

Changes in society and people's lifestyles will increase long-term demand for electricity. Responding to trends in energy demand in Japan and around the world, Toshiba is working to develop technologies that meet diverse consumer needs for stable and reliable electric power supply, new energy technologies, more effective applications and environmental protection, as well as rationalization of operations and lower costs. Toshiba also produces innovative equipment and systems in the fields of manufacturing, public works, and traffic and transportation.

### Completion of World's First Replacement of Reactor Core Internals

The Tokyo Electric Power Co., Inc. (TEPCO) has completed the world's first internal replacement project at No. 1 Fukushima Nuclear Power Station Unit No. 3 (1F-3) during the sixteenth regular inspection starting in May 1997. This is the most complete preventative maintenance program for a boiling water reactor. Toshiba was the main contractor for this project, and other major contractors included General Electric Co. and Hitachi, Ltd.

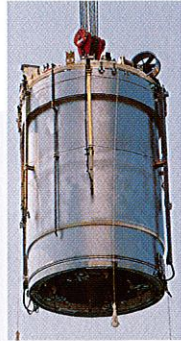
The new core internals components are made of 316L stainless steel, which will provide superior resistance to inter-granular stress corrosion cracking (IGSCC). Additionally, the new core shroud is constructed of forged rings, which reduces the number of welds.

The replacement sequence consisted of chemical decontamination, core shroud removal, jet pump removal and installation, new core shroud installation, and installation of other new core internals, such as the core plate, top guide and core spray lines.

The original reactor internals were removed, including the cutting of the shroud with a precision underwater machining technology called rotating electrode electrical discharge machining (EDM).

To allow human access into the reactor vessel, chemical decontamination was performed to remove radioactive metal oxide. Shielding was also used to further reduce the radiation levels for safe occupancy during the installation of new core internals.

An automatic welding technique was applied with an extremely narrow gap to reduce the welding time and deformation when welding the new shroud to the existing shroud support. In addition, a shroud support machining tool was developed for a precise weld prep. In the dryer/separator pool, a plasma cutter was applied to cut the removed core internals, which were then transferred to the site bunker pool and the solid waste storage facility.



Installation of new core shroud (mockup test)



Removal of existing core shroud

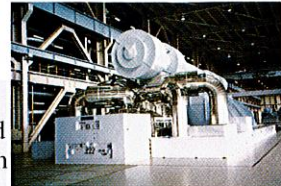
### 100,000,000kW Cumulative Capacity of Toshiba Turbines

In February 1997, Toshiba achieved a milestone in its turbine-production business when the cumulative capacity of all turbines made by Toshiba reached 100,000,000kW. Since it began manufacturing turbines in 1927, Toshiba has produced 1,671 units.

During 70 years of providing reliable, efficient power-generation turbines for its domestic and international clients, Toshiba has introduced various epoch-making units. The milestone was reached with the shipment of another 700MW steam turbine, now in the commissioning stage, to the Nanao Ohta Power Station of Hokuriku Electric Power Co. Its main steam pressure is 24.1Mpa, with main and reheat temperatures of 593°C.

Toshiba's recent activities in this field include a 1,000MW steam turbine that began commercial operation at the Haramachi Power Station of Tohoku Electric Power Co. in July 1997; a 350MW steam turbine that began commercial operation at the Shiriuchi Power Station of Hokkaido Electric Power Co. in August 1997; three sets of 600MW steam turbines being installed at China's Beilungang Power Station; and the shipment of six sets of gas and steam turbines (6x243MW; combined cycle) to the Shin-Nagoya Power Station of Chubu Electric Power Co., where the first unit is in the final stage of commissioning, and the second unit has started commissioning.

To meet the varied energy needs and site requirements of its domestic and global clients, Toshiba constantly strives to improve the efficiency of its industry-leading turbine units. The company's commitment to high standards of safety, efficiency, and client satisfaction remains a cornerstone of Toshiba's business.



