At Shimane No. 3, the integrated construction management system has been introduced and its operation has started. RFID (radio-frequency identification), which enables non-contact information transmission, is used for onsite product and resource management to support receiving management and inventory management of piping and other equipment, and for creation of work records (e.g., piping groove fit records and cable connection records).

Since RFID technology uses electromagnetic waves for identification, it is less sensitive to dirt and wear than barcode automated identification techniques. RFID technology is also capable of identifying products that are not directly visible. These features are used to verify products and personnel, to obtain installation specifications, and to input information related to installation records. The future progress is expected to expand the scope of application and to make the technology an increasingly core technology for actual practice.

(Hitachi-GE Nuclear Energy, Ltd.)



ID: identification, IC: integrated circuit, PDA: personal digital assistant

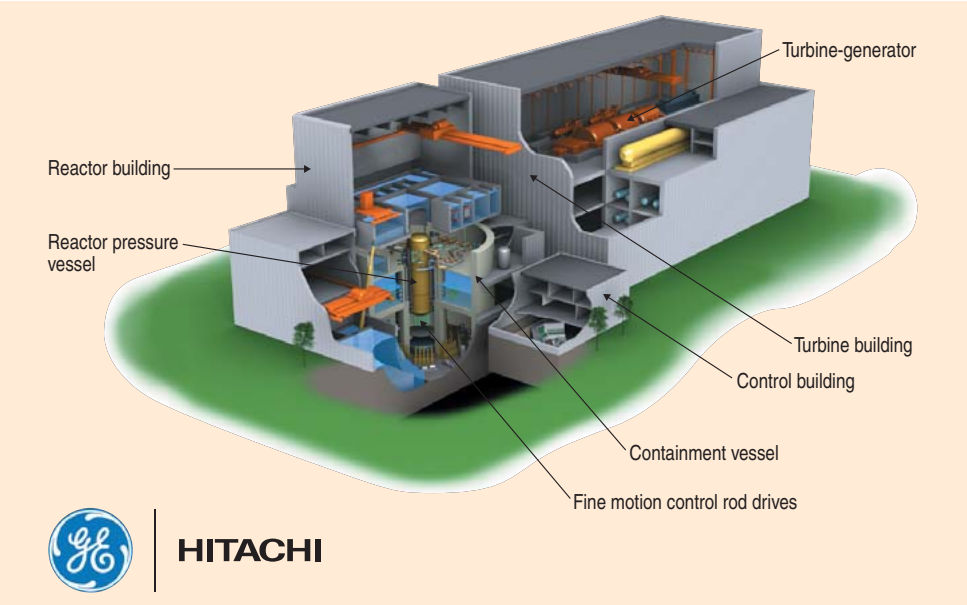
Advanced construction management with RFID application

Nuclear Technology Development for Global Nuclear Market

Hitachi, Ltd. and General Electric Company have entered into a global alliance in the nuclear energy industry, with cross-shareholding companies formed in the USA and Japan. The new union of GE-Hitachi Nuclear Energy Holdings LLC (GEH) will unite the companies' strengths and promote development of technology to advance business for global market.

The ESBWR (economical simplified boiling water reactor)—the most advanced reactor developed by GEH—is currently undergoing NRC (United States Nuclear Regulatory Commission)'s review on DC (Design Certification), and features natural circulation and a passive safety system which provides higher economical benefits. Construction of the ESBWR is slated to start after the COL (Combined License) review and approval process end. The ESBWR and ABWR (advanced boiling water reactor) are destined as key products to meet the demands in the global nuclear power plant market.

(Hitachi-GE Nuclear Energy, Ltd.)

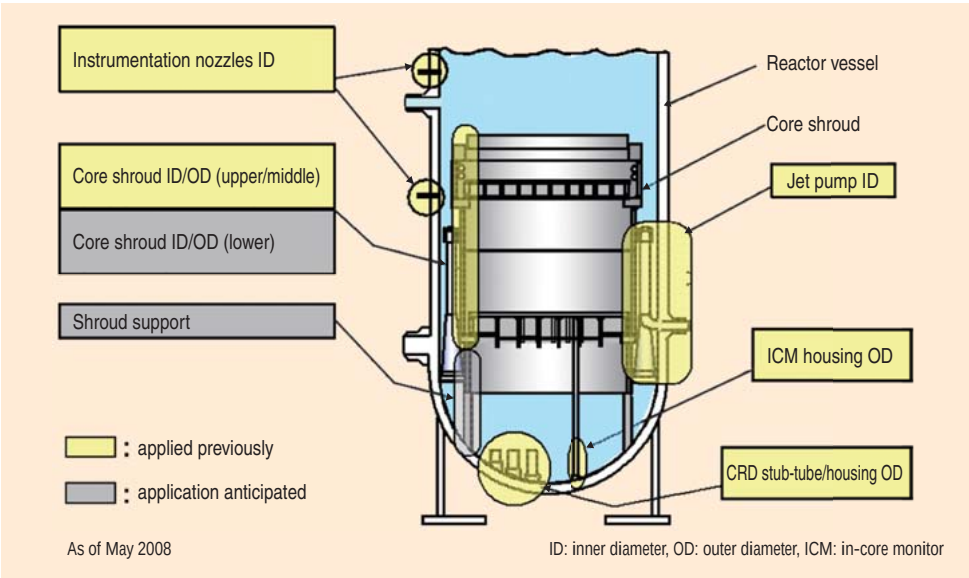


Schematic diagram of ESBWR

Preventative Maintenance of Reactor Internals via WJP

In 1999, Hitachi-GE Nuclear Energy, Ltd. (HGNE) applied WJP (water jet peening), a countermeasure against stress corrosion cracking, to preventive maintenance of the core shroud of a BWR (boiling water reactor) plant. Since then, HGNE has applied WJP to most reactor internal equipment, including core shrouds, CRD (control rod device) stub-tubes and housings, as well as jet pump riser tubes and diffusers, with satisfactory results at 12 BWR plants in Japan. These experiences have led to the development of advanced cavitation jet control technology, and remote controlled WJP equipment for application in narrow spaces, as well as the performance of mock-up tests using actual WJP equipment for each project. HGNE will continue to strive for WJP technical innovations and to contribute further to nuclear power plant safety. WJP technology has been applied not only to BWR plants in service, but to ABWRs (advanced boiling water reactors) under construction.

(Hitachi-GE Nuclear Energy, Ltd.)

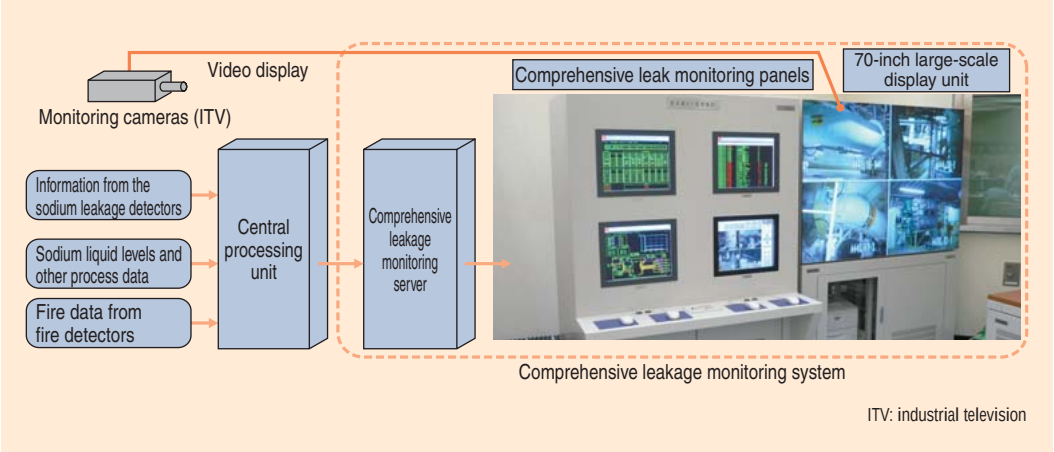


The use of WJP for internal BWR reactor equipment

Comprehensive Leakage Monitoring System Completed for Delivery to JAEA MONJU

Hitachi has completed work on a comprehensive leakage monitoring system for delivery to the Japan Atomic Energy Agency (JAEA) Prototype Fast Breeder Reactor MONJU.
This system provides a collective display of information on sodium monitoring on a comprehensive leakage monitoring panel located in the Main Control Room. The goal is to improve status judgments made by operating personnel during sodium monitoring.

