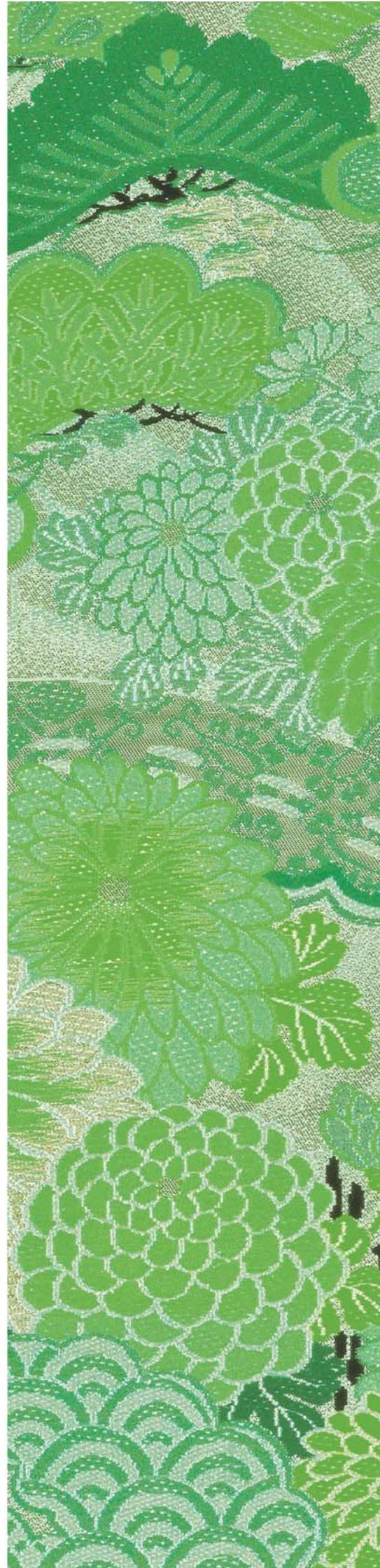


2009-2010
HITACHI TECHNOLOGY

Power & Industrial Systems

- Nuclear Power
- Thermal Power
- Hydraulic Power
- Public Facilities
- Transportation
- Industrial Systems
- Healthcare Systems
- Production Plants
- Automotive Systems
- Building Systems



Leading Role in Chinese Industry for Super Eco-factory —Dashi Factory, Hitachi Elevator (China) Co., Ltd.

Awareness of global environmental issues is increasing in China which continues to enjoy rapid economic growth. The Dashi Factory of Hitachi Elevator (China) Co., Ltd. has one of the largest shares of the Chinese market and, as a member of the Hitachi Group, took steps from an early stage to become an “environmentally-minded company” putting an emphasis on actions to raise environmental awareness and reduce the burden on the environment. As a result of these steady efforts over many years, it is now recognized as a “super eco-factory” in China.

Hitachi Elevators Make Progress by Leaps and Bounds in Chinese Market

Since its foundation in 1996, Hitachi Elevator (China) Co., Ltd. has achieved dramatic growth in terms of production volume, total production value, and market share as it has kept pace with the rapid expansion of the Chinese economy. In 2007, we strengthened all areas of our business organization from research and development through to production, sales, installation, maintenance, importing, and exporting to help us quickly and properly meet the needs of the market and our customers in our business activities which cover elevators, escalators, moving walkways, and apartment security systems that integrate building entranceway and elevator operation.

The Dashi Factory in Guangzhou as our main production base employs approximately 1,800 staff at a lush green site covering 210,000 m². Our share of the Chinese elevator market in fiscal year 2007 was more than 14% and we are ranked as one of the top companies in the industry.

Aiming to Become One of China's Best Environmentally-minded Companies

As a member of the Hitachi Group, our aim from the earliest stage has been to become an “environmentally-minded company with an emphasis on environmental protection” and we have focused on reducing environmental pollution in the factory. We have established a company-wide environmental management system based on our own philosophy of environmental activity which is built around the four themes of “establishing a green philosophy, rational use of resources, compliance and environmental protection, and building beautiful gardens.”

The factory was one of the first in the industry to obtain ISO14001 certification, which it achieved in March 2000. The site was also commended by the Guangzhou municipal government for being a “flower garden factory.” Working through the “clean production activities” program advocated by the Economic and Trade Commission of the Environmental Protection Bureau of Guangdong Province, all employees are involved in “waste minimization and the reduction of water, power and raw materials consumption” in the course of their day-to-day activities. The cumulative results of this steady work have seen the factory receive broad recognition including winning the “Outstanding Corporate Citizen Award of China” from the Working Committee on Corporate Citizenship of the China Association of Social Work.

Environmental Awareness Among Individuals Bears Fruit

The policies with top priority in our actions on environmental protection are those that aim to reduce energy consumption, water use, and the volume of waste sent to landfill, and we have a medium- and long-term plan that sets targets for each of these.

To help reduce energy consumption and CO₂ (carbon dioxide) emissions, we installed phase-advance capacitors to improve the efficiency of our grid connection and power distribution. This increased our power factor from between 0.6 and 0.7 to 0.9. In the plant, we introduced a highly efficient

FMS (flexible manufacturing system) line for sheetmetal and improved production energy efficiency. Nor were the more ancillary aspects of the plant ignored, as we also adopted long-life energy-efficient lighting and made savings in air conditioning and cooling.

To reduce water consumption, we carried out an inspection of all the steel pipes in the factory to ensure that there were no water leaks. Measures were also adopted to recycle water within the factory, including installing a filter in the fountain ponds and using a cooling tower to allow water recirculation in the production line. These measures achieved a 65% reduction in fiscal year 2007 compared with 2005.

To reduce the volume of waste sent to landfill, we improved our utilization of board, redesigned our packing crates to reduce use of blocks, and adopted the practice of collecting and recycling used cutting oil. In cooperation with a waste disposal company, incinerator ash is now recycled to make bricks instead of being disposed of in a landfill as before. The result of all this work was to reduce final waste disposal to zero.

These outcomes were achieved through ongoing education and by fostering environmental awareness, and these activities are now recognized as among our most important work. We can see how the results we have achieved are the fruits of raising the environmental awareness of individual employees.

Leaving a Rich and Natural Global Environment for Our Children

The mini-machine-room elevator developed by Hitachi Elevator (China) Co., Ltd. was certified as a Hitachi Group Eco-Product in 2007. This was in recognition of the product's reduced use of steel in mechanical parts (approximately 10%) and copper in the main transformer (approximately 5%), and also the approximately 57% reduction in the machine room floor area and approximately 14% reduction in energy consumption.

Our approach to environmental protection extends beyond environmental and energy conservation measures and considers the issue from the broader perspective of CSR (corporate social responsibility) based on our mission of leaving a rich and natural global environment for our children.

We intend to continue to make action on the environment part of our daily activities through our shared philosophy expressed by the Hitachi Group's Environmental Vision 2025.



Zeng Dong Sheng, General Manager (middle), Chen Hua Ru, Manager, Quality & Environment Management Section (right), and environmental action promotion members of the Quality Assurance Division

Toward a More Global Nuclear Power Business

The international market for nuclear energy has entered a period of growth. This growth is closely related to background factors that include vigorous growth in demand for electric power in foreign economies coupled with global energy-related concerns regarding global warming caused by greenhouse gas emissions and spikes in the cost of energy. With various countries establishing policies to encourage plans for new nuclear power generation, Hitachi, Ltd. has integrated its nuclear business with that of General Electric Company of the USA with the objective of expanding its nuclear power business in the global market.



(Left to right) Masahiko Nakane, Chief Project Manager, Global BOP Project, Nuclear Business Development and Management Headquarters, Nuclear Systems Division, Power Systems, Hitachi, Ltd.; Takashi Masui, Chief Project Manager, Global Business Operations; Noriaki Wada, Chief Project Manager (for Overseas QA); Masatoshi Takada, Senior Engineer, Nuclear Plant Department, Hitachi Works, Hitachi-GE Nuclear Energy, Ltd.

New Era for Nuclear Power

The USA has had a freeze on the construction of new nuclear power stations since the accident at Three Mile Island in 1979. In recent years, however, with countries around the world being encouraged to adopt measures to counter global warming, nuclear power has come to be reevaluated as a form of electricity generation that can produce power with very little emission of CO₂. This led the change in US policy toward the expansion of domestic nuclear generation capacity against a background of safe nuclear operation over the past decades. Following favorable treatment of taxation, financing, and similar being established by the Energy Policy Act of 2005, plans have been announced for the construction of approximately 30 new nuclear power stations. Activity directed toward the construction of new nuclear power stations can also be seen in numerous other countries outside the USA. Hitachi, Ltd. has built up a collaborative relationship with General Electric Company (GE) since we first entered the nuclear power business, and in response to this growth and globalization of the market we decided in 2007 to take this collaboration one stage further by establishing GE-Hitachi Nuclear Energy Americas LLC in the USA and Hitachi-GE Nuclear Energy, Ltd. in Japan.

World-leading Technology

Because construction of new nuclear power stations in the USA and Europe has been stalled after the 1970s, there are concerns about a shortage of engineers who are able to support the latest technology for supplying and constructing nuclear generation plant. Compared to general industry, the plant used in the nuclear power industry requires a high level of technology and has special specifications and quality assurance requirements. For this reason, very high expectations are placed on Hitachi due to our unbroken construction experience in Japan, our manufacturing capabilities for major pieces of equipment, and other advantages.

The two main reactor types competing in the international nuclear power market are the BWR (boiling water reactor) and PWR (pressurized water reactor). Hitachi's nuclear power technology, which started out using a BWR design adopted from GE, has now evolved

to the third-generation ABWR (advanced boiling water reactor). The ABWR is a third-generation reactor with an operating track record derived only from plants in Japan. Of these, Hitachi was awarded the full plant contract for Unit 3 currently under construction at the Shimane Nuclear Power Station of The Chugoku Electric Power Co., Inc. This followed on from Unit 2 at the Shika Nuclear Power Station of the Hokuriku Electric Power Company and numerous visitors from around the world have come to view the latest ABWRs at these sites. Hitachi has been involved in all ABWR construction in Japan, and based on this extensive experience we are aiming to establish a standard ABWR design for the world incorporating the international standards. In April 2008, GE-Hitachi Nuclear Energy Americas LLC and Hitachi-GE Nuclear Energy, Ltd. jointly set up the ABWR Project Office in San Jose, California with the aim of winning new orders for ABWRs in the USA.



Construction of Unit No. 3 at the Shimane Nuclear Power Station of The Chugoku Electric Power Co., Inc.

Synergies Obtained through New Collaborations

Having both built their nuclear power businesses around BWR technology, Hitachi and GE anticipate opportunities for obtaining even greater synergies in a wide range of activities including undertaking joint research, sharing design resources, and utilizing each other's manufacturing equipment.

At the same time as establishing GE-Hitachi Nuclear Energy Americas LLC, we also set up GE-Hitachi Nuclear Energy Canada Inc. This new company is involved in supplying fuel and reactor equipment for the CANDU* (Canada deuterium uranium) heavy water reactor being promoted by Atomic Energy of Canada Ltd. The advantages of the CANDU reactor include the ability to use natural uranium instead of enriched uranium as its fuel and to reuse spent uranium fuel from BWRs, PWRs, and other reactors. This technology has the potential to be used in conjunction with BWRs and other light water reactors in the future to create a new type of fuel cycle. As the only group able to construct a BWR and CANDU reactor pair, Hitachi and GE also aim to establish and develop new technology through mutual cooperation in this field.

* See "Trademarks" on page 87.

Expanding Applications for H-25 Gas Turbine through Reliability and Comprehensive Support

Dealing with issues such as energy conservation, environmental protection, and fuel diversification requires the development of gas turbines with higher efficiency and cleaner exhaust. Recognition of the high performance, high efficiency, and reliability of the 30-MW-class H-25 gas turbine has seen a growing number of orders from global markets and Hitachi is working to reduce the burden on the environment by making the system even more efficient and by developing a new burner unit.



Toshifumi Sasao (left), Group Leader Senior Engineer; Fumiharu Moriwaki (right), Senior Engineer, Gas Turbine Design Section, Gas Turbine Design and Service Department, Hitachi Works, Power Systems

Growing Track Record in Japan and Expansion into Global Markets

Industrial gas turbines contribute to energy saving through their use in combined-cycle and cogeneration systems. Combined-cycle systems are highly efficient power generation systems that use the gas turbine in combination with a steam turbine, and cogeneration systems use the gas turbine in combination with a exhaust heat recovery boiler to supply both heat and power. Since completing the first 30-MW-class H-25 gas turbine in 1988, Hitachi has built up a track record of supplying the H-25 in the oil and gas industry and general industrial applications as well as for power generation in Japan. Based on this experience gained in Japan during the latter part of the 1990s, Hitachi started supplying the H-25 gas turbine to overseas markets from the year 2000 and total orders received to date have now exceeded 100 units. The range of applications for the product is growing steadily with units supplied to power company projects in countries such as Canada and Hungary, and to petrochemical company projects in Indonesia and Russia. Orders have also been received recently from the Middle East and South Korea.

