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Special Reports
Thermal Power Plants toward the 21st Century

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*Harmony between Power Generation and the Environment
MATSUDA Takeshi

*Thermal Power Generation Technologies Aiming at Harmony with Energy Supply and Environment
OHJI Akio

Thermal generation currently accounts for 60% of the total electricity generating capacity in Japan and remains the major element of various power generation systems in the 21st century. On the other hand, the environment of electric power generation in Japan is undergoing dramatic change.

To meet these requirements, Toshiba is carrying forward the development of technologies for high-efficiency thermal generation systems including technologies for extending the life of aging existing plants, technologies for distributed generation, environmental technologies, and productivity improvement technologies.

*1,500 °C-Class Combined Cycle Systems
IIDA Yoshisuke SHIBUYA Sachio

Toshiba has concluded a cooperation agreement with General Electric Company to manufacture the so-called H System^{TM} power train for next-generation combined cycle power plants, and has started the manufacturing of commercial units. The H System^{TM} lineup consists of two types of 1,500 °C-class steam-cooled gas turbines. First, the 9H gas turbine will enter commercial operation in the latter half of 2002. The steam turbine is a reheat type admission turbine, and the generator is a newly developed hydrogen-cooled type.

The next-generation combined cycle plant incorporating H System^{TM} has 1.5 to 1.7 times the output and an efficiency improvement of 6 to 8 % while occupying a 17 % smaller plant area compared with the current 1,300 °C-class plant.

*Dynamic Simulation Technology for Combined Cycle Power System
MORIKAWA Aki SHIRAKAWA Masakazu HOSAKA Shunji

Toshiba utilizes dynamic simulation for the engineering of combined cycle power system, in order to perform optimum equipment and operation design and efficient plant commissioning. It is possible to accurately predict the dynamic behavior of a plant, since our simulation models are based on a large accumulation of power plant know-how. We also apply advanced simulation techniques to achieve expeditious engineering. Dynamic simulation will become even more important as the complexity of power plants continues to increase.

*Modern Technologies for High-Efficiency Steam Turbine Plants
OMORI Tatsuro KIYOKUNI Toshihisa

Dramatic changes have taken place recently in the Japanese electric power industry. In particular, reductions in the cost of electricity and protection of the environment are now social needs with respect to thermal power plants.

In order to meet these requirements, Toshiba has developed various new technologies for high-efficiency steam turbine plants, including an advanced 630 °C-class steam turbine, a more efficient steam pass design, and an extended last-stage bucket. Some of these technologies have already been applied to actual thermal power stations.

*Successful Manufacturing of World's Largest Tandem 1,000 MW Turbine Generator
ITO Hiromichi OTAKA Toru MIYAIKE Kiyoshi

Attention is being focused on larger thermal power units in the quest for maximal utilization of power station sites and economy of coal-fired thermal units. We have successfully manufactured the world's largest tandem, 2-pole, 60 Hz, 1,000 MW turbine generator and shipped it to the Hekinan Thermal Power Station of Chubu Electric Power Co., Inc. The first 1,000 MW machine is under installation for commissioning in 2001.

In the basic design stage, special attention was paid to enhanced operability and maintainability as well as reliability and performance. The combination of new design technologies has achieved both weight reduction and high efficiency. To ensure a sufficient safety margin, newly developed shaft forging and retaining rings were applied.

*Next-Generation Type Electricity Generating Systems
TAKAHASHI Takeo IKEDA Kazutaka

Stable electricity supplies and harmony with the environment are important subjects in the field of electric power generation. Toshiba has been constantly striving to meet these requirements through the development of high-performance power plants.

In a CO_2-recovery gas turbine system, plant efficiency is enhanced by increasing the gas turbine inlet temperature to 1,700 °C, while emissions are reduced by CO_2 separation and recovery techniques. The upgrading of existing plants to combined cycle power systems realizes higher efficiency, lower emissions, and stable fuel requirements. Integrated gasification combined cycle (IGCC) power system can accommodate fuel diversification while realizing lower emissions.

*Business Program for Corrective Maintenance of Thermal Power Plants
KITAGAWA Riichiro

Toshiba has formulated a program for corrective maintenance of thermal power plant facilities to promote business development. The most important feature of this program is a maintenance plan taking the entire life cycle of the equipment into consideration. It consists of two key concepts: equipment replacement based on life diagnosis of the equipment under long-term operation, and plant renewal including scrap-and-build programs. Our new maintenance service program using information technology (IT) effectively supports reliability and economy in power plant operations, and is expected to play an important role in the evolution of the maintenance business field.

*Maintenance Technologies for Gas Turbines
KONDO Takuhisa ISHII Junji SAKAI Yoshiaki

The number of gas turbine combined cycle systems installed in power plants is increasing. Since the hot gas parts of a gas turbine are susceptible to damage such as thermal stress cracks and hot oxidation, it is indispensable to constantly repair or replace hot gas parts. For this purpose, diagnostics and advanced repair technologies for gas turbines have been developed in the world.

