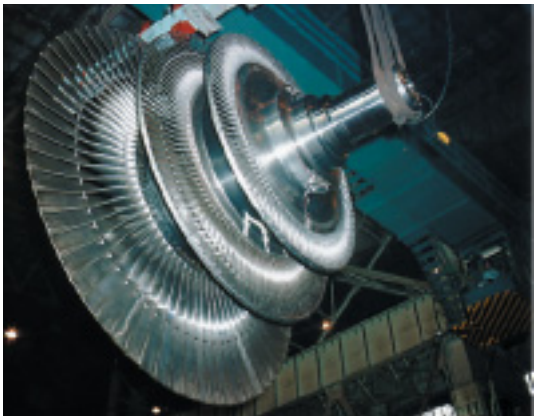
Power Systems and Industrial Equipment

Toshiba has promoted design, fabrication, building and maintenance of power generation plants with improved economic efficiency and reliability and which take into account global environment issues. Regarding products and systems that support the fundamentals of society, we have developed switch gear, etc. which also reflects our concern for the global environment as well as being designed for compactness, lightweight and safety.

Development of New 48-inch and 40-inch Last Stage Buckets for Steam Turbines

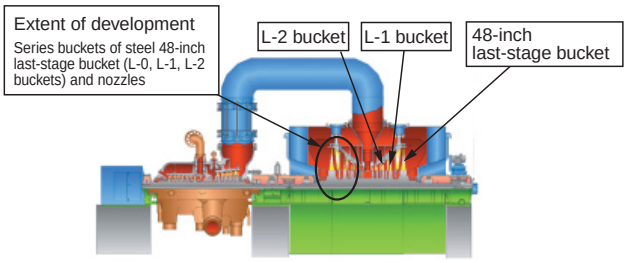


Series buckets of a steel 48-inch last-stage bucket (buckets and rotor for actual-size rotating test)

New steel 48-inch last stage buckets and 40-inch last stage buckets for steam turbines have been developed. Toshiba has developed these buckets in cooperation with GE Power Systems.

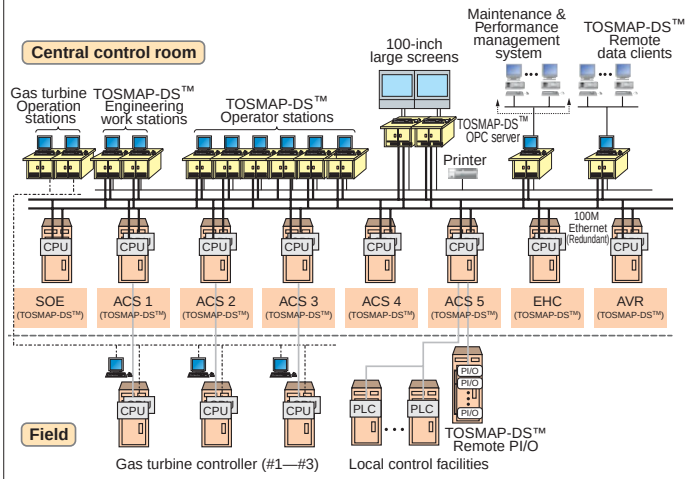
The new buckets are designed for both 50-Hz and 60-Hz applications and will increase the steam turbine power output capability, leading to improved combined-cycle plant efficiency and lower cost of electricity production. The 48-inch last stage bucket is the largest steel full-speed (3,000 rpm) last-stage bucket in the world in terms of annulus area.

Toshiba expects to offer the new buckets on steam turbines for both combined-cycle and fossil power plant applications that are shipped after 2003.



