

Special Reports

Technologies for Maintenance and Renewal of Substation Facilities

Aiming for Evolution of Maintenance and Renewal Technologies

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Trends in Maintenance and Renewal of Substation Facilities

KOSAKADA Masayuki / SUMIKAWA Toshio

A large amount of substation equipment installed during the period of electric power system expansion has been operating for a long time, and there is an increasing need for maintenance and renewal of this equipment rather than new construction or large-scale extension. Appropriate maintenance and renewal is important to ensure stable electric power supply. However, the points to be taken into consideration and technologies required for such maintenance and renewal have also been changing. As a result of this trend, sophisticated technologies and various approaches are being implemented for the maintenance and renewal of substation equipment.

New Equipment for Maintenance and Replacement of Aged Switchgears

MIYAMOTO Taketoshi / KATO Norimitsu

A large number of aged switchgears are operating in the field now. For air-blast breakers (ABBs) with old technology and early gasinsulated switchgears (GIS), there is an increasing need for systematic replacement due to difficulties in obtaining maintenance parts for the equipment and signs of degradation of main components. On the other hand, the replacement equipment must fulfill certain requirements such as minimization of the stopping range, shortening of the replacement period, maximization of the applicable range of established facilities, and easy connection with existing equipment. In response to these circumstances, Toshiba has newly developed a 300 kV GIS applying various new technologies.

Technologies for Replacement of Aged Transformers

HOSOKAWA Osamu / YAMADA Shin / SHIBATA Keigo

The power transformers stations delivered during the latter half of the 1960s and 1970s have exceeded their 30-year design life expectancy.

There is consequently an increasing need for the replacement of such transformers. On the other hand, restrictions on the transportation of transformers have become severe in recent years, and cases in which transformers conveyed in the past cannot be conveyed now are rising. Consideration for the reuse of the main parts when replacing transformers is also required, to reduce the burden on the environment.

In response to these circumstances, Toshiba has developed renewal technologies for aged transformers and has been applying a disassembled transportation technology to their renewal.

Latest Technologies for Replacement of HVDC Systems

MURAO Takeru / SHIMADA Kazuyoshi / AIZAWA Hitoshi

Partial renewal or total replacement of aged power electronics facilities in currently operating domestic power transmission systems is planned and implemented to solve problems in operation and maintenance. The main issue with respect to these aged systems is the difficulty in sustaining system performance and reliability as a result of low utilization rates, due to an increase in the failure rate and the lack of maintenance parts and skilled engineers.

In response to this situation, Toshiba is making efforts to introduce the latest technologies for control and protection systems and to carry out the replacement of high-voltage direct-current (HVDC) transmission systems within the shortest possible time.

Maintenance and Renewal Technologies Meeting Various Requirements of Existing Major Substation Equipment

SAIDA Toshiyuki / SATO Yoshimasa / ISHIHARA Yuji

The operational condition of power systems is changing as utilities request additional functions and more value-added functions in aged equipment.

The requirements of these aged facilities differ from those when they began operation. Since the establishment of the major power system in Japan has been completed, future requirements will focus on further technological development to preserve the long-term operation and extend the life of all substation facilities. This can be achieved by full or partial replacement of aged equipment or by the addition of simple smart devices that are designed to assist the operations of existing major substation equipment.

Toshiba has been developing technologies for existing major substation equipment to meet the various requirements of users.

Feature Articles

Method of Automatic Program Code Generation for Dynamically Reconfigurable LSI

KURODA Akira / MATSUZAKI Hidenori / ASANO Shigehiro

Dynamically reconfigurable large-scale integrations (LSIs) are constructed with the capability to change a logic function while it is being executed.

Toshiba has developed the FlexSword™ dynamically reconfigurable LSI for media processing. To utilize this LSI, a compiler that generates program code (executable binary code) automatically from high-level program language is desirable. We have established a novel compiling method that combines a global optimization technique and some local optimization techniques to generate optimized code in a reasonable time.

IK-HR1D Full-HD Video Camera with 1/3-Type 2M Pixel CMOS Sensor

TASHIRO Kei / SHINOZAKI Hiroshi

In recent years, the resolution of industrial video cameras has progressed to high definition (HD), especially in the areas of broadcasting and science imaging applications. Accompanying this trend, the image sensors have also been shifting from charge-coupled device (CCD) sensors to complementary metal-oxide semiconductor (CMOS) sensors featuring high resolution and high-speed data transmission.

Toshiba has developed a new industrial video camera, model IK-HR1D, which incorporates a 1/3-type full-HD CMOS image sensor (single chip with 2 million effective pixels). This camera offers full 1,920 x 1,080 HD progressive video outputs, despite the fact that it is in the smallest size class in the industry. Furthermore, this model is equipped with a newly developed graphics processing engine that makes it possible to provide high-quality images.