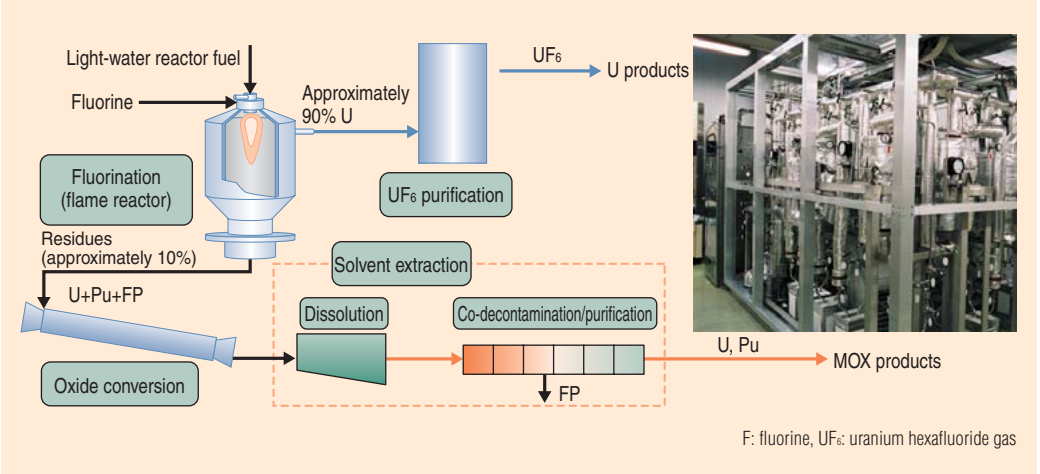
Functional tests are complete at this date, and the system is operating with an eye to the operational restart of the MONJU scheduled for October of 2008.
[Main features]
(1) Rapid status assessments via a comprehensive leakage monitoring server equipped with sodium monitoring information analysis, as well as leakage assessments, scale, location, and other judgment functions that support operational safety
(2) Support for improved status judgments via a comprehensive leakage monitoring panel, including video displays of monitoring cameras, as well as guidance on operating procedures
(3) Communization of information for operating personnel via a 70-inch (about 177.8-cm) large-scale display unit
(Hitachi-GE Nuclear Energy, Ltd.)



Overview of comprehensive leakage monitoring system

Development of Fluoride Volatility Method Reprocessing Technologies

Hitachi is currently developing reprocessing methods based on fluoride volatility as an advanced method for subsequent nuclear fuel cycle needs.
With this approach, the large quantities of U (uranium) remaining in spent fuel from light-water reactors are separated by fluorinate processing based on a flame reactor. In addition to reuse as high-purity uranium, the products are also easily storaged. The remaining U, Pu (plutonium), and FP (fission products) are processed via conventional solvent extraction methods to obtain high-purity MOX (mixed oxide fuel).
Based on public research by the Ministry of Education, Culture, Sports, Science and Technology of Japan, technical feasibility has been confirmed through U tests with prototypes,which is $\frac{1}{500}$ of the full-scale flame reactor, and in basic tests with actual spent fuel. Offering high cost efficiency, this method is easily adapted for use with a wide range of fuel cycles, including the transitional phase from light-water reactors to fast breeder reactors.
(Hitachi-GE Nuclear Energy, Ltd.)
(Scheduled commercialization timeframe: approximately 2020)



Test equipment and schematic overview of reprocessing process via the fluoride volatility method

Completion of 790-MW Supercritical Pressure Coal-fired Thermal Power Plant for MidAmerican Energy Company in USA

Building housing for steam turbines and boilers for MidAmerican Energy Company in USA

A contract for the design of a 790-MW power plant for MidAmerican Energy Company in USA went into effect in February 2003, with construction beginning in September 2003. Construction proceeded according to schedule, and the facility began operating 45 months after the start of construction.

This project marks the first for Hitachi in that it involves a comprehensive order in USA for a large-scale coal-fired thermal power station (operating at supercritical pressures), including a boiler, a steam turbine, a generator, environmental facilities, and associated civil and construction work. The generation capacity of 790 MW is the largest to date by Hitachi, Ltd. for exported thermal power plants.

Hitachi, Ltd. undertook the project in partnership with Hitachi America, Ltd. and Babcock-Hitachi K.K., taking several new approaches, including coordinated design work with Sargent & Lundy LLC, a US-based engineering firm.

Offering high efficiency and low environmental impact, the completed thermal power plant appears to have resulted in high client satisfaction. It establishes a foundation for developing future business in the area of overseas thermal plants.

Completion of a 1,000-MW Power Plant for Zouxian Power Plant in Shandong, China

In cooperation with DongFang Electric Corporation, Hitachi, Ltd., and Babcock-Hitachi K.K. manufactured and delivered boilers, turbines, and generators for the fourth phase ultra-supercritical pressure coal-fired power plants (2×1,000 MW) at the Huadian Power International Zouxian Power Plant.

Of the two plants built, the No. 7 plant began operating in December 2006, while the No. 8 plant began operating in July 2007. This expansion pushes the total output for the Zouxian Power Plant to 4,540 MW, making it one of the largest power stations in China. The facility will help ensure a stable supply of power for China.

[Specifications for major facilities]

(1) Boiler

Type: ultra-supercritical variable pressure once-through Benson boiler

Main steam flow: 3,033 t/h

Main steam pressure–temperature: 26.15 MPa (a)–605°C

Reheat steam pressure–temperature: 4.79 MPa (a)–603°C

(2) Steam turbine

Type: tandem compound four-flow exhaust type

Output: 1,000 MW

Main steam pressure–temperature: 25 MPa (a)–600°C

(3) Generator

Type: horizontal shaft and cylindrical rotating field type

Capacity: 1,120 MVA

Voltage: 27 kV

Appearance of the Zouxian Power Plant fourth phase (upper) and turbine-generators (lower) (foreground: No. 7 plant, background: No. 8 plant) in Shandong, China

Completion of H-25 Gas Turbine Power Generation Plant in the Republic of Hungary

Hitachi, Ltd. delivered a set of H-25 gas turbine power plant for the 50-MW NYKCE CHP (Combined Heat and Power) plant operated by E.ON Hungaria. The delivered power plant began commercial operation in July 2007.

With a low NOx burners used exclusively for gas fuels, this H-25 gas turbine power plant constitutes part of an order for facilities and construction work submitted to Hitachi Power Europe GmbH.

[Specifications for gas turbine and generator]

(1) Gas turbine

Type: H-25 gas turbine

Rated output: 30,060 kW

(2) Generator

Cooling system: totally-enclosed internal cooling type (air-cooled type)

Rated capacity: 37,575 kVA

Power factor: 0.80

Excitation system: brushless exciter

Full view of buildings making up the power generation facilities of E.ON Hungaria

H-25 Gas Turbine Compound Power Plant for the Nippon Petroleum Refining Co., Ltd.'s Sendai Refinery

Commercial operation of an H-25 gas turbine high-efficiency combined power plant burning by-product gas from expanded production of petrochemicals began in mid-October 2007 at Nippon Petroleum Refining Co., Ltd.'s Sendai Refinery.

