T.T. Network Infrastructure Japan

Issues and Measures for Low Carbon Society in Mongolian Electricity Sector

T.T. Network Infrastructure Japan
(Joint Venture of ***TOSHIBA Corporation*** and ***Tokyo Electric Power Company***)

December 3, 2013

What's TTNI ?

TOSHIBA
Leading Innovation

JV for Global Electric Power T&D Business

東京電力 TEPCO

Toshiba's Strength

State-of-the-art Technologies & Products/Solutions, Vast Experience in Electric Power Network

TEPCO's Strength

Knowledge/Know-How/Experience in Planning and Operation & Maintenance of Electric Power Network

T.T. Network Infrastructure Japan

To realize and expand

End-to-End Total Solution Business in T&D market

Such as:

For developing countries

- Consultancy for network planning (master plan, system design, etc.)
- Operation & maintenance support

For advanced / developed countries

- Solutions to improve withstandability against disasters
- Reliability improvement for network stability, network expansion, grid connections, etc.
- Optimal utilization of renewable energy through integration solutions

For islands or remote regions

- Realization of environmentally friendly systems

Today's Agenda

1. **Energy Efficiency Improvement by Replacement of the aged and deteriorated transformer to the new transformer**
   - ***Introduction of TOSHIBA's High Efficiency Transformers***

2. **Measures to expand the introduction amount of renewable energies**
   - ***Power Grid Stabilization by Li-ion Batteries (TOSHIBA's product: SCiB™)***

SCiB=Super Charge ion Battery

1. Energy Efficiency Improvement by Replacement of the aged and deteriorated transformer to the new transformer

Introduction of TOSHIBA's High Efficiency Transformers

Introduction of High Efficiency Transformer

Background

- The most of existing transformers in Mongol had been installed in 1960-70s, and they have been operated over 50 years. At the same time, some transformers are difficult to maintain due to the lack of repair parts. And these old transformers have comparably large losses.

Issues

- The transformer losses are rather large.
- Some transformers are difficult to maintain due to the lack of repair parts.

Measures

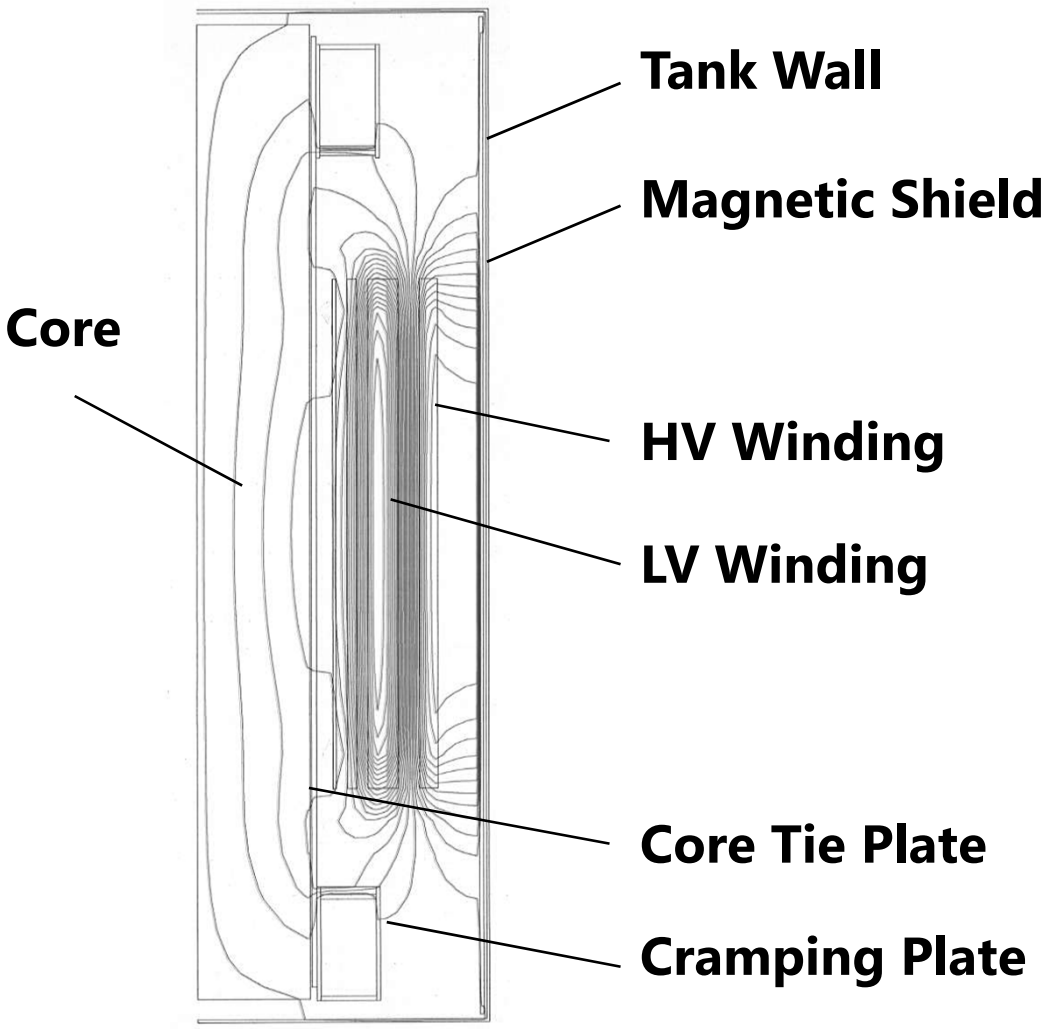
- To reduce losses by replacing the old transformer to the new high-efficiency transformer utilizing new technologies.
  → To reduce fuel costs and GHG emissions
  → To reduce air pollution