700MW turbine for Nanao Ohta Power Station



Aerial view of Haramachi Power Station



600MW turbine for Beilungang Power Station



GE-MS7001FA 1,300°C-class gas turbine for Shin-Nagoya Power Station

## Changzhou Toshiba Transformer Co., Ltd. Begins Operations

Changzhou Toshiba Transformer Co., Ltd. (CTC) is a Toshiba subsidiary in Changzhou, Jiansu Province, China that manufactures power transformers. National, provincial and city government representatives attended an opening ceremony and factory tour on May 8, 1997 that marked completion of construction of the factory.

At its state-of-the-art facilities, CTC manufactures large-scale power transformers up to the 550kV-1,000MVA class. Products will be shipped from a private jetty, now under construction at a nearby canal. The jetty will allow large-scale, three-phase transformers to be shipped directly to users, giving CTC an advantage over all the existing transformer manufacturers not located on the waterfront. CTC's first product was a 360MVA-500kV step-up transformer for An Shun Power Station that was delivered in December 1997.



360MVA-500kV step-up transformer for An Shun Power Station

With the opening of CTC, Toshiba has transformer production bases in Japan, Brazil and China. CTC aims to capture a considerable share of the rapidly growing Chinese utility market, and will begin exports in the near future.



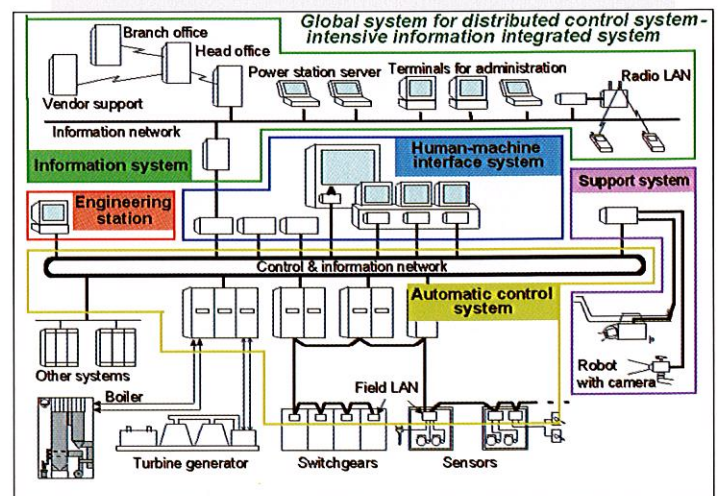
Changzhou Toshiba Transformer Co., Ltd.

## TOSMAP GSXP™ Series Information and Control Systems

In recent years, optimization has become a key requirement that operators of thermal power stations expect from equipment manufacturers. They demand optimization in all phases of a plant's service life, from installation, operation, performance and maintenance to overall system management.

In response to such demands, Toshiba developed the TOSMAP GSXP™ series of information and control systems. These open, distributed systems feature the highest levels of flexibility, reliability, availability and expandability. TOSMAP GSXP™ systems also offer diverse applications, compact size and a user-friendly graphic interface.

A TOSMAP GSXP™ system was chosen for and has been successfully applied at the Shiriuchi Power Station of Hokkaido Electric Power Co., Inc. The system's intense use of high-reliability microelectronics enabled Toshiba to provide compact system components and significantly reduced space requirements for equipment installation and cabling. The plant's central control room has consolidated, high-visibility human-machine interfaces with high performance and profound functions, enabling operators to manage the entire power station effectively.



Overall system configuration of TOSMAP GSXP™ series

## 200kW Fuel Cell Power Plants Reach 40,000 Hours of Operation

A 200kW fuel cell power plant (FCPP) installed at the Umeda Center Building in Osaka by Osaka Gas Co., Ltd. and Takenaka Corporation in 1992 has reached 40,000 hours of operation in January 1998. The FCPP is a PC25<sup>TM</sup>A developed jointly by Toshiba and ONSI Corp. of the United States. Another PC25<sup>TM</sup>A series 200kW FCPP being operated at Southern California Gas Co. has also achieved 40,000 hours of operation in October 1997.