Highly Regarded for Reliability and Environmental Performance

The high reliability of H-25 gas turbines is one reason for the growth in the number of overseas projects. In addition to proven operation over 10 years in Japan, the units are also highly regarded for their ability to operate maintenance-free for two years. Another significant factor is their ability to comply with strict environmental regulations in South Korea and other countries. For example, not only is the burner on the H-25 able to use wet methods such as water or steam injection to reduce NO_x (nitrogen oxide), use of a burner specially developed by Hitachi for dry method operation can achieve 25 ppm (dry) or less at 15% O₂ (oxygen) equivalent when operating on natural gas at the rated level. This is the first time such a result has been achieved and it is a result of know-how gained from combined cycle plants in Japan. Hitachi has developed a new cluster burner that allows combustion of dimethyl ether, which is seen as a next-generation alternative fuel that can help reduce environment impacts and diversify fuel sources, and has commenced trials of turbine rotor blades manufactured from a nickel-based single crystal superalloy with advantageous properties that include resistance to oxidation and the ability to retain its strength at high temperatures. Hitachi also continues to work on improving the efficiency of its gas turbines through measures such as reviewing the aerodynamics of turbine rotor blades by which it hopes to make efficiency gains in the order of 0.1%.

Efforts for Further Expansion of Applications

These efforts take several years from the outset of development through repeated trials until eventual application. One planned development is the installation in its gas turbines of a cluster burner that can lower NO_x levels further by allowing the use of faster burning fuels. Along with steady work aimed at enhancing its technical strengths, Hitachi is also making an effort to provide even better customer service than in the past through its after-installation service of H-25 gas turbines delivered to various sites around the world. There is more to gas turbines than just designing a product that satisfies the customer's specifications and there is significant work that needs to be done after winning an order, including installation and adjustment of equipment specifications, and along with maintenance, close attention needs to be paid to customer needs. Hitachi intends to expand the applications for its gas turbines by utilizing the technical and support capabilities it has acquired through past experience, and further improve the brand value of the "H-25" in the gas turbine market.

Environmentally Friendly A-train Rolling Stock System for Urban Transportation

Along with its quest for safety and comfort, the railway industry is placing a growing importance on awareness of global environmental issues. Hitachi develops new rolling stock systems based on its A-train concept and, having had its products selected for various subway and urban transit systems, the company is looking to make further advances with a view to expanding into global markets.



Akihiro Ishikawa (left), Senior Engineer, Rolling Stock Engineering Department, Rolling Stock Systems Division; Hirofumi Sakamoto (right), Senior Engineer, Rolling Stock Systems Design Department, Kasado Transportation Systems Product Division, Transportation Systems Division, Industrial Systems (photographed inside a carriage during construction)

A-train Brings Innovation to Rolling Stock Manufacturing

Rail has drawn renewed attention in recent years as a safe form of public transport with less adverse impact on the environment. However, unlike automobile production where labor saving and production line techniques are used, rolling stock is typically designed and manufactured on a vehicle-by-vehicle basis. As well as being concerned about how to continue producing rolling stock to high standards of quality and precision against a background of more and more experienced and skilled workers retiring from the factory floor, we also feel the need to take action on reducing life cycle costs and on reducing the burden placed on the environment. For this reason, we decided to drastically review the materials, internal structure, and production methods of our rolling stock and proceeded with the development of A-train products to address these issues. The "A" in "A-train" comes from the association with the key terms "advanced," "amenities," "ability," and "aluminum." The concept was to simplify the structural design and adopt automation and mechanization processes that allow high-quality rolling stock to be manufactured in a way that does not rely on worker experience and skills alone, and also to produce rolling stock in a way that takes account of global environmental concerns. In other words, our goal was to bring innovation to the manufacture of rolling stock.

Rigorous Pursuit of Simple Structural Design

Two technical features of the A-train are its modularization and

double-skin body structure. We have taken a rigorous approach to simplifying the structural design of carriages. In addition to integrating various parts of the carriage into modules based on their function, such as the ceiling, seats, driver's platform, and under-floor piping, other simplification measures have included adopting an aluminum double-skin body structure that eliminates framework. As a result, the number of parts was reduced from several tens of thousands to several thousands and rolling stock can be manufactured efficiently and accurately. As well as reducing welding costs, the aluminum double-skin body structure also results in a higher quality carriage by suppressing vibration and allowing it to be lighter, better insulated, and quieter. The strong and beautiful bodies of A-train rolling stock are produced using FSW (friction stir welding). FSW works by using frictional force to induce plastic flow. In addition to reducing strain in the welding joint, the absence of weld marks on the carriage means they do not need to be painted, a feature that facilitates recycling.

A-train Enhancements Aimed at Expansion into Overseas Markets

Railway carriages are typically taken out of service after 30 to 50 years of use. Being made of aluminum, A-train rolling stock are lightweight and easy to maintain and renovate, making them excellent candidates for recycling. One of the reasons why A-train rolling stock are so highly regarded is that they are designed to facilitate renovation after being taken out of service. One example of this is that they use the same type of aluminum alloy throughout, from the double-skin body structure through to the interior fittings. On the other hand, the A-train rolling stock itself is subject to ongoing development to improve passenger comfort. This includes enhanced sound and heat insulation and more spacious interiors achieved by combining the double-skin body structure with the modules, each of which integrates a different system. A-train rolling stock support the operation of highly intensive urban transport systems and are used in Japan in the TX-2000 trains run by the Metropolitan Intercity Railway Company, the 50000 series trains run by Tobu Railway Co., Ltd., and, more recently, the trains run on the Fukutoshin Line of the Tokyo Metro Co., Ltd. and the 30000 series trains run by Seibu Railway Co., Ltd. As carriage width and other specifications vary between different railway companies and tracks, we expect that the advantages of the A-train approach to the standardized manufacture of rolling stock will continue to be demonstrated in the future. In addition to supplying rolling stock within Japan, we are looking to achieve compliance with international standards and hope to continue developing the A-train concept further with an eye to expansion into overseas markets.

Integrated Digital Map Solution Based on Advanced Hitachi Incremental Map Update Technology

The broader use of digital maps in recent times brings with it a growing need for more effective and flexible updating services. To meet this need, Hitachi developed an incremental map update technology that updates digital maps quickly and introduced a map data distribution service that employs this new technology for in-vehicle navigation in July of 2008. Hitachi's integrated digital map solution uses this incremental map update technology as its core technology and Hitachi intends to continue adding new high-value-added services.



Kiyohiro Obara (left), Senior Research Scientist, Intelligent Media Systems Research Department, Central Research Laboratory; Masakazu Tsunoda (middle), Chief Project Manager, System Solutions Division, System Engineering Center, Car Information Systems Division, Hitachi Automotive Systems, Ltd.; Hiromitsu Sumi (right), Manager, Navigation Software Development Dept. 2, Software Development Division, Clarion Co., Ltd.

Epoch-making Technology that Updates Changed Part of Map Only

How to keep maps up to date is an important issue in the world of vehicle navigation systems. Finding the best route to a desired destination requires that the map contain the latest information. Unfortunately, conventional approaches to map updating have required users to spend time and effort, and as a result this information is updated less frequently than desired. Consequently, technology for efficiently updating only those parts of a map that have changed has long been awaited.

The Hitachi incremental map update technology developed by Hitachi responds to these needs and expectations. Incremental map update technology typically works by managing maps in rectangular blocks called "parcels." When a map is updated, the complete data for all parcels that have any changes are overwritten with new data. However, this causes problems when the amount of update data becomes large. In Hitachi's new technology, on the other hand, map data is managed not only in parcels but also by road. The volume of data updates is reduced by only updating the minimum data needed to keep the road connection information up to date.

The system also features an embedded RDB (relational database) and has a configuration that allows the update area size and method to be selected flexibly based on the purpose and intended use. For example, a major feature of the system is that if a small area surrounding the user's present location requires an update, the user can perform an update via mobile phone that downloads the necessary map data changes only, as required.

Hitachi Technology has Great Opportunities in Global Market

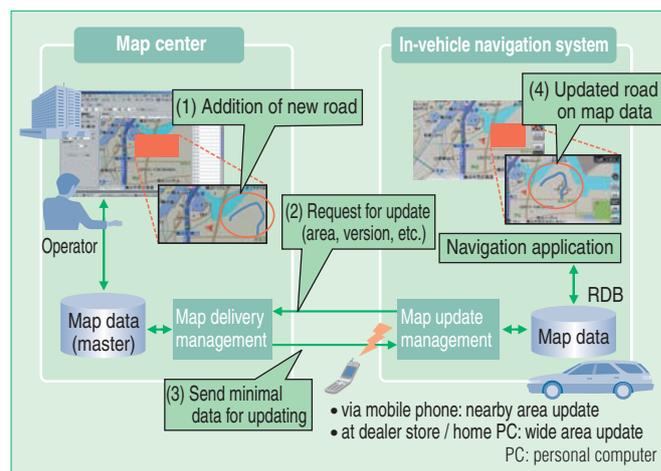
Although development of incremental map update technology has

been considered previously, it was generally recognized that such an approach would be difficult to implement. We overturned this view by adopting a new map format and succeeded in implementing the practical incremental map update technology that could be used for all roads. Hitachi has also released an integrated digital map solution based on this core technology. The solution combines the digital map compilation service, map data distribution management service, and outsourcing service and provides operational support to customers. We plan to offer our solution widely, not only in the domestic market but also in the global market in the future.

Although this is the first time Hitachi has entered the digital map business, our service has been well received and we believe the market offers great opportunities.

Making Digital Maps More Valuable with Solutions that Expand the Possibilities

Vehicle navigation systems in the near future will likely be used not only for route guidance but also for predictive control of the vehicle to prevent accidents. To achieve these objectives, the map information must be up to date and highly reliable. While working to make our products easier to use, our objectives also include making car mobility more comfortable, reducing environmental impacts by providing appropriate route guidance, and making driving even safer in the future. We also intend to extend the use of our map updating solution beyond vehicle navigation systems and into PNDs (personal navigation devices), mobile phones, and other mobile devices. Moreover, we intend to raise the value of our technology and solutions by applying them in new applications such as pedestrian navigation, and by customizing and personalizing maps using the incremental map update technology.



Operation flow of incremental map update technology

Hitachi's ESCO Business Contribution for Global Warming Prevention

The enforcement of the Kyoto Protocol, which obliges industrialized countries to reduce CO₂ and other greenhouse gases, is giving momentum to the startup of the ESCO which has a business strategy based on energy solution services. One of the features of Hitachi's ESCO business is its integration capabilities whereby it is able to call on the technologies and experience of the Hitachi Group acquired through the delivery of a wide variety of different plants and equipment. Currently, Hitachi's ESCO business is delivering energy savings, cost reductions, and reductions in CO₂ emissions by providing support to companies that are working on preventing global warming in and outside Japan.



Yuji Koga (left), General Manager; Shuichi Minagawa (right), Senior Engineer, Energy Service Department, Energy Solution Division, Urban Planning and Development Systems

Providing Support through Technology and Integration

Hitachi was an early adopter of proactive environmental measures as part of our CSR (corporate social responsibility) activities and the outcomes from these measures are utilized in by ESCO (energy service company). Unlike many other companies that specialize in particular areas, Hitachi's ESCO business provides our customers with comprehensive support ranging from analysis of energy savings in entire factories or buildings through to financing, maintenance and verification. Hitachi excels at business-wide optimization through engineering and consulting.

ESCO frees customers from the need to make capital investment and guarantees long-term reductions in energy use after energy saving modifications are introduced. The service also offers significant benefits such as gaining access to subsidy schemes and acting on the customer's behalf to deal with the complex procedures associated with obtaining credits under the CDM (clean development mechanism). Recently some companies have focused more on reducing CO₂ (carbon dioxide) emissions than on cost advantages because CSR comes first in these companies, indicating a shift in attitudes toward protection of the global environment.

Overseas ESCO Business

Hitachi's energy solution service has been adopted at 155 sites (about 70 ESCO contracts) in Japan and has been expanding globally since 2004 with work in Southeast Asia. This choice of Southeast Asia was because the region is home to a large number of factories belonging to Japanese companies and because it has a heavy demand for "cooling," with air-conditioning being required in work environments such as the clean rooms used for semiconductors, precision electronic equipment, and printed circuit boards. Also, because many of these companies entered the region between the years 1995 and 2000, Hitachi's entry into the market coincided with the need to upgrade existing facilities. Examples from Southeast Asia of where adoption of the service has

proved effective include methods for saving expensive electricity, exhaust heat recovery from generators used to supply continuous power in locations where the power supply is unreliable, promotion of centralization using packaged air-conditioning systems, and waste heat recovery from air compressor. Contract terms are from five to eight years. Hitachi has received nine orders (six ESCO contracts) to date in Southeast Asia. We currently have operations in the Philippines, Singapore, and Thailand and have presented proposals in Indonesia and Malaysia. The intention is to expand the scope of the business into other areas that consume large amounts of heat such as the food industry.

In November 2008, the "Hitachi Energy Solution Top Management Seminar" was held in Manila to introduce ESCO practices and what ESCO can offer in terms of solutions for reducing CO₂ emissions. A presentation from a visiting lecturer about the trends and future challenges for energy in the Philippines was favorably received by customers who felt that it was helpful not only for themselves but also for companies considering the adoption of the service. Many people including government officials and members from various companies with bases in Southeast Asia attended the seminar and enthusiastically asked questions even after the end of the seminar, so much so that the seminar staff were preoccupied with responses to the questions. Hitachi is planning to hold seminars in other parts of Southeast Asia to provide customers with more information.