Example of new last-stage bucket application (steam turbine of 50 Hz, 600 MW class)

TOSMAP-DS™ Systems for Taiwan Combined Cycle Power Plants



ACS : Automatic Control System
EHC : Electro Hydraulic Controller
OPC : OLE for Process Controller
SOE : Sequence Of Events recorder
AVR : Automatic Voltage Regulator
PI/O : Process Input Output

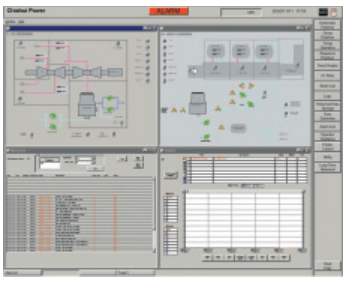
Configuration of the TOSMAP-DS™ system for Chiahui Power Plant, Taiwan

Toshiba shipped TOSMAP-DS™ systems for the following four combined cycle plants in Taiwan after the successful factory acceptance tests.

Fong-Der Unit 1	(Shipped in November 2002)
Chiahui	(Shipped in December 2002)
Fong-Der Unit 2	(Shipped in January 2003)
Chang-Bin	(Shipped in January 2003)

Control and monitoring scope of the TOSMAP-DS™ systems are:

- Power plant including
  - Steam turbine
  - Generator
  - Heat recovery boiler
  - Gas turbine
- Station including
  - Fuel system
  - Water treatment system



The human-machine interface (HMI) display of the TOSMAP-DS™ system

One of the outstanding features of the TOSMAP-DS™ system is the highly automated plant control, which realizes various patterns of full automation from unit start-up to unit shut down.

The four plants are now under commissioning and will be turned over to the customers between the end of this year and the beginning of next year.

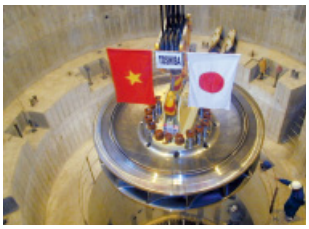
Six Hydroelectric Power Stations for the Overseas Market Commissioned in Succession

Recently, in Vietnam, Nepal, Indonesia, the Philippines and other countries, Toshiba received many orders for hydroelectric power plants, and 6 of them have now been put into commercial operation (the 5 new plants shown in the photo and Umiam power plant in India (10.5 MW × 4 units, replacement)).

In the case of a hydroelectric power plant, it generally takes from 3 to 5 years from order to completion, including design, manufacturing, transportation, installation and commissioning tests. Over a period this long it is not unusual for the commissioning date to be delayed due to some unexpected reason, however, these 6 plant's were completed within the agreed period, and the operation results and performance met with the complete satisfaction of the customers, further enhancing our fine reputation.

In 1999, Toshiba's share of worldwide hydro turbine orders was recorded as No.1 according to the McCoy Power Report.

Based on our rich experience and reliability, we are keen to further expand our world share and increase performance.



The turbine at Ham Thuan Power Station (2×158 MW, March 2002), Vietnam

The Batutegi Power Station (2×14.8 MW, August 2002), Indonesia

The spiral casing at Sipansihaporas Power Station (1×17.6 MW, November 2002), Indonesia

The turbine at San Roque Power Station (3×137 MW, February 2003), the Philippines

The generator floor at Kali Gandaki Power Station (3×48 MW, June 2002), Nepal

Inspection Technology for Nuclear Power Plant Components

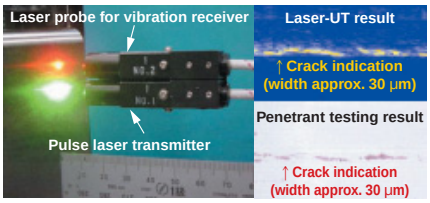
Toshiba has been promoting the development of inspection technologies for nuclear power plant components and adapting them for actual utilization as a part of the plant maintenance work.

Laser-ultrasonic testing (Laser-UT) is a technique that irradiates the surface of an object with a laser beam, and transmits and receives broad band ultrasonic waves. Laser-UT can inspect underwater micro cracks (stress corrosion cracking, etc.) of a depth of 1 mm or less which are barely detectable with conventional methods.