Toshiba has been developing various technologies for gas turbines, including life assessment technologies, long-life technologies, diagnostic technologies, and maintenance technologies.

*Maintenance Program Technologies for Industrial Power Generation Facilities
OKADA Kazuhiro AOKI Shizuma OZAWA Susumu

Industrial power generation plants are established by users such as those in general industrial fields, municipal offices, and so on, where they supply electric power or electric power and process steam to support the user's regular operations while reducing energy costs. In the event of an unexpected stoppage or running impediment, however, not only do energy costs increase but regular plant operations may also be suspended or reduced. Maintenance programs play an important part in preventing such trouble.

Toshiba offers various maintenance program technologies for industrial power generation facilities corresponding to the user's needs, including life condition diagnosis, long-term preventive maintenance programs, rationalization programs, and energy saving/total generation optimization programs.

*Control and Information Systems Fulfilling Various Needs of Thermal Power Stations
OHKUMA Eiichi ARII Michio

Deregulation of the electric power industry in Japan is exerting a major effect on information and control systems for power plant operation, monitoring, and management. This is resulting in various needs and difficulties in obtaining customer satisfaction by conventional methodologies for achieving high reliability and high performance.

As a leading supplier of information and control systems for power plants, Toshiba is continuously making efforts to provide solutions and realize high-efficiency and low-cost operation by introducing the latest information technologies including mobile and Internet technologies.

*Simulation Power Generation System Equipment for Training at Thermal Power Stations
IIDA Shoji IKEDA Fumiaki ONO Masanobu

With the application of digital automatic voltage regulation (AVR) equipment and digital protection relay systems to thermal power stations in recent years, personnel training in the maintenance and handling of digital equipment is required. We have developed simulation power generation system equipment which enables advanced education and training in both digital AVR and digital protection equipment, by providing reduction models of the generator and main circuit equipment of a thermal power station. This system has been supplied to The Tokyo Electric Power Co., Inc. (TEPCO).

Feature Articles

*Compact Injection Molding Machine for Automobile LED Lamps
ADACHI Masaki KITAJIMA Tomokazu OBARA Shoji MIYAKO Hiroyuki

Most semiconductor packages are made of epoxy resin, a thermoset compound material. Because epoxy is difficult to reuse and recycle, a new packaging technology is required from the standpoint of preserving natural resources.

We have developed a compact injection molding machine for thermoplastic resin in order to realize reliable and stable production of semiconductor packages. Among its salient features are precise control of injection and a small footprint. This molding machine is now being used for the production of automobile LED lamps molded from thermoplastic resin.

*Study on Myoelectric APDF for Consumer Product Development and Evaluation
TOMIOKA Kei

Various ergonomic methods have been applied to product development. However, as products diversify and become mature, there are cases in which such methods cannot be applied. The introduction of new methods to product development may therefore promote the development of new products.

An experiment was carried out to determine whether the amplitude probability distribution function (APDF) analysis method using electromyography (EMG) is applicable to the evaluation of consumer products. The results obtained demonstrated that APDF analysis is suitable for consumer product evaluation in terms of sensitivity and correspondence with other objective and subjective methods.

*Development of Standard CAD Data Exchange Format in Construction Field
MOCHIZUKI Yoshiaki

SCADEC (Standard for CAD data exchange in Japanese construction field) is a consortium established for the purpose of creating a basis for 2D CAD data exchange. It is part of the Construction CALS/EC (Continuous acquisition and life-cycle support/electronic commerce) project. SCADEC has formulated standard specifications for CAD data exchange and developed basic software. The usability of this basis for CAD data exchange has been verified. The standard specifications for CAD data exchange are based on STEP (Standard for the exchange of product model data), which is an international standard of ISO. SCADEC has also adopted a new concept called "Feature,"which makes the handling of STEP easier. SCADEC has presented its results at an ISO meeting and discussed international CAD data exchange.

Toshiba has served as a leading member of SCADEC from the beginning, and is continuing these activities toward the actualization of Construction CALS/EC.

*Spaceborne Diode-Pumped Nd:YAG Laser for Asteroid Sample Return Mission
NAKAYAMA Michio

With the recent trend toward global environmental protection, the LIDAR (Light detecting and ranging) onboard satellite is attracting considerable attention because it can be applied to global observation. We are developing the LIDAR system and its components for various observation applications. Spaceborne components are required to have higher reliability, lighter weight, and greater durability.

We have developed a spaceborne diode-pumped Nd:YAG laser for MUSES-C, which is the asteroid investigation program being conducted by the Institute of Space and Astronautical Science, Japan. This is the first successful accomplishment of LIDAR for space use. The output power reaches 15 W, which is also sufficiently high to cover other environmental observation fields.

Techno Notes

*Meeting the Challenge of Medical Solutions

Toshiba Technologies for the New Century

*3. Agent Technology