Heavy Electrical Apparatus

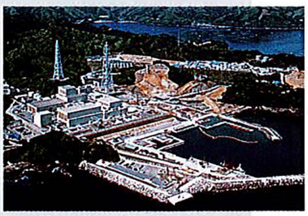
Changes in society and people's lifestyles will increase long-term demand for electricity. While giving due consideration to such factors as resources and impact on the environment, Toshiba is working to provide stable sources of energy, reliable delivery systems and effective energy saving technology. Toshiba is also introducing innovative equipment and systems in the fields of manufacturing, public works, and traffic and transportation.

Construction of BWR and ABWR Nuclear Power Plants

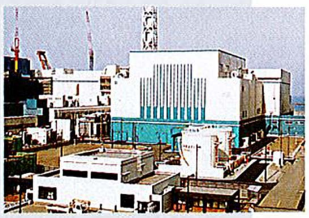
At Tohoku Electric Power Company's Onagawa Nuclear Power Station, commercial operation began in July 1995 for Unit No. 2 (825MW, BWR5; top photo), for which Toshiba serves as the main construction contractor. This is the first nuclear power plant in which Toshiba has employed a moisture separator heater. Construction of Unit No. 3 is scheduled to start within the year.

Construction of the first advanced boiling water reactors (ABWRs) at Units No. 6 and 7 (both 1,356MW; center photo) of Kashiwazaki-Kariwa Nuclear Power Station is also progressing on schedule. Unit No. 6 completed fuel loading in December 1995. The plant started generating power in January 1996 and start-up testing is in progress. The plant reached full power in April and commercial operation will begin in December. The bottom photo shows the first synchronization ceremony, held on January 29, 1996. Unit No. 7 was connected to the grid in October 1995 and pre-operational testing has started.

This ABWR was developed through international cooperation incorporating proven technology and operating experience from BWRs around the world. Plant construction is a joint venture among Toshiba, Hitachi and General Electric, with Toshiba acting as the representative company at Unit No. 6 and working to make the first ABWR a success.



Onagawa Nuclear Power Station Unit No. 2 of Tohoku Electric Power Co., Inc.



Kashiwazaki-Kariwa Nuclear Power Station Units No. 6 and 7 of The Tokyo Electric Power Co., Inc.

First synchronization of Kashiwazaki-Kariwa Nuclear Power Station Unit No. 6

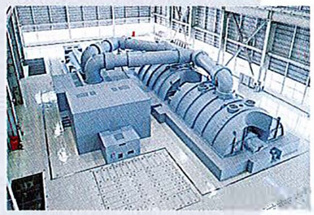
Completion of Three Kinds of Thermal Power Plants in Japan

Coal-Fired Power Plants. The Shinchi No. 2 unit of Soma Kyodo Power Company started commercial operation on July 7, 1995. This unit incorporates a 1,000MW steam turbine—a highly efficient and reliable machine employing 41 inch flame hardened last-stage blades.

Commercial operation at Kyushu Electric Power Company's Reihoku No. 1 unit started on December 14, 1995. This unit is the first 700MW turbine to comprise three casings. The central control room is especially designed for ease of operator access, a new trend in plant C&I systems.

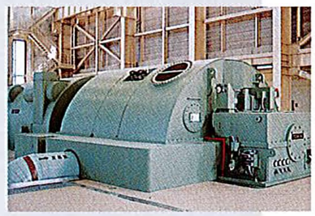
Geothermal Power Plant. The Yanaizu-Nishiyama geothermal unit of Tohoku Electric Power Company began commercial operation on May 25, 1995. The 65MW unit capacity of this turbine-generator is the largest in Japan.

Combined Cycle Power Plant. Toshiba is promoting the re-powering project of Chubu Electric Power Company in the Chita region in central Japan. Gas turbines have been installed at Chita thermal power stations No. 2 and No. 5 to increase power output and to increase efficiency. These plants commenced commercial operation in 1995. Toshiba is also re-powering the Chita second thermal power station No. 2 with a 7FA (154MW) gas turbine. This plant is expected to begin commercial operation in July 1996.