These records are highly significant to both manufacturers and users of FCPPs, since 40,000 hours of operation was a major target for demonstrating FCPP reliability. The PC25<sup>TM</sup> series includes the PC25<sup>TM</sup>C, the world's leading commercial FCPP, and 170 units have been delivered worldwide to date. Toshiba expects these new records to support accelerated commercialization of FCPPs around the world.



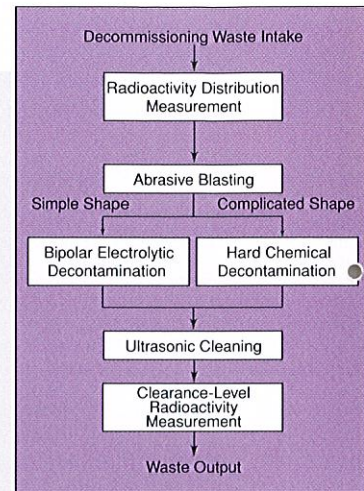
PC25<sup>TM</sup>A 200kW fuel cell power plant in the Umeda Center Building

## Development of Decommissioning Waste Processing System

To make effective use of their sites, Japanese nuclear power facilities will be dismantled after operations cease. Toshiba has developed a remote-controlled automatic system consisting of devices for measuring radioactivity and processing the contaminated waste generated during decommissioning.

Before decontamination, a specialized apparatus measures the distribution of radioactivity in waste (detectable limit: 400kBq ton<sup>-1</sup>) and determines decontamination conditions. Metal surfaces of wastes with a simple shape such as pipes and plates are dissolved by bipolar electrolytic decontamination (electrolyte: 0.5mol dm<sup>-3</sup> H<sub>2</sub>SO<sub>4</sub>). Metal surfaces of wastes with a complicated shape such as valves and pumps are dissolved by hard chemical decontamination (chemical agent: 0.4mol dm<sup>-3</sup> Ce<sup>4+</sup>). After ultrasonic cleaning of the waste, clearance-level radioactivity measurement apparatus (detectable limit: 40kBq ton<sup>-1</sup>) is used to confirm that activity of the decontaminated waste is equal to or less than the level of the natural environment.

Verification tests for the techniques used in the decommissioning waste processing system were carried out by the Nuclear Power Engineering Corporation. The tests confirmed that the system can process decommissioning waste generated by a commercial nuclear power facility with throughput of 2 ton h<sup>-1</sup>.



Verification test flow diagram of decommissioning waste processing system



Decommissioning waste processing demonstration test

## TOSDIC™-CIE DS Integrated Control System for Large-Scale Applications

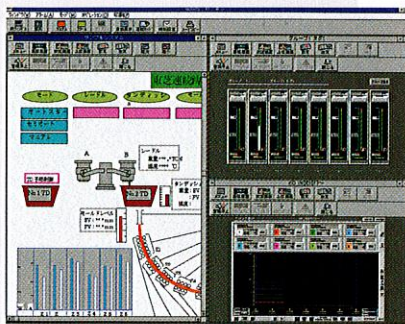
The TOSDIC™-CIE DS integrated control system for large-scale applications enables a total plant system harmonized with information systems, seamlessly linking process information distributed throughout a control system. Positioned at the top of Toshiba's "Open & Rightsizing" integrated control systems hierarchy, TOSDIC™-CIE DS can handle up to 20,000 system tags.

The human interface employs client/server architecture made up of a Windows NT®-based PC platform and database server on a workstation platform. A controller station that realizes both continuous loop control and high-speed sequence control in a single unit and a LAN Ethernet® system that allows multivendor connections ensure the redundancy required for an open, reliable system. The system is the first in the industry to introduce Fast Ethernet® with a transmission speed of 100Mbps to handle the requirements of large-scale applications. User-friendly engineering tools facilitate high productivity and ease of maintenance.