Hitachi demonstrated a super-energy-saving transformer and other products at the "Eco-products International Fair 2009" (held in Manila in March 2009) where they were favorably received. The Fair is one of the largest international environmental exhibitions and international environmental conventions in Asia.



Dr. Lilia B. De Lima, Director General of Philippine Economic Zone Authority, giving lecture at Hitachi Energy Solution Top Management Seminar

Aim is to Achieve Triple-win

It is desirable that the ESCO business be operated by local staff from the perspective of community involvement. Such an outcome would indicate that ESCO had become well entrenched. Having established this as the objective for the future form of the business, Hitachi is making an effort to develop local staff. Hitachi intends to make all of its technologies available to the ESCO business with the aim of achieving a triple-win with benefits for the global environment, customers, and Hitachi itself.

Integrity Testing Technology for Reactor Equipment

When the Niigata-Chuetsu-Oki Earthquake occurred in July 2007, the seismic wave measured at the Kashiwazaki-Kariwa Nuclear Power Station of The Tokyo Electric Power Co., Inc. exceeded the assumptions made in the plant design. Although no external damage was evident in any safety-critical equipment, microscopic deformation is not detectable by visual checking and therefore methods for detecting plastic strain were investigated and on-site testing carried out. Because there is currently no established practice for testing plant piping and other equipment for plastic strain, potential detection methods were investigated and promising methods were subjected to tests to determine their fundamental characteristics. Based on this testing and on considerations such as the practicality of using the various methods on-site, a detection method based on hardness measurement was selected. Testing for plastic strain by measuring the surface hardness of pipes and other equipment was also reviewed, and procedures were established and then used to check the piping at the Kashiwazaki-Kariwa Nuclear Power Station Unit No. 7. (Hitachi-GE Nuclear Energy, Ltd.)



Testing for plastic strain (hardness measurement)

Development of Three-dimensional Phased-array Ultrasonic Testing System

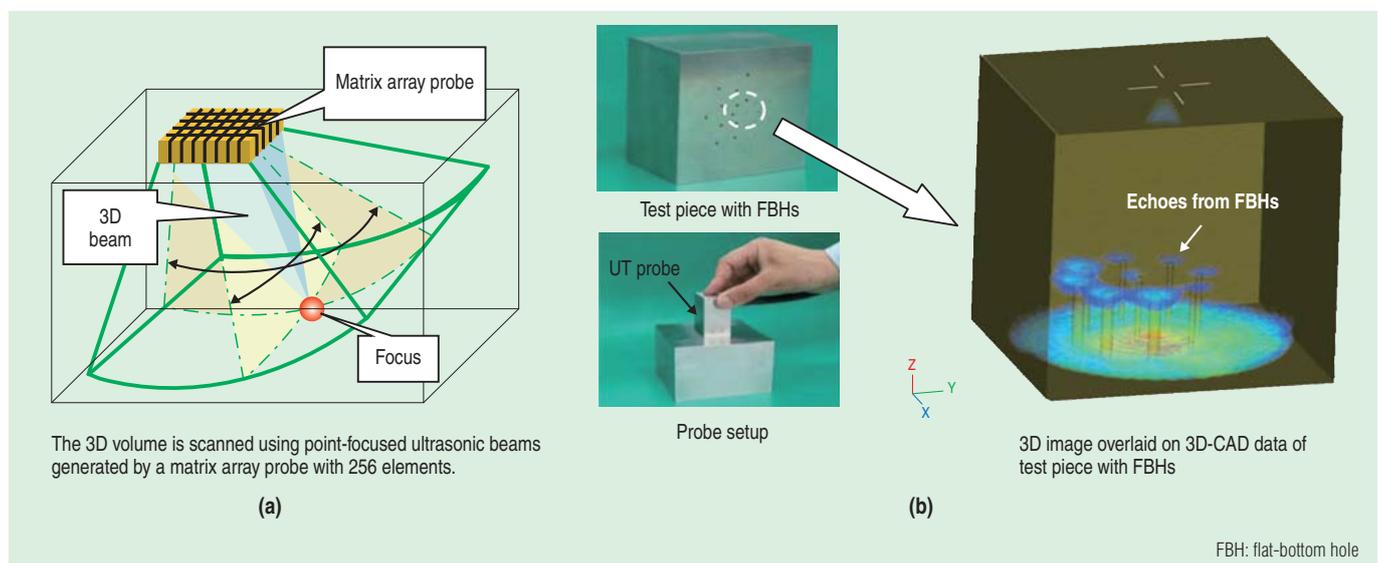
We have been developing a novel three-dimensional phased array ultrasonic testing system. The technique used by the system can scan multiple target objects volumetrically in a single operation with a scan that can penetrate through thicknesses of several hundred millimeters. The system has three main advantages compared to conventional techniques:

(1) High-speed inspection by three-dimensional electrical scanning and stereoscopic visualization of the scanned data;

(2) Higher spatial resolution obtained through the use of point-focused ultrasonic beams generated by a 256-element matrix array probe; and

(3) Easy-to-understand inspection results displayed as three-dimensional rendered images overlaid on three-dimensional-CAD (computer-aided design) data. We plan to use the system in nuclear reactor inspection to improve power plant reliability.

(Hitachi-GE Nuclear Energy, Ltd.)



Concept of three-dimensional phased array ultrasonic testing (a) and three-dimensional image (b)

Installation of New Large Monitoring Display for Unit No. 1 at the Shimane Nuclear Power Station of The Chugoku Electric Power Co., Inc.

A 46-inch liquid crystal display has replaced the existing monitor unit for the entire reactor core. The unit is installed in the center of the reactor control panel at the front of the central control room for Unit No. 1 at the Shimane Nuclear Power Station of The Chugoku Electric Power Co., Inc. Unlike the previous unit which only displayed control rod data, the new display shows information for the entire plant which is output from the process computer. This facilitates information sharing among operators, and makes operation and monitoring easier. On the other hand, the smaller display unit that is also for monitoring the entire reactor core, which displays information directly from the control rod monitoring unit, has been retained to provide a redundancy in data display.

[Key features]

- (1) In addition to displaying the control rod position, the large liquid crystal display also shows plant-wide data required for monitoring and control.
- (2) For ease of use, the information to display can be selected from any process computer console (screen switching).



Large monitoring display for Unit No. 1 at the Shimane Nuclear Power Station of The Chugoku Electric Power Co., Inc.

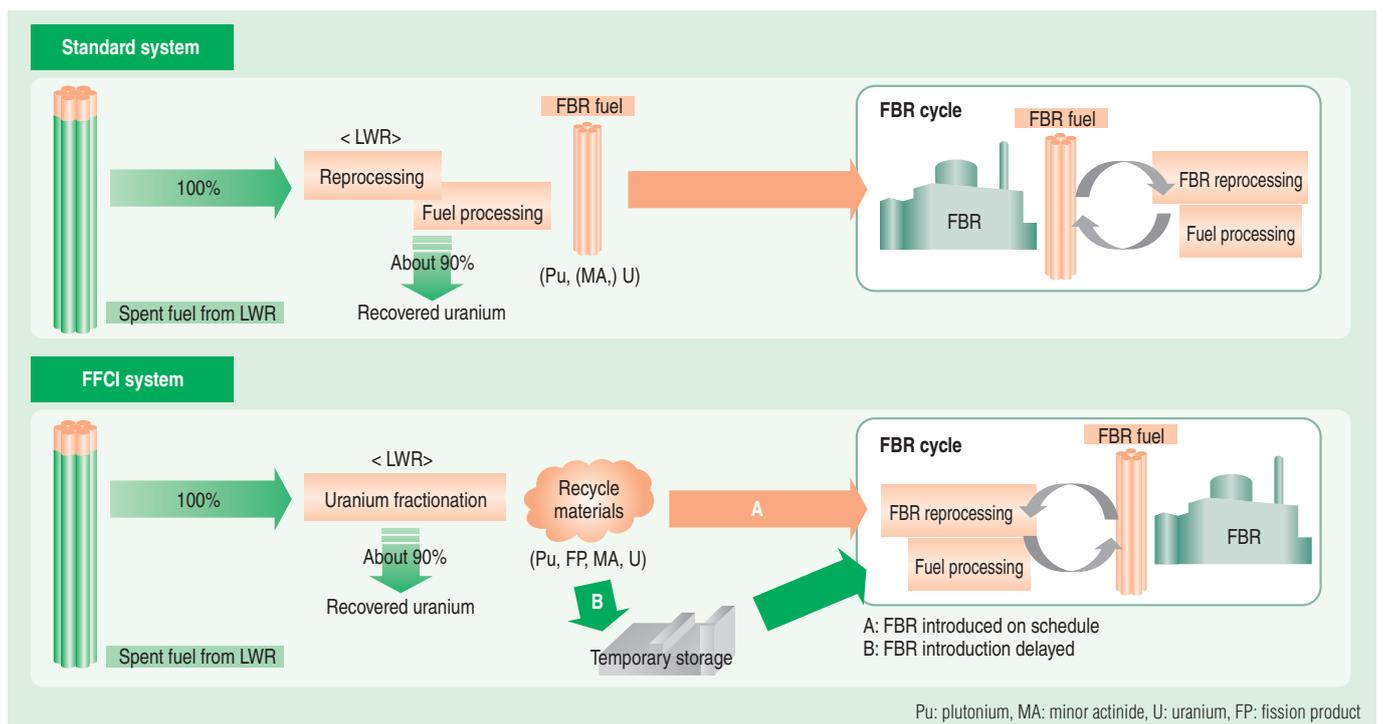
Flexible Fuel Cycle System in Transition Period from LWR to FBR

A government-initiated preliminary review on the transition cycle from LWRs (light water reactors) to FBRs (fast breeder reactors) is under way in Japan. Hitachi is currently engaged in government-sponsored research involving the development of the FFCI (flexible fuel cycle initiative) system which is suitable for use during the transition stage. It has been demonstrated that the FFCI system can deal flexibly with the uncertainties of the transition peri-

od, which include the speed and timing of FBR introduction, and that FFCI provides better economics than the standard system currently in consideration.

Hitachi will pursue further research and development aimed at commercializing this system, including the development of various technologies associated with FFCI.

(Hitachi-GE Nuclear Energy, Ltd.)



Comparison between standard system and FFCI system

Completion of H-25 Gas Turbine Generator Facility for Korea Petrochemical Ind. Co., Ltd. in South Korea

Hitachi delivered an H-25 gas turbine generator facility to Korea Petrochemical Ind. Co., Ltd. in South Korea. The facility commenced commercial operation in May 2008. The energy-saving, compact, and highly efficient H-25 gas turbine generator facility was introduced to replace an existing gas turbine generator facility operated by the company. The new gas turbine can operate on either methane off-gas (a by-product gas from the petrochemical plant consisting primarily of methane) or LPG (liquefied petroleum gas) fuel.

[Key features]

(1) Gas turbine

Model: H-25 gas turbine (heavy-duty type)

Rated output: 31,380 kW (15°C)

(2) Generator

Model: totally-enclosed internally-air-cooled type

Capacity/frequency: 34,990 kVA, 60 Hz

Excitation method: brushless exciter



H-25 gas turbine generator for Korea Petrochemical Industry Co., Ltd. in South Korea

Advanced Humid Air Turbine, AHAT-Phase II

Hitachi invented an AHAT (advanced humid air turbine), which is designated as a priority energy innovation technology for the reduction in CO₂ (carbon dioxide) emissions, and is now carrying out the technology development of a 100-MW-class medium-capacity AHAT for practical application with the support of the

Agency for Natural Resources and Energy.

This system performs heat recovery from exhaust gas as low-temperature high-humidity air by letting the discharged air from the compressor directly contact hot water in the humidifying tower. It is designed to improve efficiency by increasing the output

through the increased moisture and by pre-heating the combustion air in the regenerator to reduce fuel. In addition, the compressor power is reduced by spraying the compressor inlet of the gas turbine with fine droplets to suppress the rise of the air temperature in the compressor. These measures achieve a highly efficient system only with gas turbine but without steam turbine, which is equivalent to or higher than the combined cycle.

Hitachi developed the elemental technology in Phase I from 2004 to 2006, and in a test at a pilot plant, achieved the thermal efficiency of 40% in LHV (lower heating value), which is the highest level in the world for small machines. This result verified that the principle works out. The development of elements for practical application started during the period from 2008 to 2011.



4-MW-class pilot plant in Hitachinaka City, Ibaraki Prefecture (AHAT-Phase I)

Upgrade of Turbine Generator No. 2 at Kori Nuclear Power Plant of KHNP in South Korea

At the Kori Nuclear Power Plant of KOREA HYDRO & NUCLEAR POWER CO., LTD. (KHNP), Hitachi replaced the existing Turbine Generator No. 2 manufactured by another company and started operation in July 2008.

Hitachi manufactured the turbine generator for this project as part of a consortium with a number of Korean manufacturers. Working with the customer, they successfully completed installation and commissioning in a short period of time.

The success of this project was partly brought about by the strong relationship of trust with the customer established during a 2005 project to replace Generator No. 1 in which Hitachi overcame various technological problems associated with replacing a unit manufactured by another company.