This power generation plant is a multi-shaft model combined cycle power generation plant with a notification output at 101,980 kW (at the generating end). It consists of two gas turbines, two fully fired exhaust heat recovery boilers, and a steam turbine. Even if the gas turbine is stopped in emergencies, the boiler continues to operate independently, ensuring a supply of steam to the process.

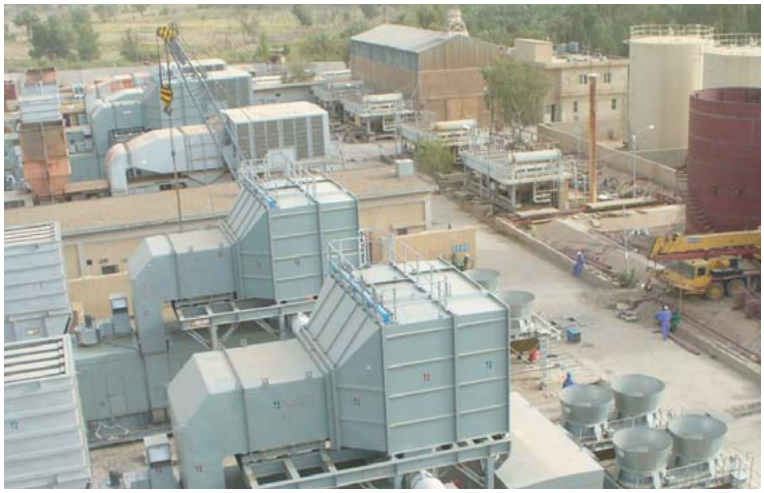
Design work began in October 2005. Construction work began in May 2006, followed by the first firing of the gas turbines in July 2007 and completion of trial operation by October 12, 2007 following three and half months of commissioning and conditioning.

The H-25 gas turbine power generation plants are the third and fourth units delivered to Nippon Petroleum Refining Co., Ltd., following those installed at Marifu Refinery (1st) and Osaka Refinery (2nd). The order was submitted to three companies: Hitachi, Ltd., Mitsubishi Heavy Industries, Ltd., and Mitsubishi Electric Corporation. Hitachi delivered the H-25 gas turbines.

100-MW class high-efficiency H-25 gas turbine combined cycle power generation plants at Nippon Petroleum Refining Co., Ltd.'s Sendai Refinery

Completion of the H-25 Gas Turbine Project at Taji Gas Turbine Power Station

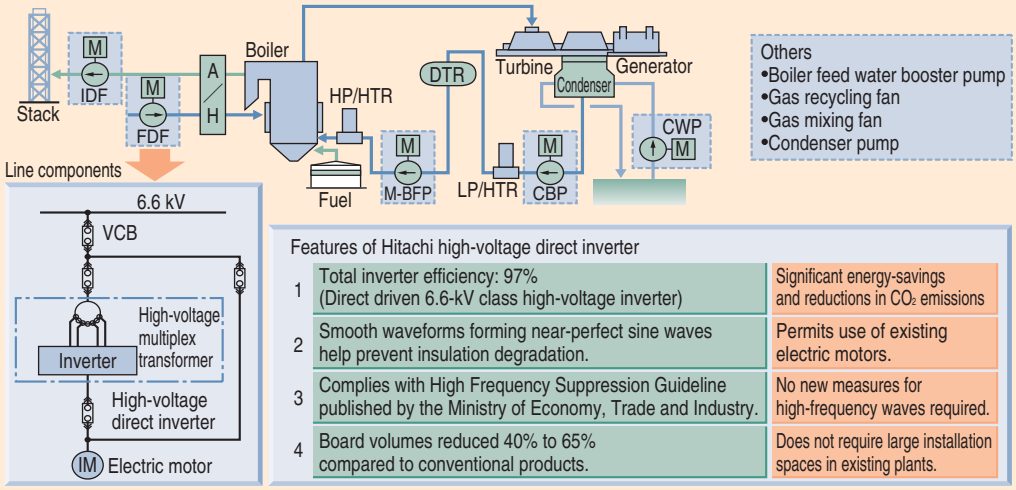
The Japanese Government announced donation for power generation reconstruction and repairs in Republic of Iraq.
In January 2006, Hitachi won an order to replace three H-25 gas turbine units for the Taji gas turbine power plant in Iraq as part of reconstruction efforts. For security reasons, no Japanese engineer or technical adviser actually visited the site. Instead, Hitachi proceeded with the project via a remote site-work management system. The remote site-work management system gives highest priority to the site-work through the project. The remote site-work management framework featured the following characteristics: strong project oversight, the application of an IT (information technology) infrastructure, implementation of site management by a local subcontractor, a detailed technical instruction sheet, and a site-work support system aided by digital engineering .
On completion of the project in 2007, three H-25 gas turbine units had been installed and successfully deployed by an Iraqi staff.
In this project and through other efforts, Hitachi will continue to seek to contribute to Iraq's future through its power supply infrastructure.



Construction status of Taji Power Station

Application of Energy-saving Inverter to No. 3 FDF Delivered to the Anegasaki Thermal Power Station Operated by Tokyo Electric Power Company, Inc.

During fiscal 2006 periodic inspections (from October 2, 2006 to February 14, 2007), the Anegasaki Thermal Power Station of the Higashi Thermal Power Office, Tokyo Electric Power Company, Inc. introduced high-voltage direct inverters to its FDFs (forced draft fans).
In this system, high-voltage direct inverters are applied to the FDFs, large-sized auxiliaries bringing air into boiler for fuel combustion.
The goal is to reduce required power of FDFs by controlling the speed of their motors.
[Major features]
(1) Incorporates high-voltage type IGBT (insulated gate bipolar transistor). Compact 6.6-kV inverter system design arranging four inverters in series per phase
(2) Stable fuel combustion achieved by utilizing both damper vane control and motor rotation speed control for air flow
This system can reduce required power by 20% or more, and is contributing to improvement of the power generation efficiency and reduction in CO_2 emission.



Large-scale auxiliary machinery driven by electric motors for a thermal power station

GH1550A: World's Most Advanced High-efficiency, Low-noise, Air-cooled Turbine-generator

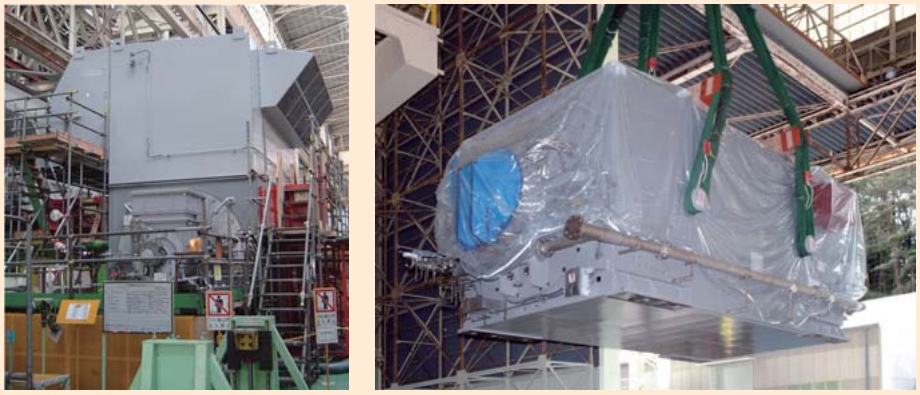
Hitachi, Ltd. has completed work on its GH1550A air-cooled turbine generator that features the world's highest efficiency* and low noise. GH1550A achieves the world's most advanced performance*. Five units (Nos. 1–5) have been delivered.