1,000MW steam turbine and generator at Shinchi Power Station No. 2 unit

Central control room at Reihoku No. 1 unit



65MW geothermal turbine and generator

Aerial view of Chita Thermal Power Station (Units No. 1-6)

Energy Management System of Hokuriku Electric Power Company

In December 1995, Hokuriku Electric Power Company replaced its Energy Management System (EMS), which operates its power system. Toshiba supplied both the previous and new systems.

With this new system, Toshiba realizes optimum expandability and maintainability by applying standard client/server and open architecture, while keeping high real-time performance and reliability, essential requirements of any EMS. The new system, called TOSCAN-E2000, is Toshiba's first open-distributed EMS. The triple construction of the VL2060 main server assures high system reliability even during maintenance. The operator's console uses the process workstation PS2000 with RAS (Reliability, Availability, Serviceability) for high reliability and an advanced human interface environment.

The newly developed automatic voltage control function provides advanced, efficient power system operation. Other features include high-level support functions such as peak load forecasting based on neural network technology and security analysis based on transient stability calculations.

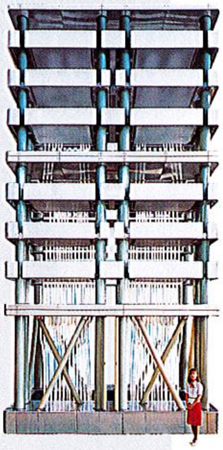
Operation room of central dispatch center

Development of 500kV HVDC Equipment

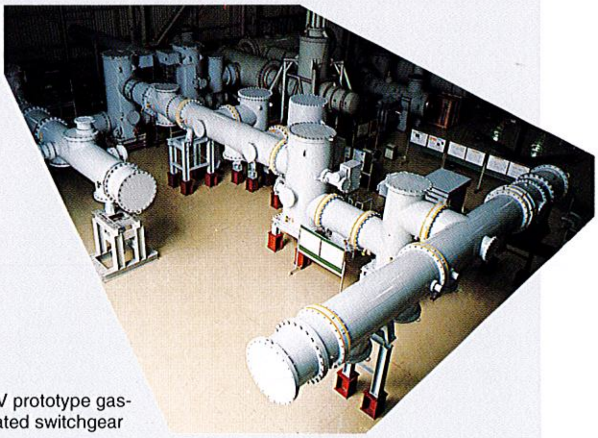
The Kansai Electric Power Company, Shikoku Electric Power Company and Electric Power Development Company are planning a 500kV high-voltage direct current (HVDC) transmission project crossing the Kii Channel that separates Wakayama and Tokushima prefectures in Japan. Toshiba has developed 500kV HVDC equipment for the project in cooperation with the three companies. The final stage of development was completion of prototype thyristor valves, converter transformer and DC gas-insulated switchgear (DC-GIS), which constitute the main HVDC equipment.

The thyristor valves use a direct light-triggering system that employs 8kV-3500A light-triggered thyristors, the largest in the world, thereby reducing both height and power loss by about 25 percent each. Rationalization of insulation structure reduced the weight of the converter transformer by about 20 percent.

DC-GIS is the first commercial application for 500kV gas insulated HVDC equipment, and uses not only gas bus but also components such as disconnecting switches, surge arresters, voltage dividers and current transformers.