[Main specifications]
Capacity: 840 MVA



Turbine Generator No. 2 at Kori Nuclear Power Plant of KHNP in South Korea

Output: 756 MW
Voltage: 22 kV
Current: 22,045 A
Rotation speed: 1,800 min⁻¹

Factory Shipment of 962-MVA Turbine Generator for Walsum Cogeneration Plant of Evonik Steag GmbH in Germany

A 962-MVA turbine generator for Unit No. 10 at the Walsum Cogeneration Plant of Evonik Steag GmbH in Germany was recently completed and shipped from the factory.

The project represents the first time Hitachi, Ltd. has supplied

equipment to a large coal-fired power plant in Germany and was managed through a consortium with Hitachi Power Europe GmbH (HPE).

In terms of capacity, the 962-MVA turbine generator is the second largest bipolar 50-Hz generator to be installed in a thermal power station after the 1,120-MVA unit which was completed at the factory in 2006. To improve performance and quality while also ensuring that the design specifications were satisfied, analysis and factory testing were conducted to verify the suitability of technologies for use in 1,000-MVA-class generators. Various measures were also adopted to ensure that the generator system configuration complied with European and German local standards, including extensive use of European vendors.

The generator is scheduled to become operational in 2010 after installation and on-site commissioning.

[Main specifications]
Capacity: 962 MVA
Power factor: 0.825
Voltage: 21 kV
Current: 26,448 A
Rotation speed: 3,000 min⁻¹



962-MVA turbine generator for Walsum Cogeneration Plant of Evonik Steag GmbH in Germany

New HMI for Power Plant

The proposed HMI (human-machine interface) system, used by power plant operators for plant monitoring and operation, satisfies diverse requirements for power plant operation. The growing demand for electric power throughout the world, especially in emerging countries, means that power plant operation needs to be made more efficient.

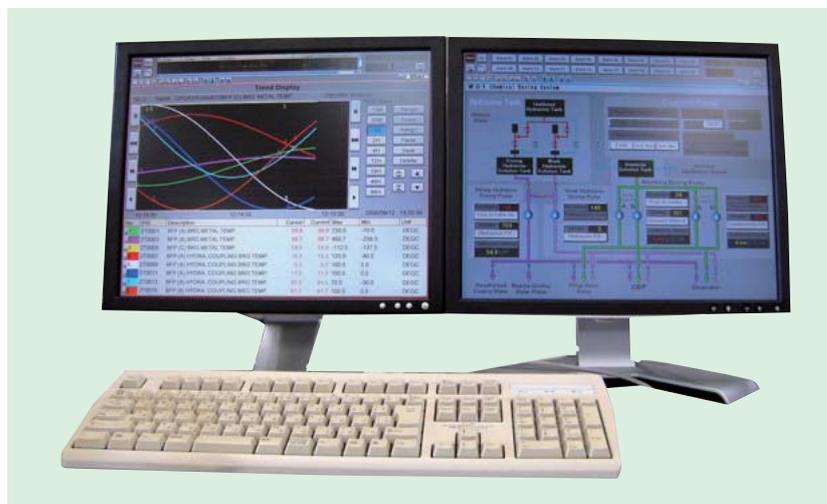
[Key features]

(1) The dual-monitor system with two monitors connected to one HMI CPU (central processing unit) allows more detailed monitoring and operation by expanding the scope of information that can be viewed at the same time.

(2) The three-dimensional and Windows-based graphic displays provide excellent visual representation that enables operators to understand the state of the power plant intuitively.

(3) The system for long-term storage of process and operational data provides efficient troubleshooting.

(4) The system is highly scalable and easy to link to the existing computer automation system. The existing computer automation



Dual-monitor system

system has functions such as plant startup schedule calculation and APS (automatic plant startup and shutdown system).

Start of Operation of the 306-MW Pump-turbine at Xilongchi PSPS Project of Shanxi Xilongchi Pumped Storage Power Station Co., Ltd. in China

After completing a 30-day reliability test, the No.4 306-MW pumped-storage power station developed as part of the Xilongchi PSPS (Pumped-storage Power Station) Project began operation on December 28, 2008. The power station has a maximum pump head of 703 m.

The purpose of the power station is to balance peak power loads

and help stabilize the power supply to Northern China including Beijing City. It took more than four years from the time the contract was signed in September 2004 until the first unit started commercial operation.

The order for the power station was handled by a consortium consisting of Hitachi, Ltd. (pump-turbine), Toshiba Corporation (pump-turbine and generator-motor), Mitsubishi Electric Corporation (generator-motor and controls), and Mitsubishi Corporation (commercial management) and was the first contract awarded to Japanese heavy electric machinery manufacturers for a pumped storage power station.

The Xilongchi PSPS Project has the highest head of any pump-turbine in China and the fourth highest in the world (after the Kazunogawa, Kannagawa, and Omarugawa power plants in Japan).

All equipment was designed and manufactured using the latest computing technology. The new design generates remarkably low vibration and noise comparing to similar high-head large-capacity pump turbines and the power station's owner has been impressed by its high performance and reliability.

On May 25th 2009, the No.3 unit also began operation.

Work on preparing the remaining two pump-turbines for operation is on schedule.



Inside the Shanxi Xilongchi Pumped Storage Power Station

Commercial Operation of 300-MW Pump-turbine and Generator-motor Unit No.4 at the Omarugawa Power Station of Kyusyu Electric Power Co., Inc.

Unit No.4 of the adjustable-speed pumped-storage system at the Omarugawa Power Station of Kyushu Electric Power Co., Inc. in Miyazaki, Japan entered commercial operation in 2007. This was the first unit to commence operation at the site.

This double-feed, adjustable-speed, pumped-storage system consists of a pump-turbine, generator-motor, frequency converter, and control system. The generator-motor and frequency converter are different from those used with conventional synchronous machines. The generator-motor has a cylindrical rotor with three-phase distributed field windings, and is excited by a three-phase field current from the frequency converter which outputs a large three-phase current at low frequency. The speed of rotation of the generator-motor is adjustable.

The rating of the system is 300 MW for generation and 340 MW for pumping, with a speed of rotation of $600 \pm 24 \text{ min}^{-1}$.

The principal features of the adjustable-speed units are the adjustability of the pump input power and the ability to use AFC (automatic frequency control) when pumping. These features help stabilize the power system at night time. The ability of the

system to vary the pumping input rapidly from 240 MW to 340 MW also helps to compensate for fluctuations from green energy sources.

Unit No.1 is now under construction and planned to be put into operation in 2011, and they will contribute power system in Kyushu area, and the global environment as well.

[Ratings]

(1) System

Maximum input: 340 MW
Maximum output: 300 MW

(2) Pump-turbine

Maximum net head: 671.8 m
Maximum output: 310 MW
Maximum total dynamic head: 720.4 m
Maximum pump input: 330 MW

(3) Generator-motor

Capacity: 345 MVA/330 MW
Rated voltage: 16.5 kV
Rotating speed: $600 \pm 24 \text{ min}^{-1}$



(a)



(b)



(c)

Installing pump-turbine runner (a), installing generator-motor rotor (b), and underground power house cavern (c)

Upgrade of 42-MW Splitter Blade Runner for Shinnakachiyama Power Station of Hokuriku Electric Power Company

The hydro turbine runner replacement work for the Shinnakachiyama Power Station of Hokuriku Electric Power Company was completed in January 2006 for Unit No. 2 and in December 2007 for Unit No. 1.

The replacement used splitter blade runners which have excellent erosion resistance and anti-cavitation properties. The shape of the runner was developed to have these characteristics in a joint research project with Hokuriku Electric Power Company that used the latest of the fluid analysis techniques, solid-liquid two-phase flow analysis, to optimize the shape. In addition to lengthening the inspection intervals and reducing the maintenance costs, the new runners will improve the efficiency of the hydro turbine over its entire operating range including operation under partial load which accounts for a high percentage of operation.

The improved equipment efficiency increases the maximum output per unit by 500 kW compared with the existing configuration. Annual power generation is expected to grow by approximately 4,300,000 kWh which represents a reduction in CO₂ (carbon dioxide) emissions of approximately 4,000 t.



Splitter blade runner for Shinnakachiyama Power Plant of Hokuriku Electric Power Company and three-dimensional CAD (computer-aided design) drawing (lower left)

Upgrade of Thyristor Starter for Numazawa No. 2 Power Station of Tohoku Electric Power Co., Inc.

The utilization of clean natural energy has been encouraged in recent years as a way of curbing global warming. One technique that can have a significant impact in leveling the electric power load over the course of a day is hydroelectric power generation using pumped storage. This works by pumping up water from a lower reservoir during times of low electricity use such as during

the night or on holidays, and then using this water to generate hydroelectric power during times of high demand and in the process returning the water to the lower reservoir.

Numazawa No. 2 Power Station is the largest pumped-storage facility operated by Tohoku Electric Power Co., Inc. and has an output of 460,000 kW. The power station generates power from

the 214-m drop between its upper reservoir, Lake Numazawa, and its lower reservoir, the Miyashita Regulating Reservoir of River Tadami. Because it is 25 years since the power station commenced operation in 1982, a number of parts used in the power station have reached the end of their lives and obtaining replacements has proved difficult. These included the thyristor converter in the thyristor starter used in the pumped-storage power generator, and electric and electronic parts used in the control protection panel.

In response to this situation, Hitachi carried out an upgrade to the power station which included installing a new thyristor converter with the latest technology, new digital control protection equipment, and a starting transformer. This upgrade will significantly contribute to stable power supply in the future.

(Start of operation after upgrade: December 2007)



Thyristor starter for Numazawa No. 2 Power Station of Tohoku Electric Power Co., Inc.

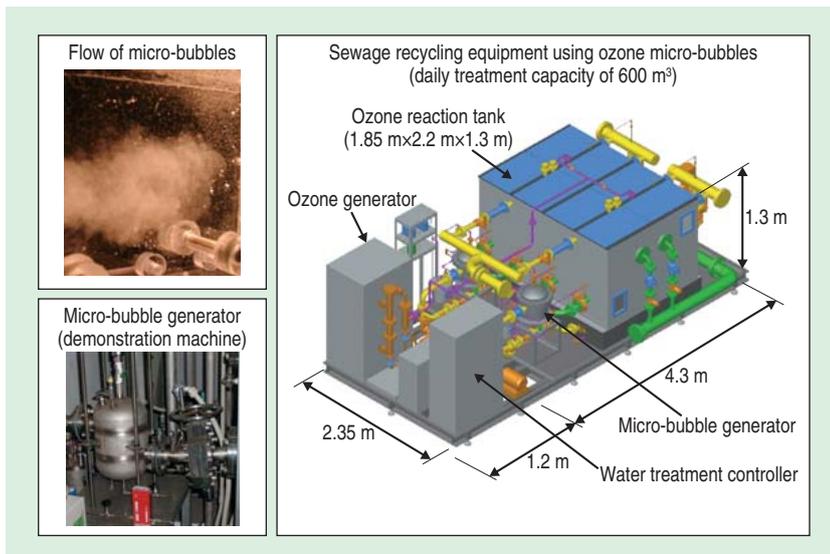
Sewage Recycling Equipment Using Ozone Micro-bubbles

With the reuse of treated sewage attracting attention against a backdrop of worldwide water shortages, Hitachi has developed sewage recycling equipment that uses ozone micro-bubbles (diameter of bubble: approximately 50 μm) for water uses that require a relatively high level of water quality. Hitachi has com-

pleted performance trials at an actual treatment plant and is now accepting orders for commercial systems with daily treatment capacities of 300 to 2,400 m^3 (models are available with capacities of 300, 600, 900, 1,200, and 2,400 m^3 respectively).

The new recycling equipment features a unique bubble generation method that increases the efficiency of micro-bubble generation and significantly reduces the associated power requirements. The high solubility and reactivity characteristics of micro-bubbles also reduce both ozone use and ozone emissions while allowing use of a smaller reaction tank. The equipment design used fluid analysis technology that modeled the micro-bubble flow to optimize the structure and dimensions of the reaction tank. These features provide a low-cost and stable supply of recycled water that meets water quality criteria for recreational use.

These technical features help reduce the burden on the environment by providing better water quality despite consuming less power than existing ozone treatment equipment for recycled water treatment.



Overview of sewage recycling equipment using ozone micro-bubbles

New "Yama Hotaru" Initiative Energy Solution

In addition to energy savings, use of renewable energy sources such as solar, water, and wind is strongly required to avoid the worsening global warming crisis. However, renewable energy is unstable and the question of how to stabilize low-capacity energy sources for practical use remains a problem.