Although an air-cooled turbine-generator, GH1550A offers rated generator efficiencies of 98.75% [60 Hz, PF (power factor) 0.85] and 98.77% (50 Hz, PF 0.8), and the noise levels of the generator are 77 dBA (at 60 Hz) and 74 dBA (at 50 Hz). To achieve such performance levels, the generator losses were thoroughly reduced with network ventilation analysis and electromagnetic analysis of the stator core. In addition, multiple noise tests were carried out to develop the ideal sound insulation structure for the generator.

To improve performance and reliability, various analytical technologies including rotor vibration analysis, temperature analysis, and stress analysis were applied to the generator.

It was confirmed by the shop performance test that the generator meets all design specifications including efficiency, noise, temperature rise, and shaft vibration.

* Checked by Hitachi, Ltd. as of November 20, 2007.



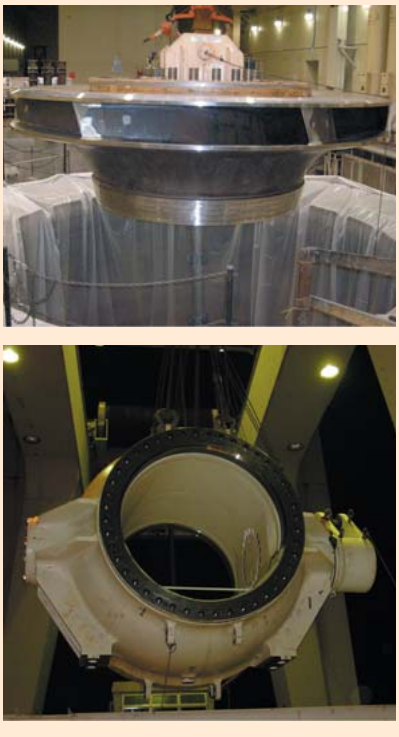
GH1550A during shop test (left) and during transfer for shipment at the shop (right)

Renovation of 300-MW Pump-turbine at the Blenheim-Gilboa Power Plant Ordered by the New York Power Authority

Renovations and upgrades of units 1 and 2 have been successfully completed at the Blenheim Gilboa Pumped Storage Project (New York, USA). Unit 2 re-entered commercial operation in May 2007 after an $8\frac{1}{2}$ month outage, and Unit 1 re-entered commercial operation in May 2008. The program is continuing with units 3 and 4.

This pumped storage power plant features a range of equipment made by Hitachi, Ltd., including four pump-turbines, generator-motors, and four inlet valves originally installed in 1973 and operated since then. To improve the efficiency and characteristics of the pump-turbine, Hitachi worked on refining stationary portions such as stay vanes and seals and installed newly designed and manufactured runners made of high-Ni-13Cr stainless steel. These renovations allow the units to operate as a turbine from approximately 140 MW to 290 MW, an important operational improvement from the 203-MW to 260-MW range of the original pump-turbines, while improving the peak efficiency and increasing the maximum output. The upgraded units also provide for a pumping capacity increase of over 10% and a significant increase in pump efficiency. Additionally, the spherical valves are being rehabilitated as part of the program, and the client opted to purchase one new valve to shorten the periods during which the upper reservoir is drained to replace valves.

Renovations and upgrades based on new technologies focusing on the expansion of operation range contribute significantly to capabilities at hydraulic power plants. Hitachi plans to focus efforts on further refining these technologies.



Installation of new runner (upper) and inlet valve (lower) for the No. 2 unit at the Blenheim-Gilboa Pumped Storage Power Plant (New York, USA)

Start of Operations of the 55.3-MW Hydraulic Turbine at Kukuan Power Plant, Taiwan Power Company

The No. 2 55.3-MW Francis hydraulic turbine delivered to the Kukuan Power Plant of the Taiwan Power Company began operating on December 26, 2007, followed by the No.1 turbine on March 5, 2008.

Installation of runner and shaft assembly of the No. 1 55.3-MW hydraulic turbine at Kukuan Power Plant, Taiwan Power Company

In 1999, an earthquake and typhoons inflicted catastrophic damage on the power plant, leading to the decision to subject the facilities to a scrap-and-build. This project was launched shortly after these events. But repeated flooding caused by a typhoon in July 2004, submerged the new facilities once again, significantly pushing back the installation timetable. The first turbine began operating two years and seven months behind schedule.

Construction of the power plant was contracted out to a consortium consisting of Hitachi, Ltd. (responsible for the hydraulic turbine), Mitsubishi Electric Corporation (power generator and control), and Chung Hsin Electric & Machinery Mfg. Corp. [BOP (balance of plant) equipment and installation]. The turbine installed by Hitachi in Taiwan marked the first such turbine installed by Hitachi since a turbine installed at the Minhu (now Takuan) Pumped Storage Power Plant in 1984.

The work introduced runners of new shapes and designs made possible by state-of-the-art CFD (computational fluid dynamics). Actual use has demonstrated that the new designs generate remarkably low vibration and noise, equivalent to levels generally associated with a partial load of 20 MW (power ratio: 36%), expanding the range over which the facility can operate reliably.

The latest round of improvements also add four drainage pumps and two jet pumps to safeguard against future flood damage.

Efforts to prepare the remaining two turbines for operations are on schedule.

Practical Application of Environmentally-friendly Water-lubricated Resin Type Bearings in Hydraulic Turbines

Hitachi has developed an environmentally-friendly water-lubricated, resin-type bearing to take the place of white metal bearings in hydraulic turbines and introduced their use in actual equipment. The resin-type bearings used in the past have been static pressure bearings, which required a constant flow of clear water under pump pressure. The newly developed bearing is of a dynamic pressure type that eliminates the need for a feed pump. With the new bearing, water is replaced simply to make up for water lost through evaporation.

[Specifications]

(1) Resin type: PPS (polyphenylene sulfide)

(2) Bearing peripheral speed: 5 m/s or greater

(3) Bearing pressure: 1.5 MPa or less

[Characteristics]

(1) The lubricant is water. This means no environmental damage occurs even if the lubricant is released into a body of water.

(2) Since water is less viscous than oil, bearing losses are minimized.

(3) Eliminates need for auxiliary machinery.

Bearing assembly (upper) and bearing surface (PPS) (lower)

New Wide-area EMS/SCADA System for Aomori Regional Load Dispatching Center

A new wide-area EMS (energy management system)/SCADA (supervisory control and data acquisition) system has been developed for the Aomori Regional Load Dispatching Center of Tohoku Electric Power Co., Inc., which plays a role in monitoring three jurisdictions. The new system was built by adding additional equipment, expanding a database, and adding functionality to the existing regional EMS/SCADA system. The system enables operators to easily implement and oversee operations as monitoring responsibilities expand to cover an ever-wider region and ever-increasing volumes of on-line information.

[Main features]

(1) "User-friendly HMI (human-machine interface)" allowing precise identification of network problems and operational conditions for operators

(2) Effective "switching order generation" and "data reporting and statistics" via close connection of information with the relevant systems

(3) Laborsaving of "outage management" and "security analysis" by on-line sharing outage information with "network planning system" and the other EMS/SCADA systems

The new system was commissioned in July 2007. Plans call for an "operator training simulator" to be added to the system to help train operators in identifying network problems and to accelerate network restoration in the event of problems. Plans also call for an upgrade of the "fault information delivery" function to confirm the accuracy of information on network problems.