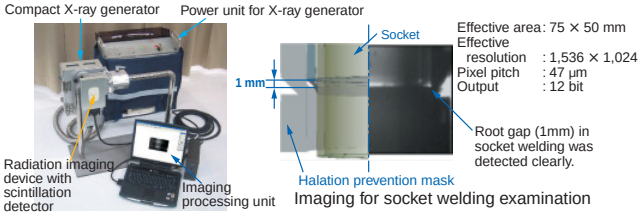
Compact X-ray radiography examination equipment has been developed and applied in the field. This equipment consists of a compact X-ray generator, a slim high-resolution imaging device combined with a high-sensitivity color-scintillator and image processing unit. Real-time and in-situ X-ray measurement for socket welds in piping is attainable with this equipment.

A remote vibration monitoring system utilizing moving image data processing measures the vibration of inaccessible machinery in high places or in high radiation areas from a distance.

The inspection technologies described above improve the reliability and increase the efficiency of the maintenance work.

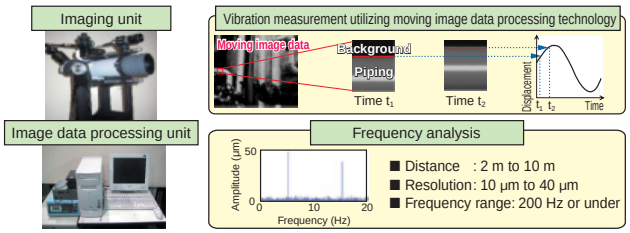


Laser-ultrasonic testing probe and testing result



Imaging for socket welding examination

X-ray radiography examination equipment and application for socket weld



Remote vibration monitoring system and measured data

ASR-2000 Airport Surveillance Radar

ASR-2000 airport surveillance radar

The ASR-2000 is a model of newly developed airport surveillance radar (ASR) for air-traffic control, providing aircraft position information coverage within an 80-n.m. radius around the airport.

The ASR-2000 was developed as a successor to the conventional ASR with klystron-tube transmitter. Two sets were delivered to the Civil Aviation Bureau, Ministry of Land, Infrastructure and Transport in March 2002.

The ASR-2000 features all solid-state power amplifier transmitter, providing stable RF (Radio Frequency) transmission output, and a wide dynamic range receiver, furnishing the latest signal processing technologies allowing improved target detection capability under dense clutter environments such as unwanted echoes from surrounding terrain, mountains, buildings, rainfall, etc.

The ASR-2000 has achieved improved radar performance, system reliability and maintainability as well as cost-reduction. The ASR-2000 is expected to contribute to the establishment of a safer air-traffic environment in the future.

n.m.: nautical mile (1 n.m.= 1,852 m)

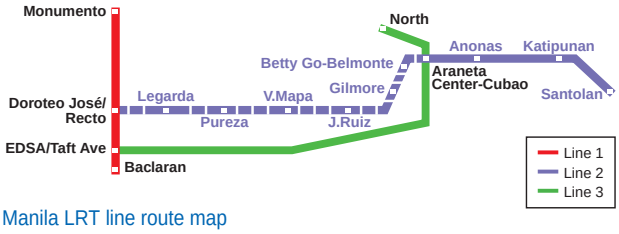
Key characteristics of the ASR-2000

Radar	ASR-2000	Conventional ASR	Remarks
Coverage	Range 80 n.m.(148 km) Azimuth 360°		Radar cross section =15 m² (YS-11 class small aircraft)
Transmitter type	All solid-state	Klystron	
Frequency	2,700-2,900 MHz		Allotted frequency
Peak power	25 kW	1,000 kW	
Pulse width	1 µs (short pulse) 80 µs (long pulse)	1 µs	
PRF(Average)	720 pps (typical)	750 pps (typical)	
Antenna gain	> 34 dBi		
Antenna rotation rate	15 rpm		
Capacity of target detection	> 400 targets	> 256 targets	

PRF: Pulse Repetition Frequency

Manila LRT Line 2 Project

LRT Line 2 trains



Manila LRT line route map

The Manila LRT Line 2 has appeared as one of the metro lines in Manila serving as an artery between the east and west of the city. The total distance will be 13.8 km, and 4.3 km of the line from Santolan to Cubao has been completed at present.