Features of High Efficiency Transformer

- TOSHIBA's cutting-edge analysis technologies
  - Well skilled 2D / 3D magnetic flux distribution and stray loss distribution analysis technologies using CAE methods. Such technologies enable to chase location and level of stray loss of the transformer precisely.

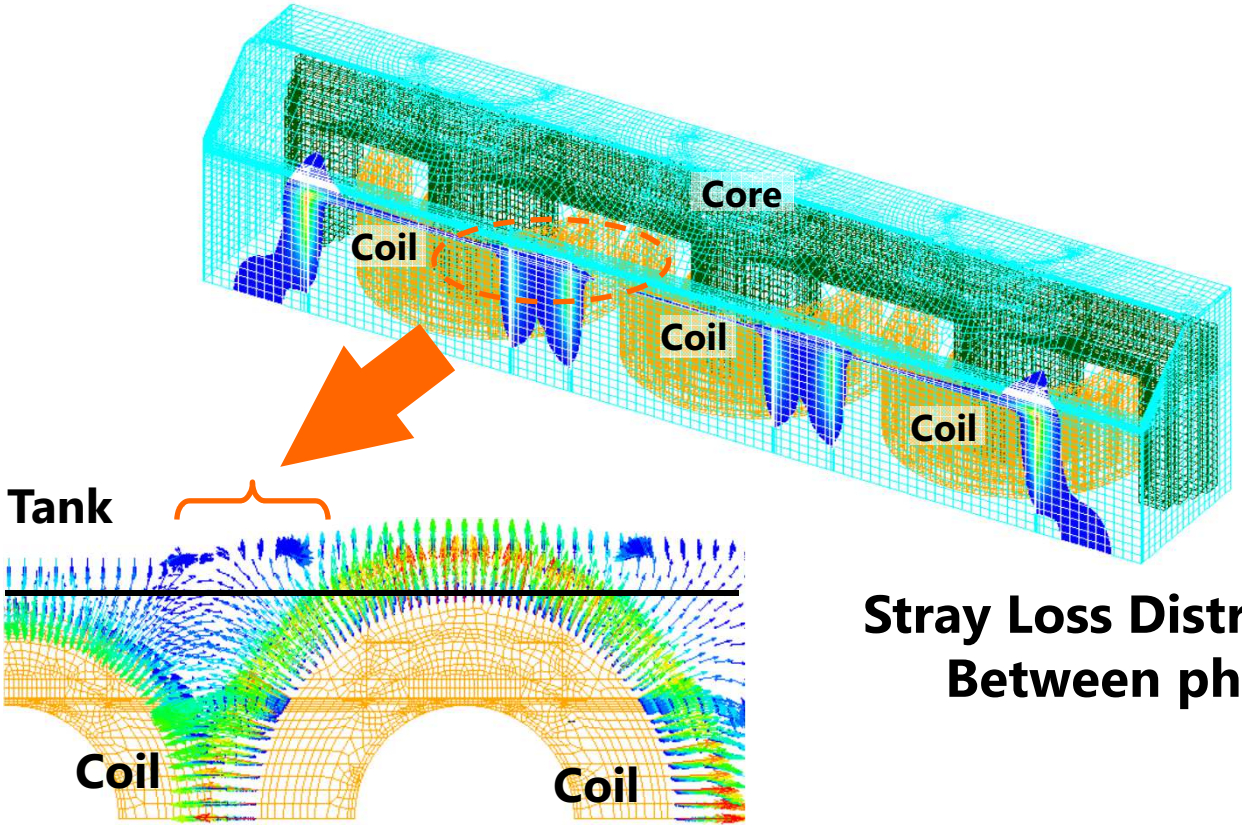
- Feature 1:
  - Effective allocation of Magnetic shield and magnetic shunt structure
- Feature 2
  - Effective slitting on core sheets and core tie plates to cut eddy current.
- Feature 3
  - Application of the transposed cable to the winding for reduction of stray loss in the winding conductor