Aomori Regional Load Dispatching Center

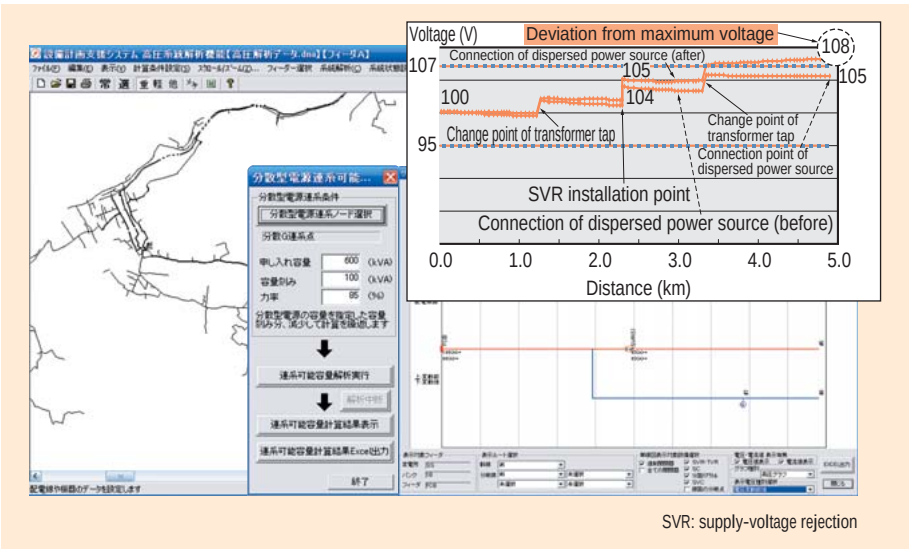
Analysis System for High-voltage Line Corresponding to Dispersed Power Sources

Hitachi develops and delivers analytical system for high-voltage lines to Tohoku Electric Power Co., Inc. to facilitate examinations when connecting dispersed power sources to distribution systems.

With ever-intensifying attention on environmental issues, demand is growing for dispersed power sources such as wind power generators, making quality control systems for electricity and system operations control ever more complex and difficult, due to voltage increases caused by reverse power flows to distribution lines and increasing loads at the parallel-off of power generation plants. Additionally, for voltage control, it is now more difficult to apply appropriate load power factors to voltage drop calculations based on the status of the load being applied.

In response, Hitachi has developed and implemented use of a high-voltage line analysis system for dispersed power sources, permitting easy calculation of voltage distributions, short-circuit capacity, and flicker when dispersed power sources are connected. This is done by determining load distributions based on measured bank voltage and current at the electric power station, current passed, and the power factor of section switches on the distribution line, then applying power flow calculations.

For their work on this system, Tohoku Electric Power Co., Inc. and Hitachi were jointly awarded The Promotion Award for Electrical Science and Engineering (OHM Technology Award) sponsored by The Promotion Foundation for Electrical Science and Engineering.



An illustration of the high-voltage line analysis system for dispersed power sources

Catalytic PFC Decomposition System to Contribute to the Prevention of Global Warming

PFC (perfluorocompound) is a greenhouse gas with long-lasting impact tens of thousands of times that of CO_2. For example, CF_4, one type of PFC, is estimated to remain in the atmosphere for up to 50,000 years.

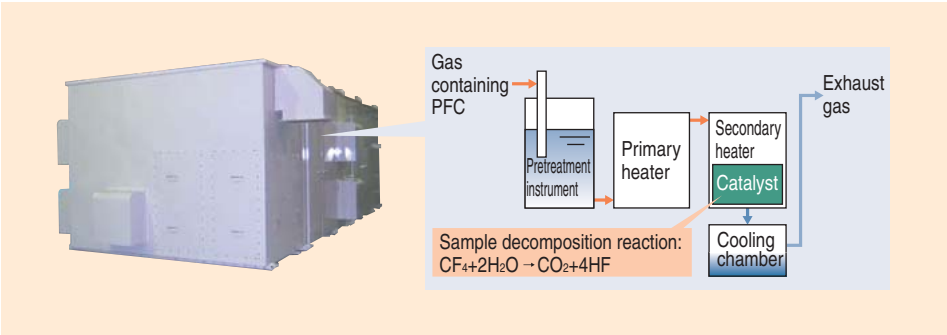
In response to pressing demand in the semiconductor and liquid crystal manufacturing industries, which use significant volumes of PFCs, to reduce the quantities of these compounds released into the atmosphere, Hitachi has developed an original catalyst that decomposes more than 99% of PFCs and commercialized a new decomposition system (up to 200 L/min) for indoor installation at individual manufacturing lines for semiconductors and other equipment in 1999. To date, more than 300 such units have been operated in the world.

In a world's first, Hitachi has also commercialized the CD (catalytic decomposition)-3000, a large capacity catalytic decomposition system, with a processing gas capacity of 3,000 L/min. This instrument features the ease of scaling associated with catalytic systems and offers both batch processing of factory exhaust gases and outdoor installation capabilities.

In addition to featuring the world-leading decomposition performance at low temperatures of 750°C, the CD-3000 is easily maintained. Since it can be installed outdoors, it does not require installation in expensive clean rooms, offering clients benefits both in terms of performance and cost. Six units have been operated in the manufacturers of liquid crystal in Japan.

The development of the new large system (CD-3000EX), which lowered the price, was just finished.

Hitachi presents this system to an overseas semiconductor and liquid crystal factory and is going to plan the spread.



External view and overview of the large-capacity CD-3000 catalytic PFC decomposition system

Making Environmentally-friendly Ballast Water Purification Systems a Global Reality

A significant current problem in the world's oceans involves ecosystem damage caused by invasive species. For example, starfish native to Japan conveyed with ballast water are proliferating in great numbers in the waters near Australia, causing major problems for the fishing industry. In response, in 2004, the International Maritime Organization (IMO), an agency under the United Nations, established an international treaty on ballast water management, a primary source of ecosystem damage. The treaty is scheduled to go into effect in 2010.

Tankers are used to transport crude oil from exporting nations to consumer nations, where the oil is unloaded. Ships become lighter during unloading and must take on water to maintain proper draught and buoyancy in sea water. This water is known as ballast water. The treaty will require all ships to install ballast water management systems.

Two types of ballast water management systems have been developed. One removes living creatures from the ballast water; the second sterilizes the water. Hitachi, Ltd. has adopted a safe removal method that generates zero environmental burden. Development of this system in collaboration with Mitsubishi Heavy Industries, Ltd. is currently underway, and plans call for obtaining Type Approval Certificate. The equipment has been installed on a ship owned by the Yuyo Steamship Co., Ltd. since April 2008, and dedicated shipboard tests have begun.

Projected to become a global reality, Hitachi's environmentally-friendly ballast water purification system business was transferred to Hitachi Plant Technologies, Ltd. as of April 2008.

(Hitachi Plant Technologies, Ltd.)

Installation image of prototype

Ship displacement: 78,500 m^3 LPG freighter
Ship owner: Yuyo Steamship Co., Ltd.
Ship manufacturer: Mitsubishi Heavy Industries, Ltd.
Installation date: August 2007
Test: From April 2008

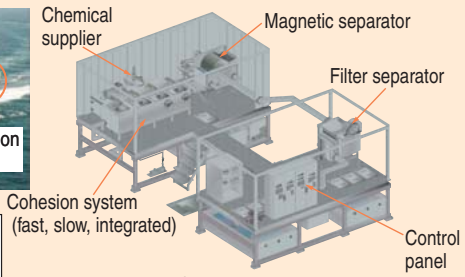


Diagram of prototype ballast water purification system installation

LPG: liquefied petroleum gas

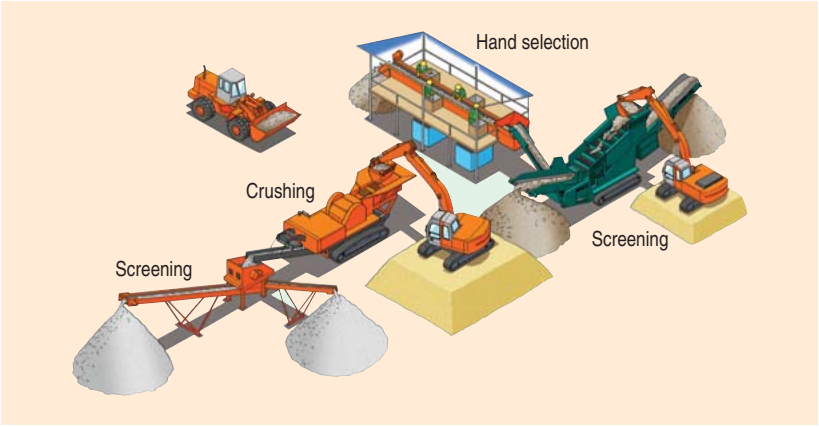
Overview of ballast water purification system