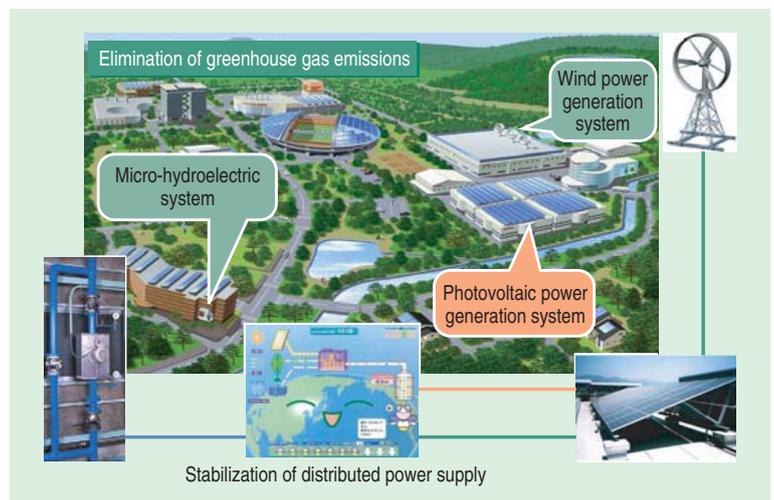
With a new energy solution called the "Yama Hotaru" Initiative (Yama Hotaru refers to a mountain firefly), Hitachi aims to expand the use of such energy sources by establishing systems that utilize motor and inverter technologies to provide stable use of electrical energy based on the concept of "local production for local consumption."

The scale of use of nearby renewable energy sources is small and accordingly small-scale distributed power supply systems are appropriate. Also, because the quantity of electric energy able to be obtained is limited, the return on investment is small. Rather than considering pre-packaged equipment, a utilization plan for renewable energy requires careful investigation of actual case studies and customization to suit actual circumstances which can then be deployed in similar situations elsewhere. Making highly efficient use of the available electric energy also requires that the energy be utilized directly in direct current form rather than only in alter-

nating current form through a conventional interconnection with the electricity grid.

These approaches can be expected to lead to widespread use of safe and stable systems in the future.

(Hitachi Industrial Equipment Systems Co., Ltd.)



Overview of new energy solution called "Yama Hotaru" Initiative

Train Maintenance Business in the UK



Class 395 high-speed trains at Ashford Depot in the UK

Hitachi entered the UK railway market in 2005 with an order for its Class 395 high-speed train for the CTRL-DS (Channel Tunnel Rail Link—Domestic Service). This contract included the manufacture of new vehicles and post-delivery maintenance. As a result, Hitachi Rail Maintenance (UK) Ltd. was founded in

December 2005 to establish a maintenance organization by constructing a depot, recruiting staff, and making various arrangements.

A new depot was built at a site next to Ashford International Station, an important operational hub. The layout of the new depot was designed specifically for maintenance of Class 395 trains with state-of-the-art facilities including automatic measurement equipment and an information management system. Because the arrangement with the customer made the manufacturer responsible for whole lifetime up to and including disposal of the trains, maintenance personnel were involved from the initial planning stages to ensure that the trains were designed and manufactured for maintainability and to minimize life-cycle costs.

In addition to maintaining the trains being used for testing, Hitachi is currently preparing for the commencement of commercial operation in December 2009 by establishing a comprehensive maintenance organization, including improving operation manuals and carrying out thorough employee training.

High-speed Train for UK with Diesel-hybrid Traction

The DEL (diesel electric locomotive), DMU (diesel multiple unit), and DEMU (diesel electric multiple unit) are the mainstays of the UK's long-distance high-speed trains. In order to improve the environmental performance of these locomotives by reducing fuel consumption and harmful exhaust emissions, Hitachi developed a large-capacity diesel-hybrid system for use in the high-speed DEL, DMU, and DEMU. This system features the use of regenerative braking in a non-electrified rail system, something that was not possible in the past. Use of regenerative energy provides energy savings and assists with acceleration performance by means of a storage battery.

The newly developed hybrid system has been installed in an upgrade to a DEL from an existing HST (high-speed train) through a joint venture with the rail operator in the UK. The upgraded locomotive was incorporated into an existing train which commenced trials on a heritage railway in May 2007. Between September 2007 and September 2008, it was used for track and overhead wiring inspection where it traveled along commercial routes all over the UK at a maximum speed of 125 miles per hour (approximately



High-speed train with diesel-hybrid drive running on commercial route in the UK

200 km/h).

The environmental performance and reliability of the system have been demonstrated over more than 100,000 km of fault-free operation.

Japan Freight Railway Company GPS-based Operation Support System

Japan Freight Railway Company introduced an operation support system based on the GPS (global positioning system) called PRANETS (positioning system for rail network and safety operating) on the Tokaido Line (between Tokyo and Osaka) in March 2008 to ensure safe and reliable transportation. System components are installed in the operator's seat on the locomotive. These include speakers, displays, antennas, and an in-vehicle unit that performs GPS satellite reception and transmits the acquired position information to the fixed system via the mobile telephone network. The system provides the driver with accurate and timely information in audio and visual form, such as advance notice of low-speed sections, overspeed warnings, and station departure information. The information is generated based on operational data produced by the fixed system and train position information obtained from the GPS. The system is being deployed in locomotives throughout Japan where it prevents human errors by helping assess situations while also supplying the fixed system with train position information to improve service levels and help achieve reliable operation.



Display terminal in operating train (top right of the photograph) (photograph courtesy of Japan Freight Railway Company)

(Start of operation on major lines: March 2009)
(Hitachi Industrial Equipment Systems Co., Ltd.)

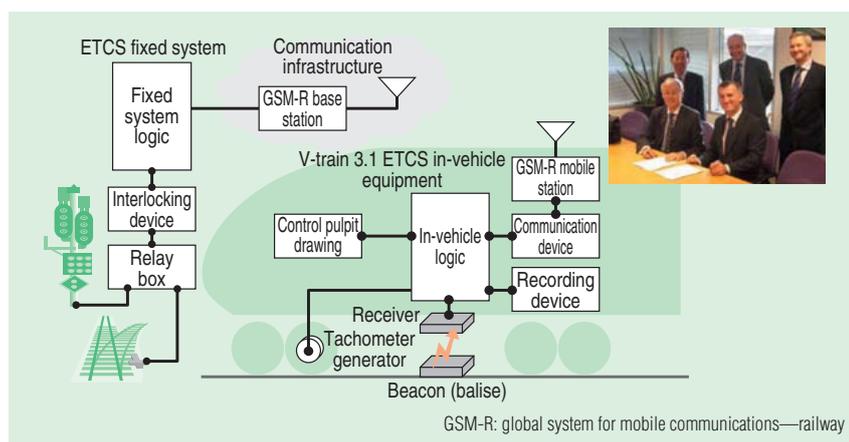
In-vehicle Train Control System Compliant with European Standards—UK V-train 3.1

The ERTMS (European Rail Traffic Management System) and ETCS (European Train Control System) common European standards for train control systems were established at the initiative of the Union Internationale des Chemins de fer (UIC), also known as the International Union of Railways, and European railway operators and suppliers with the objective of facilitating shared use of rail networks and increasing transport volumes. The systems were established as European Union (EU) standards in 1996 and are currently being put into practical use.

As the only standardized train control systems, it is anticipated that they will also be adopted outside Europe in Asian countries such as China, India, and South Korea. Given these circumstances, Hitachi became the first non-European supplier to embark on ETCS development with a view to the expansion of its railway business in markets outside Japan.

Hitachi selected the UK, where introduction of ETCS had just started, as its first target market because of the openness of the country's market and the strong ties that the company has established with customers and related organizations through the Class 395 high-speed train for the CTRL-DS (Channel Tunnel Rail Link—Domestic Service) and other projects for which Hitachi has bid in the past.

Hitachi began a technology exchange with its UK customer Network Rail (the railway infrastructure management company) in 2005 and signed an agreement in September 2007 to jointly develop a UK specified ETCS and carry out demonstration trials. The agreement was announced to the press in February 2008. This project was named "UK V-train 3.1." Hitachi plans initially to develop in-vehicle equipment and this will subsequently be commercialized after various safety certifications are obtained.



System configuration of V-train 3.1 and scene from signing of contract in the UK (upper right)

HTM1500 Motor for Oil Drilling Rigs



HTM1500 motor for oil drilling rigs

Although oil drilling rigs in the past typically used DC (direct current) motors, recent years have seen a shift to AC (alternating current) motors because they are achieving higher power output and more ease of maintenance.

Despite its high power output, the HTM1500 has a very compact design which was realized by adopting technology through the use of detailed airflow analysis and temperature analysis techniques.

[Key features]

(1) Universal terminal box facilitates installation in restricted on-site environments.

(2) Compatibility with existing DC motors facilitates easier retrofitting.

Hitachi intends to develop higher-capacity AC motors and expand its product range to meet the need for greater equipment capacity.

24-kV Vacuum-insulated Switchgear

Hitachi has developed a 24-kV vacuum-insulated switchgear unit for power distribution markets outside Japan that is IEC (International Electrotechnical Commission) standards compliant. Key features of the switchgear include its environmental performance, safety features, ease of maintenance, and lighter, compact design.

In terms of environmental performance, the 24-kV switchgear design combines solid insulation with vacuum switchgear to eliminate completely the use of SF₆ (sulfur hexafluoride) gas which has a global warming potential approximately 23,900 times higher than CO₂ (carbon dioxide). The vacuum switchgear uses vacuum insulation which is both clean and provides excellent insulation. The design also considers safety by using a dual contact mechanism in the circuit breaker to improve reliability and by a phase-segregated structure to prevent short-circuit accidents. To reduce maintenance requirements, the mechanical moving parts of the switchgear are designed to use solid lubricant and therefore do not require grease.

[Main specifications]

(1) Rated voltage: 24 kV

(2) Rated current: 630/800/1,250 A

(3) Rated withstand voltage: 50 kV at power frequency, 125 kV for lightning impulse



24-kV vacuum-insulated switchgear

(4) Dimensions: 600 mm (width)×1,300 mm (depth)×2,000 mm (height)

90–120-kW Two-stage Oil-free Screw Compressor

Oil-free rotary screw compressors are widely used in industries such as foods and beverages or chemicals that have high environmental standards and require compressed air free of oil contamination. Hitachi Industrial Equipment Systems Co., Ltd. has released newly designed oil-free rotary screw compressor models



90–120-kW two-stage oil-free screw compressor

rated between 90 and 120 kW as part of its next generation product line.

[Key features]

- (1) Best-in-class compressed air delivery using a newly developed high-efficiency air end (compression mechanical component)
- (2) Lower operating sound level achieved through the use of low-noise air ends, the adoption of an anti-vibration structure in the drive train, and lower air intake and discharge noise
- (3) Lightweight space-saving design achieved through a small and lightweight drive train system and a layout that locates the cooling fan motor in the upper part of the unit
- (4) Discharge pressures up to 0.93 MPa are achieved by adoption of newly developed air ends and the pre-cooler cooling system.
- (5) An oil mist remover (patented by Hitachi) is provided as a standard feature to prevent the compressor from discharging oil mist from the gear case to the atmosphere.
- (6) An intermittent drainage valve for condensate water is provided as a standard feature to reduce consumption of the compressed air used for the drainage line.
- (7) A new control board is adopted to provide easier operation, additional functions, and enhanced communication capabilities. (Hitachi Industrial Equipment Systems Co., Ltd.)

Stainless Submersible Deep Well Pump

Deep well pumps are used for a wide variety of applications including water supply in areas that have no piped water, melting of snow on roads and parking lots, sprinkling water on golf courses, and pumping hot spring water from the ground.

The products in the Hitachi deep well pump series support well diameters of 150 mm or 200 mm and complement the small well diameter (100 mm) stainless series released earlier.

[Key features]

- (1) Excellent durability and corrosion resistance

The main parts of the pump are made of stainless steel for excellent durability.

- (2) Excellent anti-sand performance

The pump impeller is either a polytetrafluoroethylene movable ring (in the 150-mm model) or a stainless steel casting (in the 200-mm model) to withstand the heavy abrasion to which it is exposed.

- (3) Can be used with PVC (polyvinyl chloride) wells

Pumps with a pump diameter of 65 mm or smaller can be installed in PVC wells (maximum outside dimension: 141 mm)

- (4) Performance (models for 150-mm and 200-mm wells)

50 Hz: Water volume: 0.11 to 1.3 (m³/min)

Total head: up to 200 m

60 Hz: Water volume: 0.12 to 1.5 (m³/min)

Total head: up to 200 m

(Hitachi Industrial Equipment Systems Co., Ltd.)



Submersible deep well pump

High-performance Electric Chain Hoist

Users place many different requirements on equipment used to lift and transport heavy loads and the demand for products that satisfy these requirements is increasing. Because of the heavy loads lifted by these machines, there is a perpetual risk of loads falling and reducing the potential causes of such falls is an important challenge for the manufacturer. These requirements



High-performance electric chain hoist

are expected to grow further in the global markets. In response, Hitachi has developed a new electric chain hoist that combines advanced functions with a high level of safety.

[Key features]

- (1) Increased motor and chain size provides faster operation, lower noise, and a higher rated number of lifts.
- (2) Oil lubrication extends gear life.
- (3) Mechanism to prevent loads from falling if the gears are damaged is provided as a standard feature.
- (4) Aluminum die-casting body improves robustness.
- (5) Motor and other electrical components are designed to the IP (international protection) 55 standard to improve durability in adverse environments.
- (6) Electrical components are all located in the same place to facilitate maintenance.

[Models to be released]

Rated hoist load: 2 t to 5 t, traversing equipment
(Hitachi Industrial Equipment Systems Co., Ltd.)