The inauguration was conducted on April 5, 2003 with the President G. M. Arroyo in attendance.

Toshiba has participated in this project with the Korean car builder, Rotem, and has taken a leadership role in the development of the rolling stock system.

These trains consist of Mc1+M1+M2+Mc2 (4 motored cars), and 18 train sets (72 all motored cars) have been ordered. These trains are commuter cars called "MEGATREN" operated by ATO (Automatic Train Control) and are constructed with a light weight stainless car-body.

We supplied our standard main traction inverters (VVVF) with traction motors and the train monitoring system (TMS).

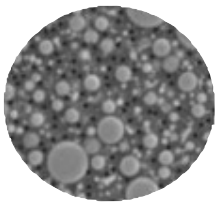
VVVF uses the largest capacity IGBT (3,300 V-1,200 A). Low noise control for comfortable passenger ride is applied and the compact dynamic brake for effective availability of the electric brake with regenerative braking are also adopted.

All of the electric equipment on board is supervised and monitored by TMS. In the case that the rolling stock suffers a failure, it will automatically be shown on the TMS display to inform the driver in the cab and the operation center as well through the communication system.

The entire line is scheduled to be completed within 2004.

LRT : Light Rail Transit
VVVF : Variable Voltage Variable Frequency
IGBT : Insulated Gate Bi-polar Transistor

Solid Insulated Switchgear (SIS)



High-quality epoxy resin

24 kV SIS

Toshiba has developed medium voltage switchgear to meet the demand for size reduction, environmental conformity, and improved safety and reliability. The use of C-GIS (Cubicle-type Gas Insulated Switchgear) has contributed to the minimization of size, because of the higher dielectric strength of SF_6. However, SF_6 was put on the list of greenhouse gasses in the Kyoto protocol 1997. Therefore, Toshiba has developed the new 24 kV SIS (Solid Insulated Switchgear) that uses no SF_6 and conforms to environmental requirements.

SIS is cast with a newly developed hybrid epoxy resin, and many recyclable materials are used. Moreover, by isolating each phase and providing a grounding layer on the insulator surface, phase-to-phase faults are prevented and safety is improved. In addition, far fewer parts, low maintenance and improved reliability are achieved through the adoption of a vacuum circuit breaker (VCB), a vacuum disconnecting switch (VDS) and a balanced magnetic actuator (BMA) in the operating mechanism.

The SIS is about 60 % of the volume, and about 50 % of the weight of the conventional C-GIS. SIS is the next generation switchgear developed through continuous innovation.

Outdoor Type Observation Elevator

Outdoor type observation elevators are popular as a transportation method commanding an extensive view as well as enhancing the exterior appearance of hotels and high-rise buildings in many countries.

Toshiba installed 2 units of outdoor type observation elevator on the Izumi Garden Tower in Tokyo. These both offer 17-person capacity, 360 m/min rated speed and the first outdoor type elevator installed on a skyscraper in Japan. The waterproof cage is made of stainless steel with glass windows. The window glass can be turned opaque to accommodate the occasional passenger afraid of heights.

Special devices called rope sway suppressors are installed at 3 locations along the hoistway to prevent the ropes from swaying in the wind while the car is alighting.

These elevators will automatically slow down the rated speed to 180 m/min if wind velocity exceeds 15 m/s and will cease operation if it exceeds 20 m/s.

An outdoor type observation elevator

Izumi Garden Tower, Roppongi, Tokyo
Total production: Sumitomo Realty & Development Co., Ltd.
Design and Supervision: Nikken Sekkei Co., Ltd

The elevator hoistway and cars