High-quality Solutions for Waste Recycling and Reducing CO_2 Emissions

Decrease in the negative environmental impact, from an economic viewpoint as well, has become serious problems on various earthworks and the industrial waste disposal sites.
Hitachi on-site screening & solution, which integrates construction machinery and recycling equipment, recycles site-generated construction materials at the same site, making it possible to reduce CO_2 emissions and processing costs.
Hitachi on-site screening & solution offers benefits in the following cases:

(1) Recycling at various civil engineering work sites including residential land development and roadwork
(2) Groundwork to prevent landslides in the event of earthquakes, volcanic eruptions, and flooding
(3) Recycling sites of wood and concrete generated by structural demolition
(4) Restoration construction of illegal dumping site of industrial
(5) Decontamination of soil at construction sites to remove oil, volatile organic compounds, and heavy metals

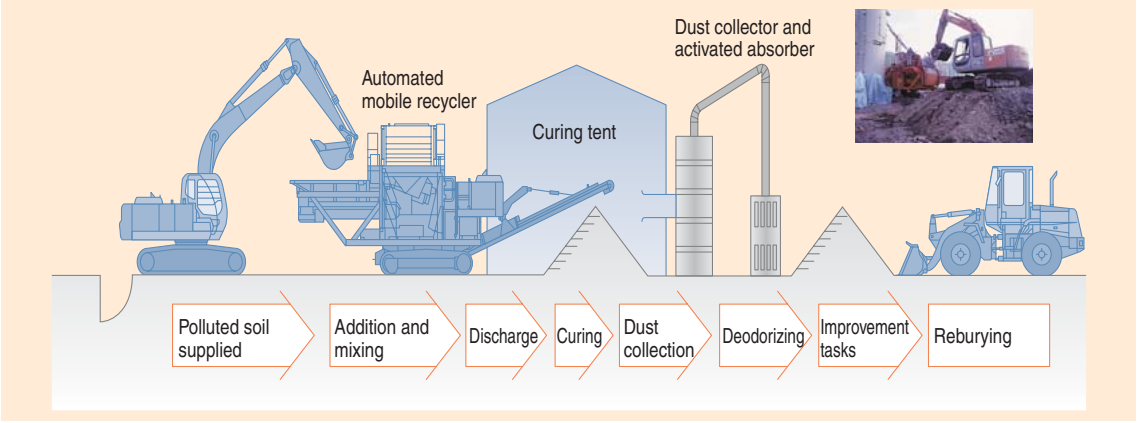
Hitachi is offering and developing Hitachi on-site screening & solution, through the consulting activity.
(Hitachi Construction Machinery Co., Ltd.)



Case example (93% of waste generated at construction sites is recycled and reused within the site itself.)

On-site Polluted Soil Recovery System

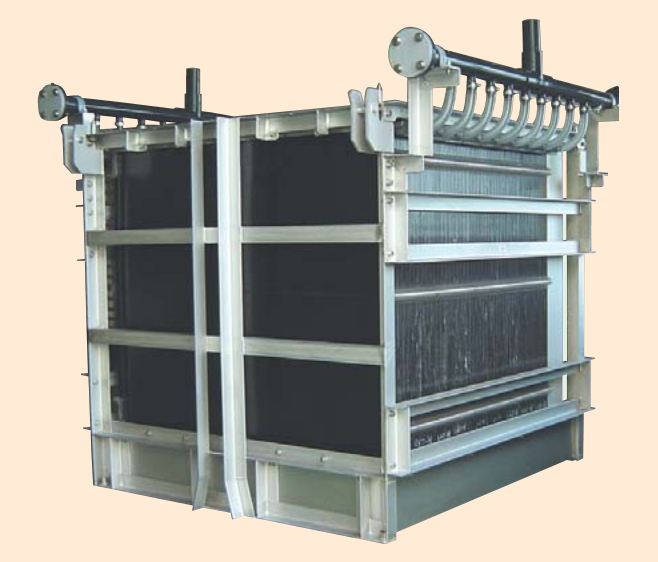
Problems involving soil pollution have come to light in recent years due to efforts to expand and improve factories in accordance with changes in industrial structure zoning and to the urbanization of neighboring plots, leading to factory closures and ensuing redevelopment. Investigations and projects to counter soil pollution are proliferating.
There are two basic methods for remedying polluted soil. One is to transport the polluted soil offsite to a treatment facility; the other is to purify the soil at the site where the pollution occurred. Hitachi Construction Machinery Co., Ltd. has applied techniques accumulated through experience in the construction equipment industry to develop an on-site polluted soil recovery system based on the SR Series (including SR-P1200 and SR-G2000) track-mounted soil recycler.
With this method, chemical agents that treat pollution by heavy metals, VOCs (volatile organic compounds such as trichloroethylene), and oils are mixed onsite with soil polluted by chemical liquids. The soil is checked to confirm that it has been effectively purified and insolubilized and is then reburied onsite.
Compared to offsite treatments, this method is especially effective in several ways. It reduces construction costs as well as CO_2 emissions and traffic problems by obviating the need for dump trucks for offsite transport.
(Hitachi Construction Machinery Co., Ltd.)



Structure of on-site polluted soil recovery system

Membrane Bio-reactor System

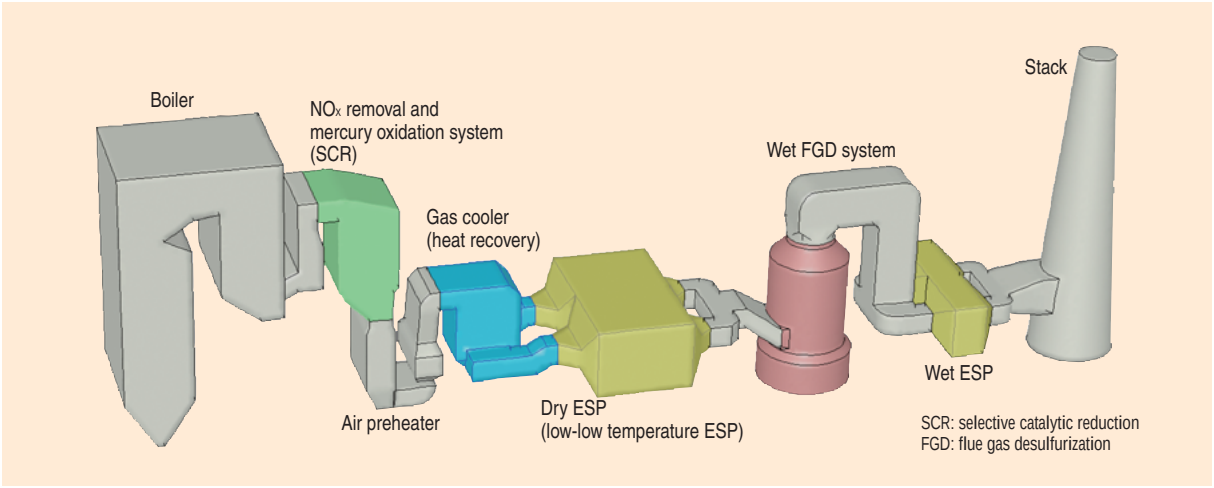
There is demand at both municipal and industrial wastewater treatment facilities to expand water circulation by recycling treated water and to conserve water quality at discharge sites by removing nitrogen, phosphorus, and other organic compounds.
In recent years, the membrane bio-reactor has attracted significant interest as a technique for addressing these needs. This water treatment system combines biological treatment with membrane-based solid/liquid separation. Hitachi Plant Technologies, Ltd. has developed a new PVDF (polyvinylidine difluoride) membrane unit, creating a system that offers high filtration performance and excellent maintenance properties. Successive orders are being received not just for municipal wastewater treatment in Japan, but also for industrial wastewater treatment and overseas sewage treatment.
Development is currently underway on a treated water recycling system that (1) reduces the operating power required for the membrane bio-reactor system and (2) incorporates an RO (reverse osmosis) membrane. The system is intended for both industrial and municipal water reuse.
(Hitachi Plant Technologies, Ltd.)