Toshiba plans to further improve the functions of TOSDIC™-CIE DS in preparation for the anticipated implementation of standards such as OLE for Process Control (OPC) and Foundation Fieldbus.



TOSDIC™-CIE DS integrated control system for large-scale applications



Example of operation screen

## Press-Pack IGBT Converter for New Shinkansen

Railway applications are rapidly increasing for the insulated gate bipolar transistor



Series 700 shinkansen

(IGBT) due to its improved ability to withstand higher voltages and current capacities. In addition, its use of semiconductors enables faster switching than conventional gate turn-off (GTO) thyristors. An IGBT converter also produces less noise than a GTO thyristor. As a result, it is used in the Series 700 shinkansen (bullet train) now being tested for introduction in 1999.

Toshiba's new high-performance, press-pack type IGBT (2.5kV-1kA) is used as a quiet, reliable and compact pulse width modulation (PWM) converter. A 32-bit processor with vector control improves efficiency. Toshiba is also supplying other components for the Series 700, including the main transformer, traction motor, auxiliary power supply and air conditioner. All these products support the goal of the Series 700 of providing better riding comfort, reduced ecological impact, higher reliability and lower energy consumption.

Current semiconductor technology is focused on the injection enhanced gate transistor (IEGT). In the near future, Toshiba plans to develop a 4.5kV-1kA press-pack type IEGT with the ability to withstand high voltage, which will reduce converter noise, weight and dimensions for improved control.

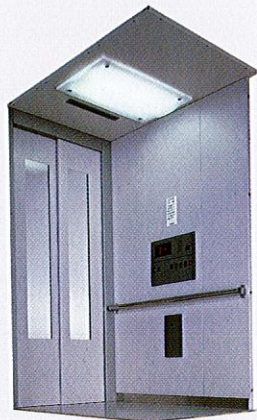


Press-pack IGBTs play an important role in making the Series 700 shinkansen quiet and comfortable.

## ELPALACE™ Elevator for Medium- and Low-Rise Residences

Toshiba's ELPALACE™ is an elevator for medium- and low-rise residences. Mounting the traction machinery in the hoistway and the control panel in the jamb eliminates the need for a machine room. A 10mm-diameter rope and small-diameter sheave contribute to a compact hoistway. A high-efficiency helical gear for speed reduction in the traction machinery allows the use of a 1.8kW motor, the minimum for an elevator of this type. In addition, the cage has doors on two sides for greater flexibility in building design.

ELPALACE™ was designed for ease of use by elderly and disabled passengers. Although the cage load is four passengers, the space is equivalent to a six-person cage to facilitate use by assisted wheelchair-bound passengers. Buttons are easy for passengers in wheelchairs to reach, and windows twice the conventional size in door panels promote passenger security.



Cage of elevator for medium- and low-rise residences

## Two New Smart Sensors

To meet the latest demands of measurement and control systems, Toshiba has developed two next-generation smart sensors. The **LF400 series electromagnetic flowmeter** uses state-of-the-art technologies to combine low maintenance with high performance in an expanded range of applications at an economical cost. Special noise suppression circuits with square wave excitation and multi-sampling achieve excellent noise immunity, and optimized magnetic field distribution enables accurate measurements across a range of unfavorable fluid flow velocity distributions.

The **LQ167C microwave density meter** employs the new measurement principle of phase-shift-detection, in which the microwave signal is beamed through process fluids to measure the density and consistency of substances mixed or dissolved in the fluids. This technique achieves higher accuracy and stability than conventional mechanical, optical or ultrasonic measurement methods. The meter has applications in a wide range of industries, including waste water processing, pulp and paper, construction materials and food and beverages.



LF400 series electromagnetic flowmeter



LQ167C microwave density meter