TOSHIBA's cutting-edge technologies
- Analysis of leakage flux distribution -



Toshiba has well skilled leakage flux analysis technologies based on manufacturer's experiences.

TOSHIBA's cutting-edge technologies
-3D Magnetic Field Analysis and Stray Loss Analysis-

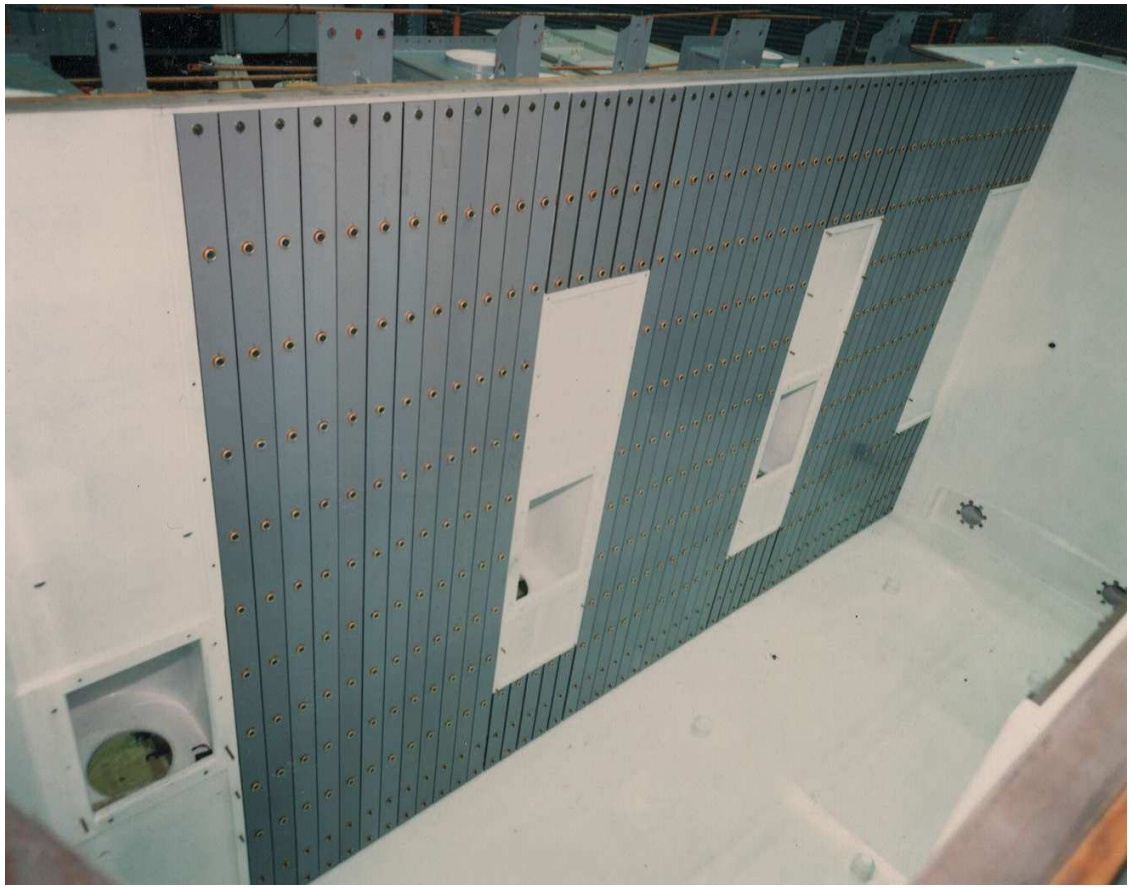