Entirely Fabricated Pump Series

Recently, the extent to which industrial machinery reduces CO₂ (carbon dioxide) emissions has become an increasingly important criterion for evaluating the machinery in terms of LCA (life cycle assessment). Work is being carried out in the field of turbomachinery, specifically pumps.

Demand for vertical mixed-flow pumps is strong due to their wide use in applications such as rainwater drainage, water circulation, and intake of seawater. Also, manufacturing the pump using a fabrication process reduces the volume of CO₂ emitted during production by more than 40% compared with the conventional casting method.

The characteristics of the entirely fabricated pump are as follows.

- (1) A shorter production period is possible because using fabrication instead of casting makes supply chain management easier. The use of high-strength materials makes the pump lighter which in turn lowers costs and reduces the area required for a pump station.
- (2) Use of homogenous rolled materials eliminates the risk of material defects, provides high reliability, and allows easy repair.
- (3) In pumps intended for use with sea water, LCC (life cycle costs) can be minimized by using duplex stainless steel (a high strength material) because this significantly reduces the maintenance costs associated with corrosion prevention.

One of the traditional issues faced in designing the pump of this type was that the complex channel geometry of the impeller and guide vane (diffuser casing), which requires a high-level of precision, has meant that in the past they were only manufactured by casting. In the new pump, however, all the components including the impeller and guide vane are produced using a fabrication

process. This was achieved through the use of Hitachi's proprietary manufacturing technologies and by utilizing fluid-structure simulation.

(Hitachi Plant Technologies, Ltd.)



Entirely fabricated pump series vertical mixed-flow pump (a), discharge casing (b), and fabricated open impeller (c)

Hitachi Microreactor System

A microreactor carries out chemical processes on a microscopic scale. The advantages of microreactors are excellent control of temperature and concentration and that they can perform reactions quickly.

Hitachi microreactor system that uses this technology can be used to explore new applications and develop mixing, reaction, and emulsification processes in an efficient manner. They have attracted attention for their use in new product development and pro-

duction in industries such as fine chemicals, functional foods, cosmetics, and pharmaceuticals.

Hitachi commenced sales of a laboratory model with added functions and a wider range of example reactions in September 2008 and delivered the first unit in the same month. The company is working to expand sales in various different industries, with a particular emphasis on fine chemicals, cosmetics, medical supplies, and food. The new functions and features of the new model are as follows.

(1) Support for multi-stage reactions

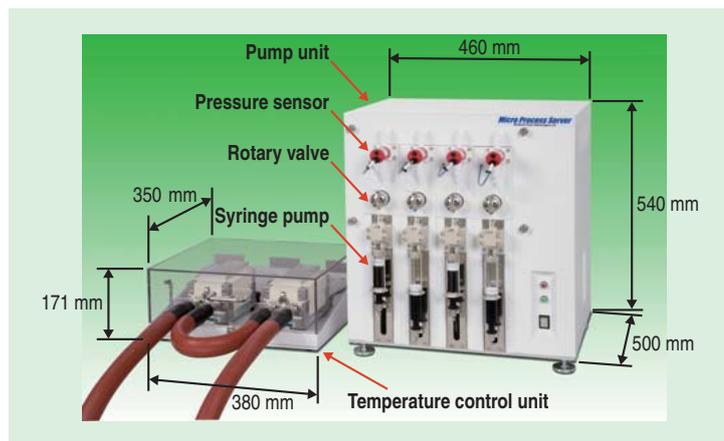
The micro-process server can perform in-line multi-stage reactions in which, for example, the reaction (solution A + solution B → solution C) is followed by (solution C + solution D → solution E).

(2) Continuous solution transport system

Continuous solution transport is achieved by alternating between two syringe pumps for each solution to prevent any interruption of solution flow.

(3) Wider temperature control range

A wide temperature control range is achieved via a temperature control mechanism in which a temperature control jacket heats or cools the chip using a constant-temperature circulator with a temperature setting range of -30 to 120°C. (Hitachi Plant Technologies, Ltd.)



Hitachi microreactor system

Large-scale Energy Monitoring System Based on Wide-area Wireless Sensor Network

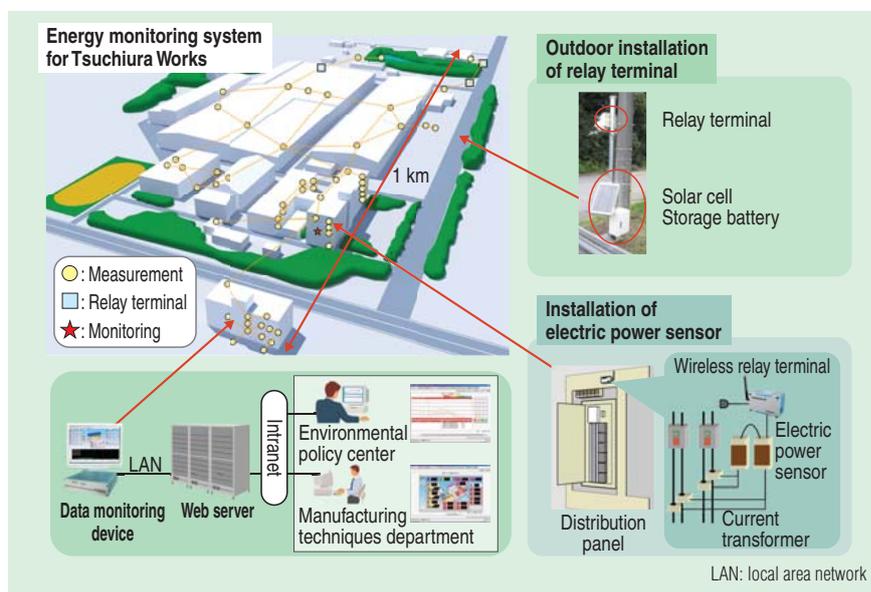
Countering global warming requires reductions in CO₂ (carbon dioxide) emissions by curbing the use of energy such as electricity and gas. Also, reducing energy use requires that we make this usage “visible” (obtain a quantitative understanding) so that we can analyze waste based on our data and then take appropriate steps. However, this is difficult to achieve in large factories and other buildings because installing a monitoring system requires extensive wiring work and it can take a long time.

In contrast, the proprietary long-distance wireless multi-hop communication function in Hitachi’s wireless sensor network system allows large-scale energy monitoring systems to be established at low cost and in a short period of time.

System installation only requires the connection of radio repeaters to power meters and does not require major wiring work. The monitoring software included with the system means that users can put it to use from the day it is installed. In addition to energy, it is also possible to collect information on the level of worker comfort by collecting room temperature, humidity, and other data

via wireless sensors. The wireless connection system is, as its inherent merit, easy to expand or move and offers excellent scalability.

(Hitachi Plant Technologies, Ltd.)



Energy monitoring system for Hitachi's Tsuchiura Works

Very Large Electric Power Shovel

Hitachi has developed and supplied very large electric-hydraulic shovels in the 350-t and 550-t classes. Although Hitachi has supplied more than 20 electric power shovels, mainly in the 250-t class, since the 1970s, the rising price of oil in recent years is driving demand for the development of standardized models. To meet this demand, Hitachi started developing a power shovel



250-t power shovel at work in China

driven by electric motors* (supplied via a power cable) for use in its existing mining shovel models. This followed on from the development of a very large shovel series in 2006 that complied with engine emission regulations.

[Key features]

- (1) Helps prevent global warming by reducing CO₂ (carbon dioxide) emissions.
- (2) Cuts air pollution by reducing NO_x (nitrogen oxide) emissions.
- (3) Saves energy by reducing oil consumption.
- (4) Contributes to environmental conservation and zero emissions through the elimination of oil waste and filter waste.

In anticipation of further growth in demand for electric power shovels, Hitachi plans to continue with the development of new product series including converting its 190-t and 800-t shovels to electric operation.

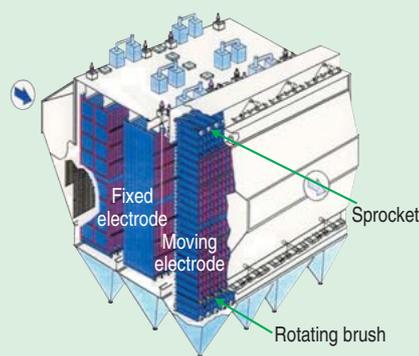
(Hitachi Construction Machinery Co., Ltd.)

* The power is usually supplied by a generator at the work site.

Moving Electrode Type Electrostatic Precipitator



Moving electrode type electrostatic precipitator for coal fired power plant



reed-shaped electrode is rotated and moved by the chain and sprocket in such a way that the dust that adheres to the dust collecting electrode is removed by a brush fitted inside the hopper. More than 50 units of this moving electrode type electrostatic precipitator have already been delivered for coal-fired power generation, steel sintering, and other applications and its reliability has been improved to a suitably high level by various modifications made

Dust contained in combustion exhaust from thermal power generation boilers must be reduced to such a level that it is not visible coming out of the chimney. Electrostatic precipitators are widely used for this purpose due to their high reliability and low running costs. Whereas typical conventional electrostatic precipitators strike the fixed dust collecting electrode with a hammer to dislodge the collected dust from the electrode, Hitachi Plant Technologies, Ltd. has developed a unique method whereby the

over this time. Features of this device include the small space required for installation and its high collection rate for dust with high electrical resistivity which is a consequence of the surface of the dust collecting electrode being kept clean and the absence of dust being scattered by hammering. These features provide space-saving benefits when new precipitators are retrofitted to existing plants to meet strengthening environmental regulations.

(Hitachi Plant Technologies, Ltd.)

Wastewater Treatment System for Canadian Oil Sand

The Canadian oil sands are famous for being the world's second largest oil deposit. One type of heavy oil extracted from the oil sand using a large amount of hot water and steam is bitumen. However, every hour, the extraction process produces several thousands tons of wastewater containing sand, bitumen, rare metals, dissolved organic compounds and so on. Because the sand is very fine-grained with a size of about $1\ \mu\text{m}$, it is difficult to remove from the wastewater in a short time using conventional techniques such as sedimentation or hydrocyclone separation. The method currently used is to transfer the wastewater to a holding pond to allow the sand to settle out, but it takes several months before the water reaches a state suitable for extracting the bitumen.

Now, Hitachi Plant Technologies, Ltd. has successfully field tested a procedure for removing not only sand but also bitumen from the wastewater in few minutes in its mobile laboratory. (Hitachi Plant Technologies, Ltd.)



Mobile laboratory located in a suburb of Calgary, Canada (left) and test result (right)

Soil Toxicity Testing System Using Bioassay

This soil toxicity testing system uses the intensity of light emitted by luminescent marine bacteria to measure acute toxicity due to soil pollutants. The testing system has excellent features including easy operation, fast testing, the ability to perform on-site measurements, and the ability to perform simultaneous measurements of multiple samples. In short, it can test for biological influences. Simultaneous measurement of up to 22 samples can be completed within 2 hours, including soil sampling and pre-treatment. Whereas effects on the human body are the basis for the reference values used in the current method of analyzing soil components, it is anticipated that testing for soil pollutants

will, in the future, require a methodology that considers effects across the entire ecosystem. The method used in this testing system is suitable for the "acute toxicity" category of soil testing and this is expected to be adopted as one of the tests for soil pollution in the future in addition to chemical analysis. (Hitachi Chemical Co., Ltd.)



Soil toxicity testing system tester (left) and reagent kit (right)

Agriculture Information Management System Using GIS Technology

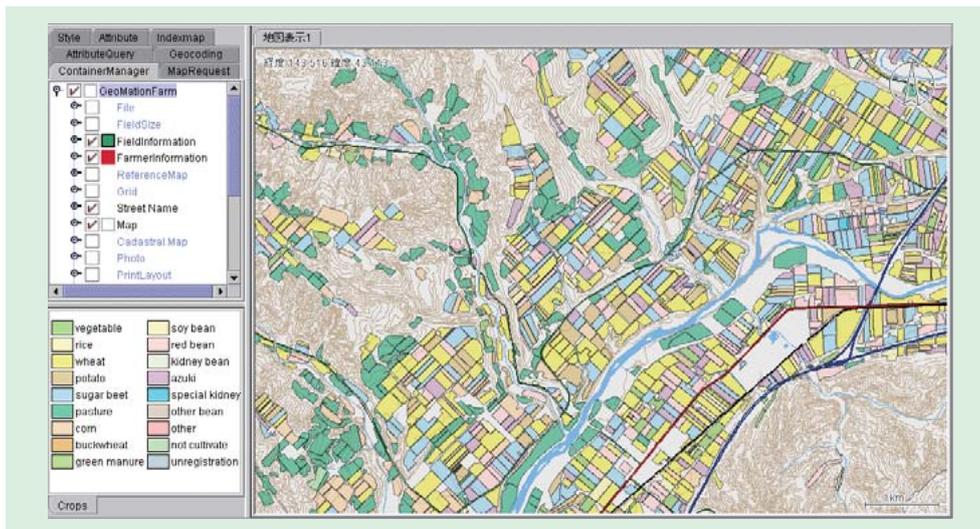
Hitachi Software Engineering Co., Ltd.'s agriculture information management system is a software solution for managing and utilizing agricultural information using GIS (geographic information system) technology. Hitachi started its agricultural ICT (information and communication technology) business six years ago. Hitachi's software has undergone numerous enhancements during the years and is now used by about 40 customers in Japan, mainly agriculture cooperatives.

