Simulation Study

To better tend to customer’s needs, Toshiba offers a more customer-oriented engineering which includes a simulation study using Toshiba’s advanced traction power simulation software engines. With this, Toshiba can offer a more suitable solution.

Ratings and Specifications

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Find out more on  http://toshba-railway.com
**Traction Energy Storage System with SCiB™**

When a train set is braking, it generates energy which can be used by the adjacent accelerating trains. But in most cases, this regenerative energy is not efficiently utilized by the next train and is wasted as heat through onboard or wayside resistors. Such cases do not only incur energy wastage but also likely to cause abrupt shift from regenerative braking to mechanical braking. This sudden change may further cause passenger ride discomfort and degradation of the brake shoe due to abrasion.

Toshiba’s Traction Energy Storage System efficiently stores surplus regenerative energy in the SCiB™ and discharges it to another accelerating train. TESS is installed with Toshiba’s patented advance control system which allows flexible control of charge-discharge cycles in accordance to the battery’s State-of-Charge (SOC). This allows significant increase in battery lifetime.

Toshiba developed Traction Energy Storage System (TESS) with SCiB™, a new energy saving solution with Toshiba’s own battery technology of high quality.

**Key Benefits**

- **Better Regenerative Braking Operation**
  - Surplus regenerative energy can be efficiently charged and discharged from the SCiB™ Battery thus preventing regenerative brake failure.

- **Energy Saving**
  - SCiB™ remarkable charge-discharge efficiency characteristics can reduce energy wastage and ultimately, promote power demand peak cut.

- **Line Voltage Stabilization**
  - Installation of TESS can improve traction power quality through voltage stabilization.

- **Emergency Power Supply**
  - Stored energy can be utilized to accelerate the trains and safely bring passengers to the nearest station during power failure. This function is most applicable when installed in tunnel and bridge sections.

**System Outline**

- **Control Panel**
  - 500W x 6000 > 2100H x 2Panel
  - Installed with user-friendly HMI with increased functionality - Charge and Discharge Control - System Monitoring - System Control - Data Logging

- **DC Switchgear**
  - 600W x 170H x 2100H x 2Panel - Safe and Easy maintenance design - Compact Design

- **Converter**
  - 1800W > 2300W x 2300H
  - High capacity design applicable to a wide range of feeding systems

- **Battery Panel**
  - 600W x 6500 > 2100H x 8Panel
  - Utilizes high output 40Ah Battery Modules - Compact design

**Advanced V-SOC Battery Control**

Toshiba also developed a completely new and advanced Charge-Discharge algorithm for the efficient control of TESS. For conventional energy storage systems, battery is charged and discharged to keep specified SOC (State of Charge). Thus, battery is charged and discharged regardless of the feeding voltage. There will be instances when the battery will be unnecessarily charged/discharged even at rated line voltage (area between the Charge Start Voltage and Discharge Start Voltage). Thus causing feeding voltage imbalance and shortened battery lifetime.

As for Toshiba’s advance V-SOC control method, charge and discharge characteristics automatically shifts depending on SOC. When SOC is low, charge-discharge characteristic will shift to the higher voltage side, hence the battery shall be easily discharged. On the other hand, when SOC is low, charge-discharge characteristic will shift to the lower voltage side. This function is more applicable when installed in tunnel and bridge sections.

Toshiba’s system does not define any certain SOC which means that charge and discharge will be performed dynamically within a wide range of SOC.

**TESS utilizes Toshiba’s own high performance SCiB™**

This battery has various outstanding characteristics. By using unique oxide materials, SCiB™ holds high resistance against thermal runaway caused by internal short circuiting brought about by physical stresses.

- **Wide Effective SOC Range**
  - Can be operated up to 15,000 charge-discharge cycles.

- **High Temperature Operation**
  - Can be used at temperatures as low as -20°C.

- **Low Temperature Operation**
  - Can be used at temperatures as low as -30°C.

- **Rapid Charging**
  - Can be fully charged in 6 minutes.*

- **Long Life**
  - Charge and discharge can be greatly reduced.

- **Safe**
  - Uses highly safe lithium titanium oxide (Li4Ti5O12).

**Crush Test for SCiB™ Cell Battery**

*Results of cell level tests under certain conditions. Not a guaranteed performance.
When a train set is braking, it generates energy which can be unilaterally absorbed by the next train or safely dissipated through onboard or wayside resistors. Such cases do not incur energy wastage but also likely to cause abrupt shift from regenerative braking to mechanical braking. This sudden change may further cause passenger ride discomfort and degradation of the brake shoe due to abrasion. Such cases do not only incur energy wastage but also likely to cause abrupt shift from regenerative braking to mechanical braking. But in most cases, this regenerative energy is not efficiently utilized by the next train and is wasted as heat through onboard or wayside resistors. When a train set is braking, it generates energy which can be used by the adjacent accelerating trains.