Stray Loss Distribution Between phases

Leakage Flux Distribution

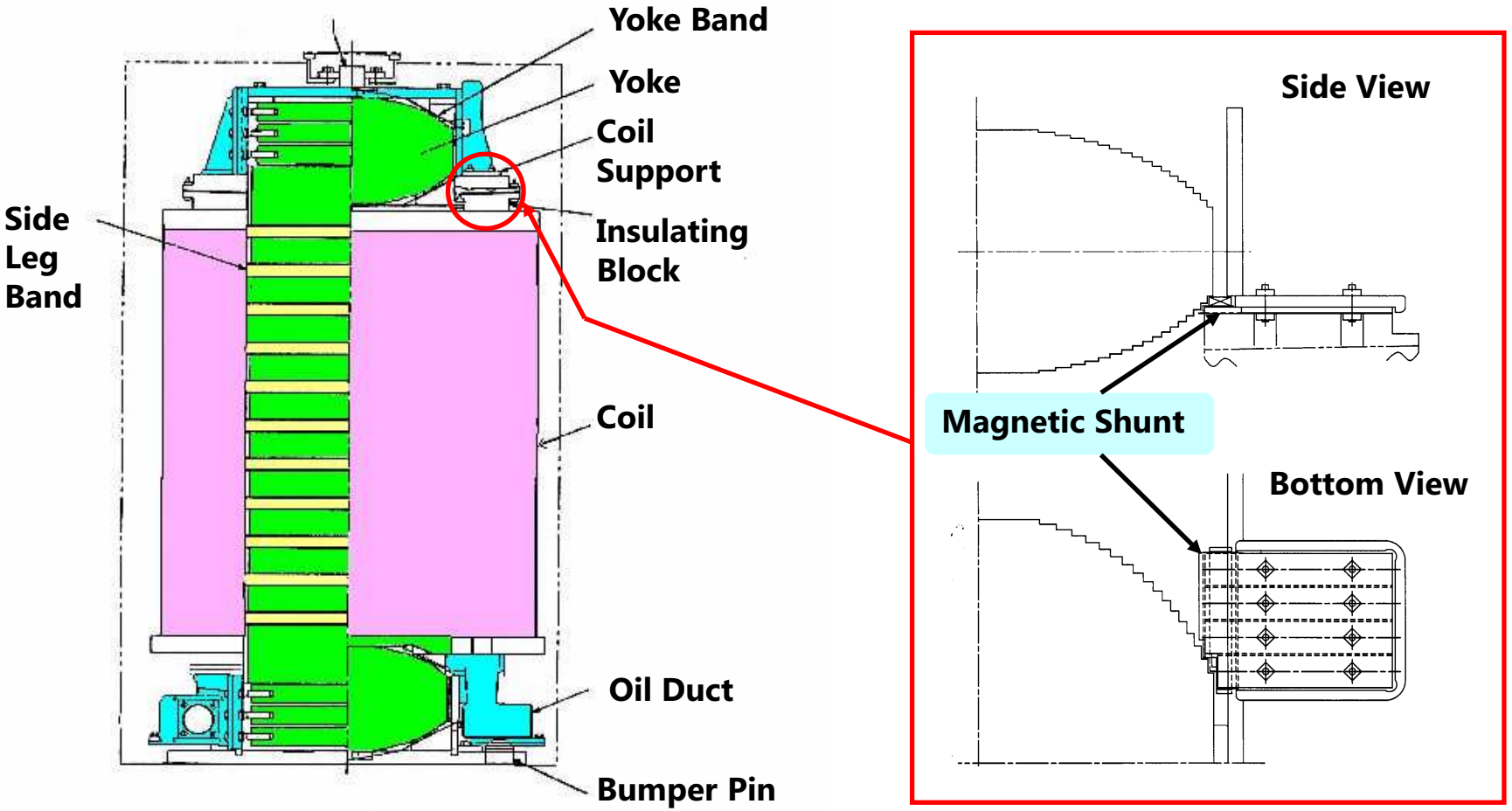
3D CAE flux distribution analysis and stray loss distribution analysis are also available. These CAE technologies enable precise and reliable chase of stray loss location and its level.