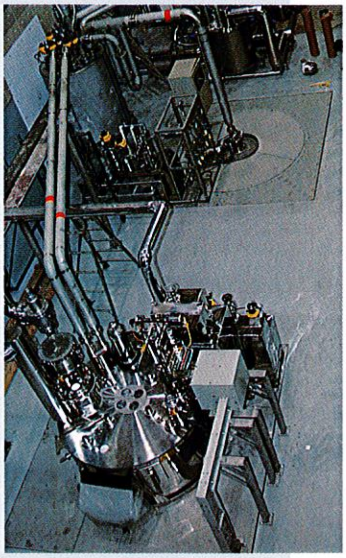
500kV prototype thyristor valve



500kV prototype gas-insulated switchgear

World Record Magnetic Field Using 40T Class Hybrid Magnet

All components of the 40 tesla (40T) class hybrid magnet system at Japan's National Research Institute for Metals (NRIM) were designed and manufactured by Toshiba. The magnet system is used for physical research under super-high magnetic field conditions and in September 1995 produced the world's strongest continuous magnetic field to date.


40T class hybrid magnet

The system comprises a 15T superconducting magnet and a 25T water-cooled magnet, producing a combined magnetic field of 40T. The magnet is one of the largest pool-boiling superconducting magnets in the world, with an energy storage capacity of 64MJ. The water-cooled magnet is mounted in the 400mm diameter room temperature bore of the superconducting magnet. The coil is made of alumina-reinforced copper alloy for strength and conductivity. The material also allows the effective elimination of the Joule heating induced in the water-cooled coil, and withstands the massive electromagnetic force generated.

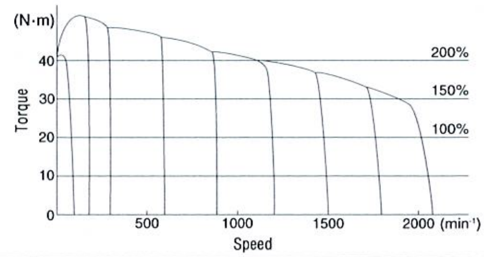
Operation of the system started in the summer of 1995 at NRIM's Tsukuba Magnet Laboratory. At the end of September 1995, the hybrid magnet produced a continuous magnetic field of 36T—22T from the water-cooled magnet and 14T from the superconducting magnet—currently the world's strongest continuous magnetic field.

Tesla (T): unit of magnetic strength (1T = 10,000 gauss)

VF-S7 and VF-S7e User-Friendly Inverters

To meet the rapidly growing demand for low-end and compact inverters for industrial use, Toshiba has introduced the user-friendly TOSVERT VF-S7 and VF-S7e series. Specifications for the VF-S7 include a range of 0.4kW to 3.7kW (3ph-200V), with plans to expand the range to 15kW for both 200V and 400V by the end of 1996; sensorless vector control for high torque at low frequencies; and three automatic setting functions. The VF-S7e also has three automatic setting functions, as well as a range of 0.1kW to 0.4kW (1ph-100, 200V) or from 0.1kW to 0.75kW (3ph-200V); simplified operation using a potentiometer; and compact design using an original power module.

Torque characteristics obtained by vector control algorithm
Example torque characteristics of a 4P-3.7kW-200V Toshiba induction motor



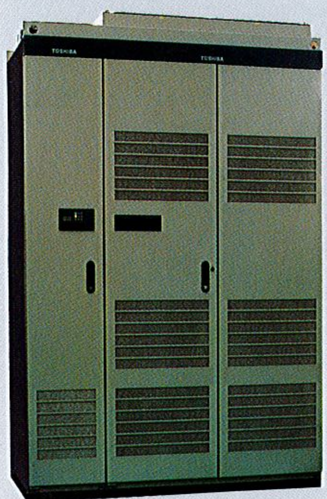
VF-S7 inverter
200V-1.5kW

VF-S7e inverter
200V-0.1kW

TOSVERT™-μ/S350 Three-Level IGBT Inverter for Large-Capacity AC Drives

Toshiba has developed a three-level insulated gate bipolar transistor (IGBT) inverter, the TOSVERT™-μ/S350, for use in large-capacity AC drives. The high-performance inverter is small and highly efficient.

The large 1,800 kVA capacity of the new IGBT inverter was achieved by employing a parallel operation technique of high-voltage, large-capacity IGBTs (1,700V-400A). A capacity of 3,600kVA is possible using two inverters. Output is 1,200V. Despite its capacity and power, the inverter is small; an evaporative cooling system allows a reduction in volume to half that of a conventional air-cooled unit. Drawout-type construction for both the main power unit and the capacitor unit simplifies maintenance.