New PVDF membrane unit

AQCS Technology that Removes Trace Compounds from Boiler Exhaust Gas

Hitachi leads the world in implementing flue gas treatment technologies for high-efficiency removal of NOx, SOx, and other atmospheric pollutants generated by coal-fired power plants. Hitachi has now developed the advanced AQCS (air quality control system) for simultaneous removal of trace metals in exhaust gas, gradually becoming regulatory targets in North America and Europe.
Developed technology as part of Hitachi's comprehensive combustion and flue gas treatment research facilities has already been proven at a pilot test plant in USA. Public relations and commercialization efforts are expected next, with the goal of achieving a clean global environment as well as integration with CO_2 reduction technologies.
[Main features]
(1) Comprehensive boiler with AQCS warranty and high reliability
(2) High dust (SO_3) removal technologies based on low-low temperature ESP (electrostatic precipitator), combining gas cooler (heat recovery)
(3) Trace metal removal technologies allowing multifunctional use of NOx removal and mercury oxidation catalyst to eliminate the need for activated carbon and reduce operating costs.
(Babcock-Hitachi K.K.)



Overview of Hitachi AQCS system

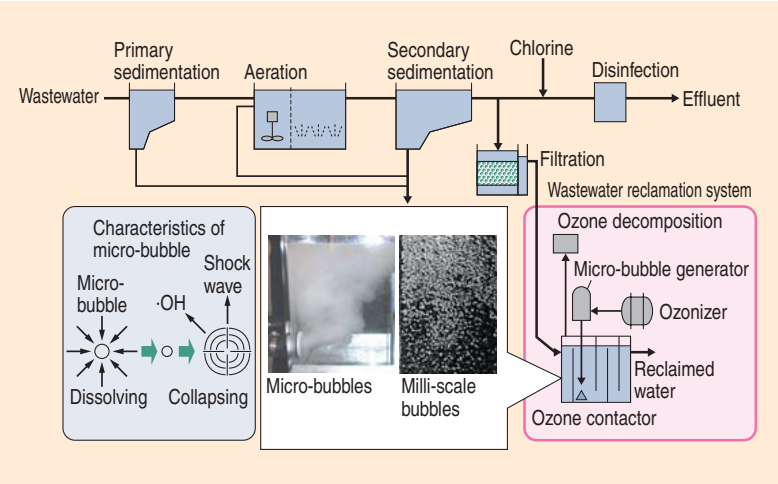
Micro-bubble Treatment System for Wastewater Reclamation

Wastewater reclamation represents an important solution to the world shortage of potable water. Hitachi has developed a new water treatment technique that effectively applies ozone micro-bubbles as part of a wastewater reclamation system.

Micro-bubbles of approximately 50 µm in diameter have high solubility and reactivity, and reports indicate these micro-bubbles generate hydroxyl radical and shock waves when they collapse. In addition to its disinfecting function, ozone treatment of treated wastewater removes color, odor, and turbidity. However, the relatively high cost of the electric power required to generate ozone has led to various efforts to reduce the startup and operating costs associated with such systems.

With its proprietary and highly effective bubble generation mechanism, Hitachi's ozone micro-bubble treatment systems offer significantly reduced ozone contactor size, the ozone dosage required, and the energy required to generate micro-bubbles. Due to reduced levels of waste ozone, Hitachi's ozone treatment systems also permit simplification of ozone decomposition equipment.

Through this novel water treatment system, Hitachi will contribute to water resource recycling.



Overview of ozone treatment system using micro-bubbles

N700 Shinkansen Cars and Electrical Components Delivered to Central Japan Railway Company

The new Tokaido and Sanyo N700 bullet train cars entered operation on July 1, 2007.

The new faster, improved N700 was adopted for the Tokaido and Sanyo Shinkansen Lines to succeed the current 700 model.

These cars are equipped with high-performance, semi-active vibration control devices to provide a more comfortable ride. The area covered by the car body's aluminum double-skin has been expanded, and train-connecting sections have been completely covered to better muffle exterior noise. The shape of the nose has been optimized and the weight of the entire car reduced to improve environmental performance. All seats are now non-smoking to avoid exposing passengers to passive smoke. Smoking rooms equipped with smoke extraction devices and photocatalytic deodorizers have been installed in cars 3, 7, 10, and 15.

The N700 has a running speed of 300 km/h in the Sanyo region, on par with the current 500 model. In the Tokaido region, the current speed of 250 km/h on curves can be increased to 270 km/h, thanks to the adoption of a body tilting system using air springs, the first of its kind on the Shinkansen Lines. The N700 completes the run between Tokyo station and Shin-osaka station in two hours and 25 minutes, five minutes faster than the current 700 model.

N700 Shinkansen car (above) and its main converter (right)

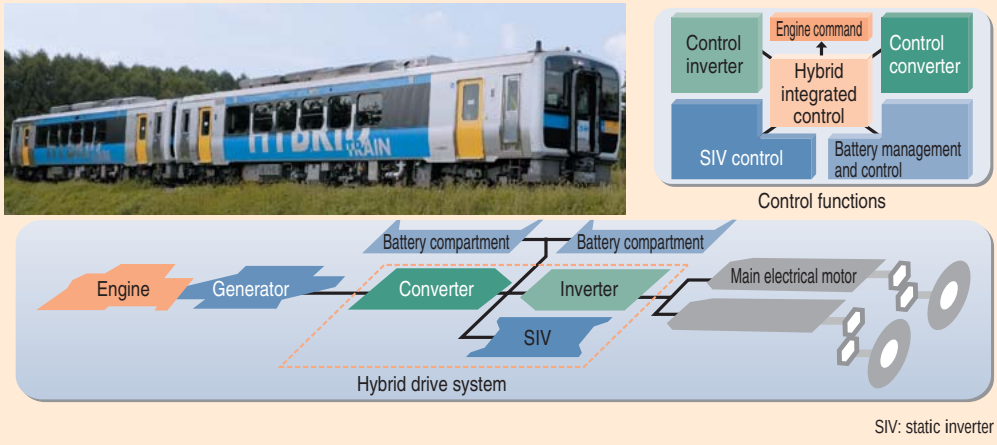
Kiha E200 Hybrid Drive System for East Japan Railway Company Trains

Hitachi has delivered a hybrid drive system for use in the world's first operational Kiha E200 hybrid-electric train. The East Japan Railway Company and Hitachi have worked side by side since 2001 to develop a hybrid drive system for hybrid cars with the goal of reducing the environmental burdens imposed by trains. An NE (new energy) train prototype has been subjected to system verification and battery life evaluations.