Compact, Low-Noise, Level-Shifting IC for SD Memory Card in Cellular Phones

NIMURA Tomoki / TSUJITA Taketoshi / KITAHARA Takaya

With the increasing volume of data being saved in multifunctional cellular phones, large amounts of data need to be transmitted between cellular phones and SD memory cards. When connecting a cellular phone to an SD memory card, a level-shifting integrated circuit (IC) that converts the voltage of each data signal is required because the power supply voltages of the cellular phone and SD memory card are different.

Toshiba has developed a low-noise, level-shifting IC in a compact package of 2.5 mm in width, 2.5 mm in length, and 0.67 mm in height, that was realized by both employing a chip-scale package (CSP) structure and laying out the level-shifting and power-regulator circuits in a single complementary metal-oxide semiconductor (CMOS) chip. The new level-shifting IC achieves good performance of radio frequency (RF) noise rejection in the frequency range from 800 MHz to 2.5 GHz used for wireless communication systems of cellular phones, due to optimization of the electromagnetic interference (EMI) filter design using simulation.

Automatic Train Operation System for Subway Trains

OHYA Junko / IBA Satoshi / NAKAZAWA Hiroji

In recent years, automatic train operation (ATO) systems that can operate trains automatically in place of the drivers have been introduced by many railway companies, in order to ensure that train operations are maintained according to the timetable and that trains stop exactly at the platform safety doors installed at each station.

Toshiba installed its first ATO system for rolling stock of Tobu Railway Co., Ltd., whose services have been extended to through-operation on the Tokyo Metro Fukutoshin Line inaugurated in June 2008. This new system operates a train according to a running plan calculated to adjust its run time to the timetable and to save energy. It also controls braking based on prediction, to stop the train comfortably and accurately at the target positions even with braking in small steps.

SpecPrince™ Support Tool for Generating and Verifying Specifications Based on Specification Metamodel

INOKI Mari / MATSUO Hisanori / KODA Shusaku

In the early phases of a system development life cycle, it is essential to clarify the system requirements, specify documents related to the requirements or basic design specifications, and carry out reviews between the purchasers and developers on the basis of such documents so as to achieve mutual agreement. However, the following problems in this process have not been addressed so far: (1) there is a lack of unification as to which specification elements in the documents should be described, (2) no method exists for defining specifications consistently, and (3) the contents of specifications are not sufficiently discussed due to excessive emphasis on the appearance of the documents.

Toshiba Solutions Corporation has developed a tool named SpecPrince™ that supports the generation and verification of specifications.

SpecPrince™ incorporates two forms of know-how: one for defining the elements and their relationships that are necessary for the requirements and basic design specifications, and the other for verifying such specifications. We have applied this tool to an actual software development project and evaluated it. The evaluation confirmed that SpecPrince™ is effective in solving the above problems and assists in the efficient creation of specifications.

Eco-friendly Totally Enclosed Type Traction Motor for Commuter Trains

TOMIKAWA Hidetomo / MURAKAMI Satoru / KOYAMA Taihei

Toshiba has been developing totally enclosed type traction motors with oil-lubricated bearings aiming at the realization of environmentally conscious products by improving maintainability, achieving energy saving through high-efficiency operation, and reducing noise.

We have developed new totally enclosed type traction motors with oil-lubricated bearings by adopting a new cooling structure that makes it possible to reduce the temperature of the bearings. This simple structure with high cooling efficiency was designed by thermal fluid analysis in conjunction with structural analysis and electromagnetic analysis. We have supplied the new traction motors to Shin-Keisei Electric Railway Co., Ltd. for the 8000 series commuter trains that have been changed to the variable-voltage variable-frequency (VVVF) system, which were put into service in March 2008 as the first commuter trains in the industry equipped with motors of this type.

New SCiB™ High-Safety Rechargeable Battery for HEV Application

TAKAMI Norio / KOSUGI Shinichiro / HONDA Keizoh

The market for rechargeable batteries for hybrid electric vehicles (HEVs) will continue to expand to meet the global demand for clean energy.

Toshiba has developed the SCiB™ high-safety rechargeable battery offering high power performance, long life, and high safety for HEV application.

The SCiB™ battery has flat high power characteristics exceeding 2,600 W/kg over a wide state-of-charge (SOC) range of 20 to 80 %, due to the use of a lithium titanium oxide (LTO) anode and lithium manganese oxide cathode. Life performance between -40 and 60 °C was enhanced by suppression of the manganese (Mn) dissolution problem in the cathode and no use of lithium (Li) metal plating on the LTO anode. The high-power and long-life characteristics of SCiB™ make it possible to realize light and compact battery systems for HEV application.

Frontiers of Research & Development

Technology for Removal and Recovery of Phosphorus from Wastewater Realization of Advanced Sensory Inspection Algorithm