TOSVERT™-μ/S350 three-level IGBT inverter with 1,800kVA capacity

Four-Passenger Hydraulic Elevator

In many Japanese cities, regulations relating to slant on the north side of buildings and shade have led to increased demand for hydraulic elevators, which do not require a roof machine room, as well as reducing the area required for the hoistway. Toshiba's hydraulic elevator with a 4-passenger rating was developed to meet this demand.

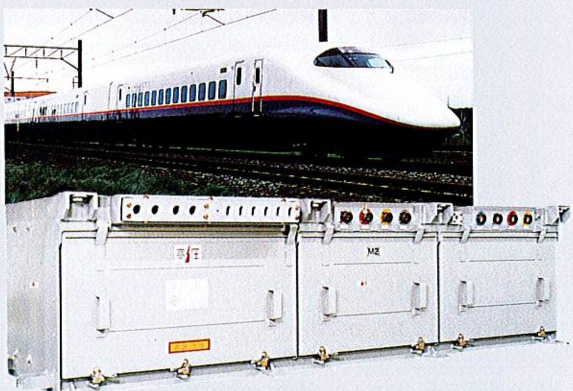
A wider cage for the elevator makes getting in and out easier. Integration of the cage rails and hydraulic jack rails allows a more compact hoistway. A multi-beam door safety device emits infrared beams at short intervals to monitor passengers boarding and departing the elevator.

Four-passenger hydraulic elevator

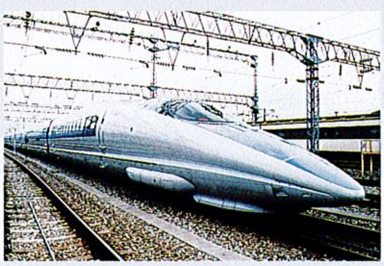
Propulsion System for Next-Generation Shinkansen

Series production began in 1995 for a new type of lightweight, high-speed *shinkansen* (bullet train) with a VVVF propulsion system. Models include the Nozomi for Central Japan Railway Company (JR Central) and the all double-decker MAX for East Japan Railway Company (JR East). In addition, planning and testing is under way for the next generation of *shinkansen,* including the series 300X, a prototype train for 300km/h service for JR Central; the series E2 for JR East; and the series 500 for West Japan Railway Company (JR West).

Toshiba has supplied the propulsion systems for all these models, consisting of pulse width modulation (PWM) converters using large-capacity GTO-thyristors (4,500V-4,000A), VVVF inverters and lightweight induction motors. New switching devices currently under development will reduce the noise, weight and size of the converter and offer better controllability.



Series E2 prototype *shinkansen* and on-board main converter



Series 500 *shinkansen*

TECHNO-RAINBOW® Natural Color LED Display

Toshiba's new TECHNO-RAINBOW® realizes natural color in a light emitting diode (LED). The indoor model has a screen size of 5.12m wide by 3.84m high, with a total of 640 horizontal and 480 vertical dots. Brightness is 600cd/m² (at white peak) and gradation of each primary color (red, green and blue) is controlled in 256 steps for a total of 16,780,000 color variations. The outdoor model, with a screen of 5.44m wide by 4.16m high, has nine LEDs per dot to provide sufficient brightness for outdoor use. Both types are superior to displays using electric discharge tubes or CRTs in power consumption, life, and maintenance at a smaller size and weight.

Outdoor natural color LED display

TECHNO-RAINBOW® is compatible with NTSC video signals and a variety of image control functions are available, including multi-screen splitting for simultaneous display of images, characters and graphics; superimposition of characters and graphics onto images; and multilayering. Toshiba is convinced of the outstanding quality of LED displays, and will continue working to make them better and brighter.

Multiscreen mode full color LED display