The solution manages information such as cultivation records, soil type, soil conditions, growers, quantity and quality of harvest, and the location of the machines used in each field. The system uses this information to provide farmers and advisors with useful functions for managing crop rotation systems, ensuring appropriate use of agrichemicals and fertilizers, checking growth differences by using remote sensing technology, and so on. The GIS technology makes it easy for users to see the situation on the

ground and decide what actions to take to improve productivity.

In this sustainable century, agriculture not only needs to be more cost effective and productive, it must also be concerned with the environment and food safety. This is a common challenge all over the world. Being able to manage agricultural information and utilize this information in farming practice is an important part of meeting this challenge. Hitachi's solution helps meet these market needs.

(Hitachi Software Engineering Co., Ltd.)

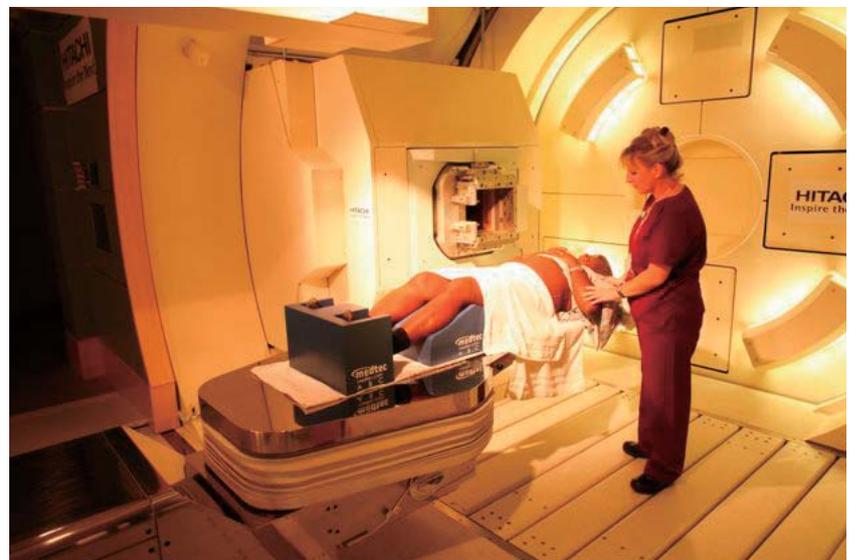


Crop/field management

Advanced Particle Beam Therapy System

Particle beam therapy takes advantage of the superior beam concentration properties of protons and other baryonic particles and is recognized as a leading-edge technique for cancer radiotherapy. Hitachi supplies advanced particle beam therapy systems that use synchrotrons based on accelerator technology and radiological technology. A proton therapy system supplied to the M. D. Anderson Cancer Center in Texas in the USA uses a synchrotron able to produce protons with a maximum energy of 250 MeV and started operation in May 2006. Three of four therapy rooms use conventional passive irradiation nozzles which enlarge and shape a thin proton beam from the accelerator by scattering the protons in the nozzle to adjust the beam based on the position and shape of the affected area in the patient's body. The fourth room uses a pencil-beam scanning nozzle that was the first such device to gain U.S. Food and Drug Administration clearance in December 2007. This nozzle achieves highly accurate and efficient therapy by directly irradiating the affected area in the patient's body with a thin proton

beam that is scanned in a three dimensional pattern without scattering. This nozzle has been used for therapy in same manner as other conventional nozzles since May 2008.



Particle beam therapy system

Completion of Utilities and Off-site Facilities for Petro Rabigh in Saudi Arabia

In March of 2009, one of the world's largest oil refineries and petrochemical complexes, which includes a 1,300,000-t/y ethylene plant, was completed in Rabigh, Kingdom of Saudi Arabia by the Rabigh Refining and Petrochemical Company (Petro Rabigh), a joint venture between Sumitomo Chemical Co., Ltd. and Saudi Arabian Oil Company. In April of 2006, Hitachi Plant Technologies, Ltd. was awarded the engineering, procurement and construction contract for the UO-1 Facilities which are part of this huge complex. The UO-1 Facilities consist of utilities and other off-site plant such as cooling water, plant air, nitrogen and oxygen gas supply, sulfur forming and delivery, and incinerator and waste water treatment. All of this equipment had been commissioned by October 2008. The UO-1 Facilities are very large and include five cooling towers located in each process plant in the huge complex.

(Hitachi Plant Technologies, Ltd.)



Cooling water supply system, part of the UO-1 utilities and off-site plant for Petro Rabigh in Saudi Arabia

Delivery of Centrifugal Thin Film Evaporator for Candy Production Plant

The Hitachi centrifugal thin film evaporator is suitable for process-heat-sensitive, high-boiling-point, and highly viscous materials. It uses a high centrifugal force to form stable thin films inside a cylindrical shell and its high heat-transfer capacity means that vacuum heating concentration can be performed quickly. Hitachi Plant Technologies, Ltd. has been selling evaporators since 1962 and has delivered more than 1,000 units for a wide range of applications including medicine, food, chemistry, and atomic energy.

Hitachi has six small pilot plant models available to suit different evaporative concentration processes. Hitachi is working on expanding sales into a wide range of fields and has established a support organization that provides users with backup from research and development through to delivery and operation (covering process investigation, how to scale-up processes, determining the specifications for actual plant, quotation, fabrication, installation, and test operation).

[Features]

Hitachi has worked with a user who was planning a candy production plant to conduct trials on the Hitachi centrifugal thin

film evaporator using the same liquid as the actual process. In the food industry in particular, the development of new products requires that actual production also be carried out to evaluate factors like taste that cannot be determined by numerical analysis.

Hitachi has delivered 20 units for candy and caramel production and this experience allows Hitachi to identify the most appropriate operating conditions quickly.

A feature of the Hitachi centrifugal thin film evaporator is that it can reduce production losses because its tendency to burn the material being processed is less than that of conventional evaporators, especially for candies rich in dairy ingredients, and this allows for a longer interval between cleaning. The reason for this is that the Hitachi centrifugal thin film evaporator performs all processing in the same vessel, in contrast to conventional evaporators that have separate heating and vacuum evaporation sections. The robust design needed to ensure that the evaporator can stand up to the rigors of use in the petrochemical industry is another key reason why it is able to remain in continuous operation over long periods.

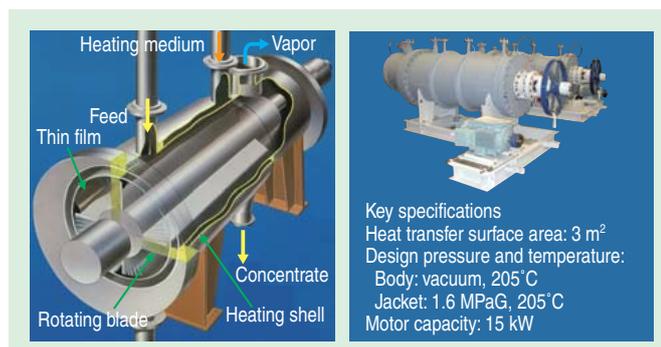
The customer was very satisfied with the results of the actual-liquid trials and with the evaporator features and this led to two horizontal-type centrifugal thin film evaporators (with a heat transfer area of 3 m²) being delivered during May 2008.

[Future developments]

Hitachi has delivered high-quality products for applications such as concentration, solvent removal, and distillation processing of pharmaceuticals, chemicals, and synthetic resins.

The new evaporator for candy production has been well received. As in this example, Hitachi's aim is to expand its sales into new applications such as removing solvents from optical resins, high-level concentration of functional resins, and distillation and concentration processes used in the production of solar cell materials and elsewhere.

(Hitachi Plant Technologies, Ltd.)

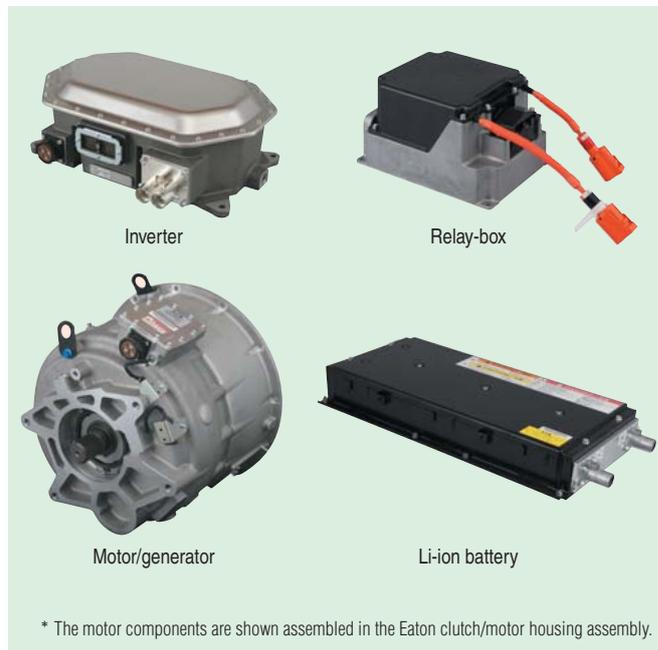


Internal structure of horizontal thin-film evaporator (left) and horizontal thin-film evaporator (right)

HEV System for Trucks

The HEV (hybrid electrical vehicle) concept which combines an internal combustion engine with an electric motor is being increasingly adopted in the commercial trucking industry in response to global environment issues. Hitachi, Ltd. has developed an HEV electric motor and associated controls for use with a hybrid power system supplied by Eaton Corporation. The HEV system combines Hitachi's motor/generator, inverter, relay-box, and Li-ion (lithium-ion) battery with Eaton's automated manual transmission, automated clutch, and supervisory hybrid control module. The system is scalable for both medium-duty and heavy-duty truck applications. This system works in conjunction with a diesel engine, automated clutch, and automated transmission. The electric motor is mounted between the clutch and transmission. This configuration can deliver high torque at low RPM (revolutions per minute). The battery voltage is supplied to the system via a relay-box which incorporates a leak detection capability.

- (1) Motor/generator: maximum output 44 kW/3,000 rpm, maximum torque 420 Nm/1,000 rpm
- (2) Inverter: maximum output 63 kVA
- (3) Relay-box: battery supply control with battery leak detection function
- (4) Battery: Li-ion battery 5.5 Ah/module (already developed) (Hitachi Automotive Systems, Ltd.)



HEV system components for trucks

DCT Control System

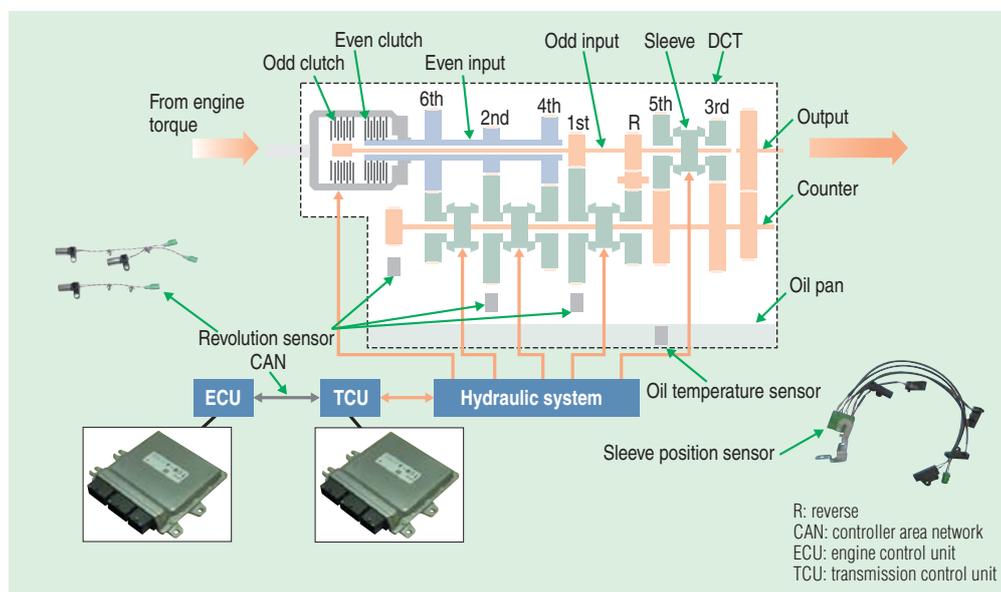
The AMT (automated manual transmission) was developed, primarily in Europe, as a way of reducing vehicle CO₂ emissions by reducing fuel consumption and thereby complying with emission regulations. AMT is a synchro-mesh type transmission in which the clutch operation and the gear change are automated. However, when AMT is used, the driver may still experience some

discontinuity when the driving torque is interrupted by the shift control mechanism engaging or disengaging the clutch during a gear change.

To improve shift quality, a new generation of transmissions are being developed that use DCT (dual-clutch transmission). This provides shift quality equivalent to that of a conventional stepped automatic transmission with a torque converter while still delivering the high level of efficiency that keeps the fuel consumption down to that of a conventional manual transmission.

A DCT has two clutches and uses these alternately during gear change operations. Hitachi has been working on the development of AMT technology since 1997 and, based on this experience, has developed a transmission control unit, revolution sensor, shift position sensor, control strategy, and control software for DCT systems in production models.

(Hitachi Automotive Systems, Ltd.)