The main converter used in the hybrid drive system integrates the inverter (controlling the train's speed adjustments), converter (controlling engine generator power), and auxiliary power supply (supplying power to service equipment such as air conditioning and fluorescent lights). The energy required by the train is managed and controlled via the hybrid integrated controller. Switching between battery charging and discharging is determined by train speed and the main battery's SOC (state of charge), ensuring high-efficiency energy usage and reducing fuel consumption by 10%, noise by 30 dB, and emission of toxic substances by 60%.

Data from the Kiha E200 is currently being evaluated to develop more hybrid cars with the aim of further reducing environmental impact.

(Entered operation: July 2007 on East Japan Railway Company's Koumi line.)



Exterior view of Kiha E200 car (upper left) and the structure of the hybrid drive system

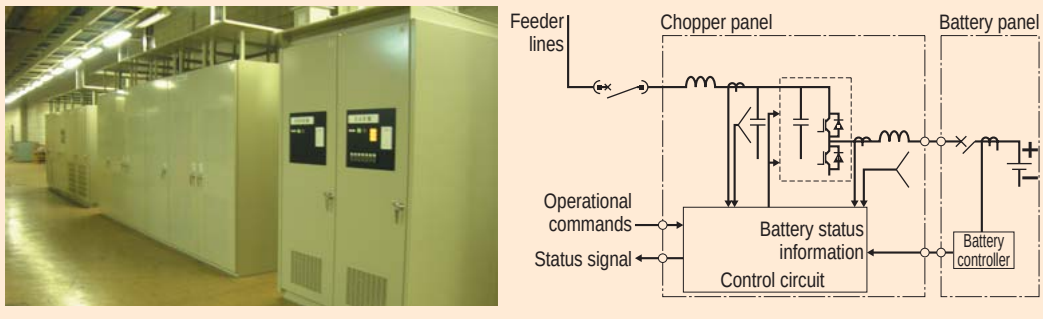
Regenerative Power-storage Equipment Using Batteries Developed for Electric Railways

Several railway companies are currently seeking to reduce energy and labor requirements by introducing regenerating cars, platform doors, ATC (automatic train control), and ATO (automatic train operations). For substation systems, in addition to conventional regenerative loss prevention measures, there is pressing need to build groundbreaking energy-efficient systems.

Hitachi has developed B-CHOP (battery-based regenerative power equipment), a system that effectively stores regenerative power generated when rail cars are braking, then discharges power while cars are running. The initial equipment has already been delivered and has been operational since February 2007.

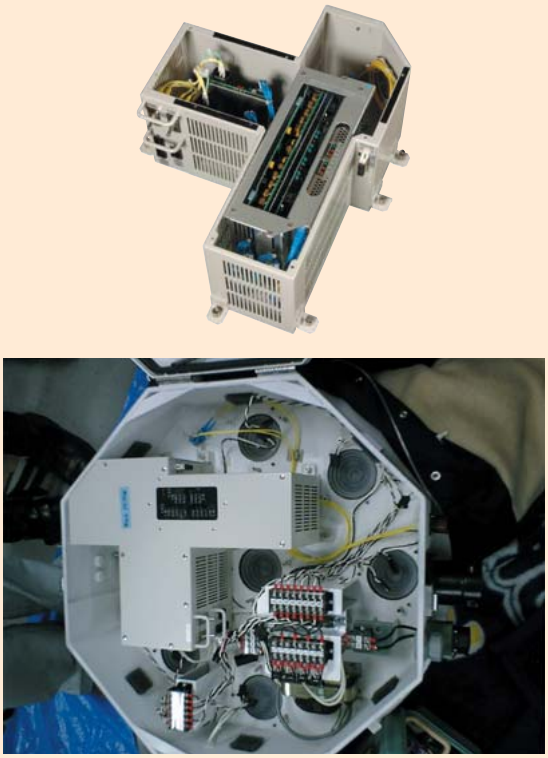
Lithium ion batteries developed for hybrid automobiles are used as the storage media, achieving compact dimensions and long life.

The B-CHOP substation system has wide-ranging applications beyond regenerative power storage, including installation at sites subject to significant feeder line voltage drops to avoid hindering acceleration and as countermeasures for peak cuts via stored power.



Regenerative power-storage equipment installed at electric railway substations

New Interlocking System Utilizing Network Technology

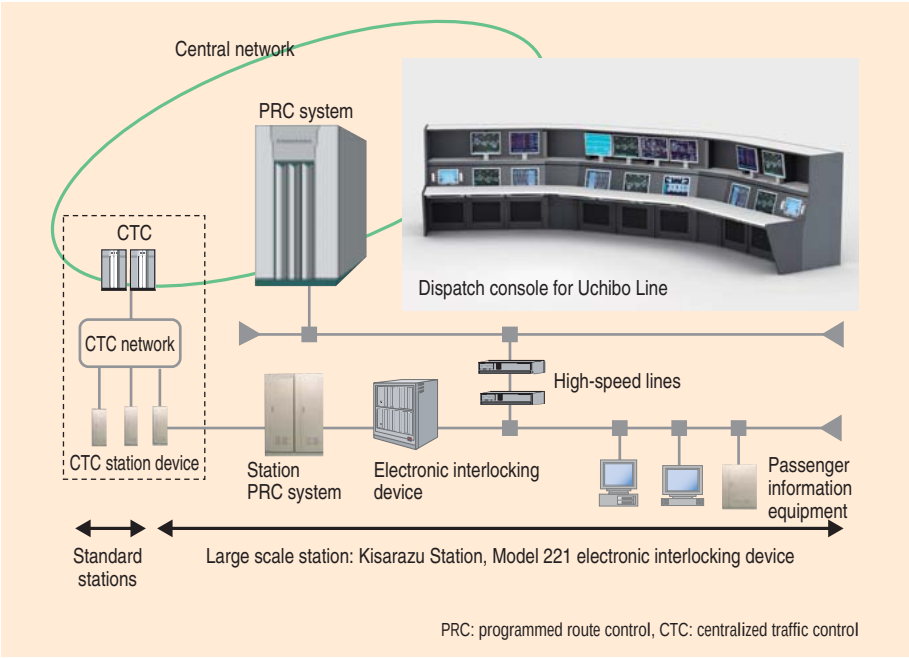


Small-scale control terminal (upper) and mounting (lower)

The prototype of a new interlocking system (network signal control system), using network technologies developed cooperatively by East Japan Railway Company and Hitachi, began operating at Ichikawa-ono station on the Musashino Line in February 2007.
This system consists of onsite equipment, including a signal device equipped with a control unit (small-scale control terminal), and a logical unit installed in an equipment room, connected by fiber optic cables. The onsite equipment is controlled via signals transmitted over these cables.
This system eliminates the need for the enormous numbers of metal cables conventionally laid to provide control voltage to onsite equipment at each facility, significantly reducing the number of cables (a long-standing problem) and cutting construction times. This reduces the time and labor required for system construction and maintenance while maintaining or improving the safety and reliability provided by conventional equipment.
Mass production measures are being taken to expand the introduction of this equipment from the second unit on.

Traffic Control System for Uchibo Line Delivered to East Japan Railway Company

The new traffic control system for the East Japan Railway Company's Uchibo Line between Soga and Tateyama began operating on September 3, 2006.
The Uchibo Line features a mixture of single and double lines and shunting at Tateyama Station. The introduced system supports various operations related to the above characteristics, and enables control of the entire Uchibo Line, including larger stations, through online connections with the Model 221 electronic interlocking system previously delivered to Kisarazu Station. The design of the graphical user interface and functions results in a system optimized for user-friendliness.
Hitachi will continue to create transport control systems that meet the needs of railway companies.



Schematic diagram of Uchibo Line traffic control system