Toshiba developed Traction Energy Storage System (TESS) with SCiB™, a new energy saving solution with Toshiba’s own battery technology of high quality.

**Key Benefits**

- **Better Regenerative Braking Operation**
  - Traction Energy Storage System (TESS) is installed in the last car of a train set: it is charged and discharged along with the train.
  - SCiB™ batteries are charge and discharge efficiently by applying special battery management systems.

- **Energy Saving**
  - TESS can efficiently store and discharge surplus regenerative energy.
  - Surplus regenerative energy is discharged back to the DC bus of the train.

- **Line Voltage Stabilization**
  - TESS was able to stabilize line voltage without having to build a new substation.
  - TESS for Line Voltage Stabilization:
    - **Substation:** Unga Station Battery Post
    - **Power Supply:** Line Voltage [V]
    - **Charge and Discharge Control:** 2 Panel
    - **Converter:** 500kW
    - **Battery Panel:** 600W × 650D × 2100H × 16 Panel
    - **Control Panel:** 600W × 600D × 2100H × 2 Panel

- **Emergency Power Supply**
  - TESS was able to independently power a 10-Car Train for Energy Saving
  - TESS Output: 500kW
  - Battery Modules: 600W × 650D × 2100H × 8 Panel

**System Outline**

- **Control Panel**
  - With TESS, daily traction energy consumption was reduced to 356kWh/day (-32%) during weekday and 883kWh/day (-32%) during weekend while reducing the total energy consumption in all substations.

**Performance Record**

- **TESS for Line Voltage Stabilization**
  - Toshiba Urban Park Line – Unga Station Battery Post
  - During the adoption of new type of cars, significant loss in line voltage was expected to occur between: Noda Station, and Toyohashi/Gakuen Station (5 km distance). To stabilize line voltage in this section and avoid building new substations, TESS was installed at the battery post.

- **TESS for Energy Saving**
  - Okinawa City Monorail – Sueyoshi Substation Field Test Results
  - TESS was installed in Sueyoshi Substation of Okinawa City Monorail.
  - With TESS operation, 15% power peak cut was achieved in Sueyoshi SS. Significant power peak cut was also achieved in total power consumption in all substations.

- **TESS for Emergency Power Supply**
  - Tokyo Metro – Ayase Substation Field Test Results
  - TESS was installed in Ayase Substation of Tokyo Metro for energy saving and emergency power supply. TESS was able to independently power a 10-Car Train for Energy Saving with additional battery characters can reduce energy wastage and demand peak cut. Ultimately, promote power saving line voltage stabilization.
**Key Benefits**

- Better Regenerative Braking Operation
- Energy Saving
- Line Voltage Stabilization
- Emergency Power Supply

**System Outline**

- Control Panel
- Battery Panel
- Converter
- DC Switchgear

**Performance Record**

**TESS for Line Voltage Stabilization**

- **Tobu Urban Park Line – Unga Station Battery Post**
  - During the adoption of new types of cars, significant loss in line voltage was expected to occur between Noda, Substation, and Toyoshiki Substation (10km distance).
  - To stable line voltage in this section and avoid building new substations, **TEE5** was installed as a battery post.

**Tobu Rapid Line – Onga Station Battery Post**

- **Extension to Unga Station**
  - To meet increased demand for regenerative energy, a new battery was installed.

**Tobu Skyliner Line – Onga Station Battery Post**

- **Extension to Unga Station**
  - For new trains equipped with regenerative braking, a new battery was installed.

**Traction Energy Storage System with SCiB™**

- **Substation Key Benefits**
  - Allows significant increase in battery lifetime.
  - According to the battery’s State-of-Charge (SOC).

**Traction Energy Storage System with SCiB™**

- **Braking Operation**
  - Compact design
  - Battery Modules
  - Utilizes high output 40Ah

- **Energy Saving Line Voltage Stabilization**
- **Charge and Discharge Control**

**Traction Energy Storage System with SCiB™**

- **Monitoring**
- **Data Logging**
- **System Control**

**Traction Energy Storage System with SCiB™**

- **Stabilization**
  - DC600V
  - DC1500V

- **Installation of TESS**
  - Can improve regenerative energy consumption.
  - Efficiency during weekday and 883kWh/day (-32%) during weekend while reducing the traction energy consumption.

**Okinawa City Monorail – Sueyoshi Substation Field Test Results**

- **With TESS operation, 10% power peak cut was achieved in Sueyoshi SS power supply.**
- **Significant power peak cut was also achieved in total power consumption in all substations.**

**Tokyo Metro Ayase Substation Field Test Results**

- **500kW TESS was installed in Ayase Substation of Tokyo Metro for energy saving and emergency power supply.**
- **TESS was able to independently power a 10-Car Train including all auxiliary equipment (air conditioners, etc.) through a 2.4 kilometer stretch of steep gradient up to 33‰.**

**Performance Record**

**TESS for Energy Saving**

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