DCT control system

Small Oxygen Sensor for Engines

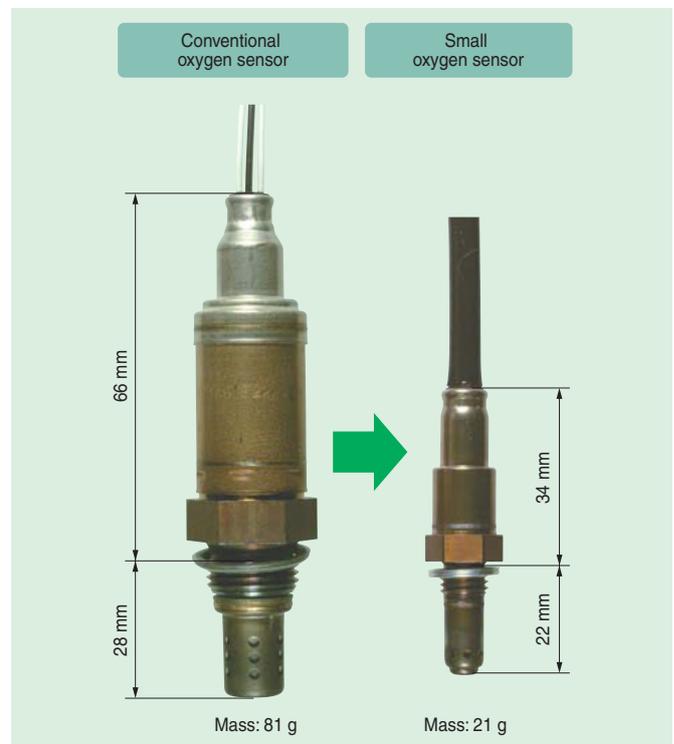
The emission regulations applied to four-wheel vehicles have become progressively more stringent in recent years and, as concern for the environment grows, the scope of these regulations is now being extended to cover small-displacement vehicles such as motorcycles and general-purpose engines. Along with the need to reduce fuel consumption, this trend has led to the widespread adoption of electronic fuel injection control systems that use an oxygen sensor and three-way catalyst.

Unfortunately, conventional oxygen sensors are subject to a number of problems, including that their size makes them difficult to mount in small-diameter exhaust pipes and that they increase exhaust resistance.

Recognizing this growing need for a small and lightweight oxygen sensor, Hitachi has developed one of the world's smallest oxygen sensors using its proprietary curved surface printing technology for ceramics. Sales of such sensors for motorcycle use started in May 2007.

In keeping with its aim of helping protect the global environment, Hitachi intends to make the sensor available in the Asia and Latin America vehicle markets where use of electronic fuel injection control is expected to become more widespread.

(Hitachi Automotive Systems, Ltd.)

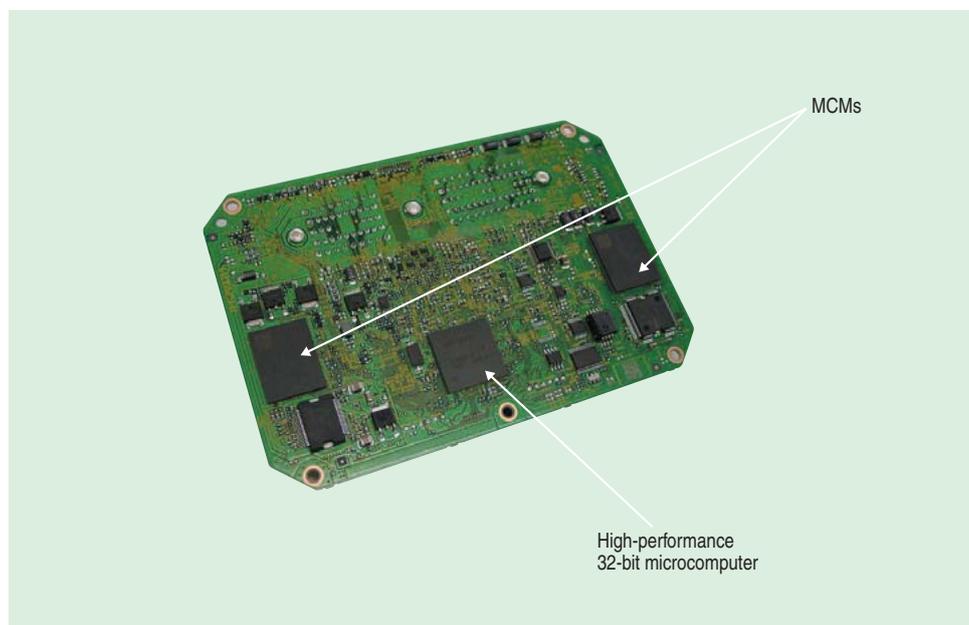


Small oxygen sensor for engines

Integrated Engine and AT Control Unit with MCMs

Hitachi has developed an integrated engine and AT (automatic transmission) control unit with smaller size and lighter weight to

facilitate installation in vehicles and lead-free solder to help protect the environment.



Circuit board of MCM-based integrated engine and AT control unit

The control unit uses MCMs (multi-chip modules) supplied in a BGA (ball grid array) package and an SH7059F high-performance 32-bit microcomputer to integrate engine and AT control in a single microcomputer, functions that were previously implemented on separate chips. As a result, the footprint of the control unit is 30% smaller than Hitachi's current standard model.

The MCM also features a well-balanced heat dissipation design with a single driver for the various solenoid actuators used in engine control and another driver for the hydraulic solenoids used in AT control. (Hitachi Automotive Systems, Ltd.)

FSW Monoblock Caliper for Motorcycles

Hitachi has developed a small and lightweight disk brake for motorcycles (the 935-g weight compares to 1,150 g for the previous version of the same model).

[Key features]

(1) Caliper body uses FSW (friction stir welding).

The cover is welded to the caliper body using FSW which is characterized by a low level of thermal strain. Changing from the previous two-piece structure to the new monoblock (one-piece) design with no fastening bolts simplifies the structure while also improving rigidity.

(2) Aluminum piston and newly developed surface treatment

Use of dual-layer iron-chromium plating to coat the aluminum reduces the weight and provides a favorable lever feel.

Hitachi plans to market the new monoblock caliper to motorcycle manufacturers by primarily targeting their flagship models.

(Hitachi Automotive Systems, Ltd.)

(Production started in November 2007)



FSW monoblock calipers for motorcycles

New Shock Absorber Self Levelizer

A new self levelizer has been successfully introduced on Fuji Heavy Industries Ltd.'s Subaru Forester*.

This new self levelizer is a shock absorber with a built-in pump that controls the rod reaction force and automatically adjusts the vehicle height.

[Key features]

(1) The unique design of the high and low pressure gas chambers reduces the weight and number of weld positions (5% less weight and three less weld positions than the previous model).

(2) The specially designed dual seal reduces friction (20% less friction than the previous model).

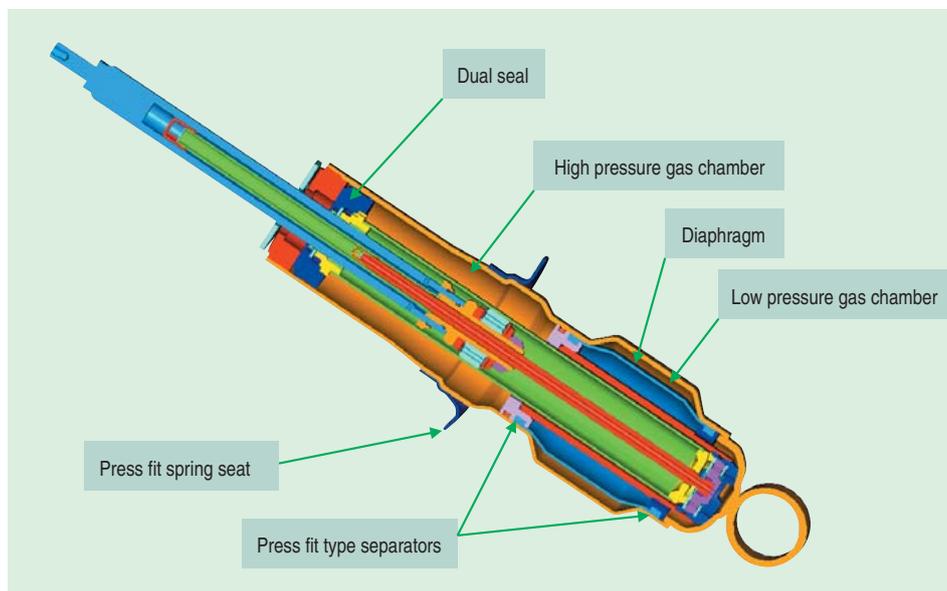
(3) The redesigned structure using a diaphragm improves pumping performance (25% faster vehicle height control).

The nature of the self-levelizer design means that it does not require any control or energy from outside the system. Also, the lower number of welds means the new self levelizer also saves energy in the manufacturing process.

These energy and weight saving benefits are likely to see the self levelizer gaining a growing share of the market.

(Hitachi Automotive Systems, Ltd.)

(Production started in October 2007)



New shock absorber self levelizer

* See "Trademarks" on page 87.

Clarion to Release Revolutionary Mobile Internet Device in North America and Europe



Mobile Internet navigation device ClarionMiND

Clarion Co., Ltd. released ClarionMiND (mobile Internet navigation device), a next-generation mobile Internet navigation device, in the US market last November.

ClarionMiND is a revolutionary new product that combines connected personal GPS (global positioning system) navigation and a real-time POI (points of interest) function with Internet-based

entertainment and full web browsing.

Based on the new Intel Atom* processor Z5xx series, ClarionMiND provides an all-new portable device experience and access to two-way connected navigation, high-speed Internet access, digital music and video playback, and many other innovative entertainment features. ClarionMiND will transform the way people connect to their electronic lives whether they are on the go or in their vehicles.

Thanks to multiple Internet connections, users can download the latest information in real-time and keep access to today's most popular websites including Google* Maps, YouTube*, and MySpace*. Clarion has utilized its years of experience in creating car audio and navigation systems, which offer award-winning, best-in-class features, with user interfaces that provide rich information and make operation quicker

and more intuitive.

(Clarion Co., Ltd.)

(Released in late 2008 in the US and Canadian market, and in 2009 in the European market)

* See "Trademarks" on page 87.

Around View Monitor

Xanavi Informatics Corporation (existing Clarion Co., Ltd.) has developed a system that combines the images from four cameras located on the back, front, and either side of a vehicle to generate a single image showing the view looking down on the vehicle from above. The system is called the Around View Monitor and deliveries to Nissan Motor Co., Ltd. have already commenced.

The system can be activated either by changing to reverse gear or by pressing the CAMERA button. When activated, the system splits the display into two images, one showing the view from the front or back and the other showing the view from above or an enlarged view of an area around the front wheels.

By displaying the approach information, width marker line, and route prediction line from the corner sonar as an overlay on the camera images, the system provides easy intuitive operation when parking or pulling over by making the driver well aware of the surroundings.



Example images from Around View Monitor

The forthcoming system will use several cameras and provide driver assistance and perimeter monitoring functions. Around View Monitor received a 2008 PACE (premier automotive suppliers' contribution to excellence) Award from US Automotive News. (Clarion Co., Ltd.)

Sophisticated High-speed Elevators for Al Hamra Mixed-use Complex

The Al Hamra Mixed-use Complex currently under construction by Al Hamra Real Estate Co., a major developer in the State of Kuwait, will be the tallest building in the country. All of the vertical transportation for this project is supplied by Hitachi and includes 39 elevators and 8 escalators. In particular, the four high-speed, high-capacity shuttle elevators to the sky lobby on the 52nd floor are the fastest ever supplied by Hitachi, with a speed of 600 m/min and load capacity of 3,000 kg (40 persons). The 600-m/min elevators feature the following three systems and use technology developed at Hitachi. The first is an active guide system that ensures ride comfort by suppressing the vibrations that occur when the elevator is moving at high speed. The elevator cage travels along rails that are built into the building and vibration is suppressed by guide rollers on the cage. The elevators also have an active guide system that further improves the ride quality compared to conventional guide systems by detecting any vibration that occurs during elevator travel and then applying a force in the correct direction to suppress the vibration. The second system is used under conditions of strong wind. When a long-period swing occurs in the building due to strong winds, this system performs a real-time calculation to analyze

what is happening and predict the roll amplitude at four different levels in the building. This information is then used to control the operation of the elevator. The analysis system uses a technique for calculating the generation, growth, and convergence of the movement of long objects such as ropes in terms of the long-period swing. The control system reduces the potential for damage caused by a long object interfering with or touching equipment in the elevator shaft and also improves the efficiency of operation by minimizing the duration of service interruptions. The third system is a control system. The control system for the 13 sets of ultra-high speed lifts has a new inverter control system called "motor current and cross current control," which controls the motor using two inverters in parallel (set-parallel). "Motor current and cross current control" consists of two inverter control circuits and uses microcomputer arithmetic processing to generate separate "motor current" and "cross current" inverter currents. The new system achieves smooth motor control and low inverter losses. Featuring original technologies developed by Hitachi, these elevators are expected to be flagship products for Hitachi in the Middle East.



Al Hamra Mixed-use Complex