Feature 1-(1): Magnetic Shield on The Tank



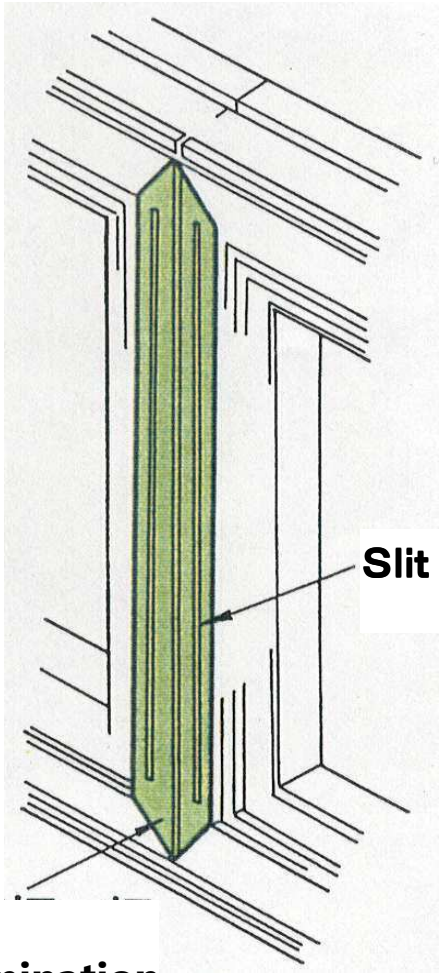
Magnetic shield is applied onto inside wall of the transformer tank. This magnetic shield prevents for the flux to leak to the transformer tank wall. If the flux leaks to the tank wall, tank local heating occurs to increase stray losses.

Feature 1-(2): Magnetic Shunt structures

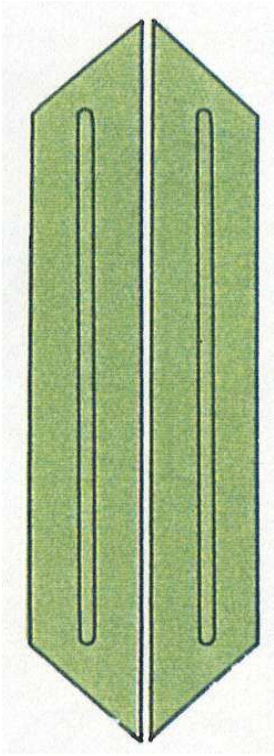


If the leakage flux leaks to the steel structure of core and coil clamping materials, local heating also occurs on such portions. Magnetic shunt structure prevents such leakage of the flux to the core/coil clamping materials.

Feature 2-(1): Slitting on the Core Lamination



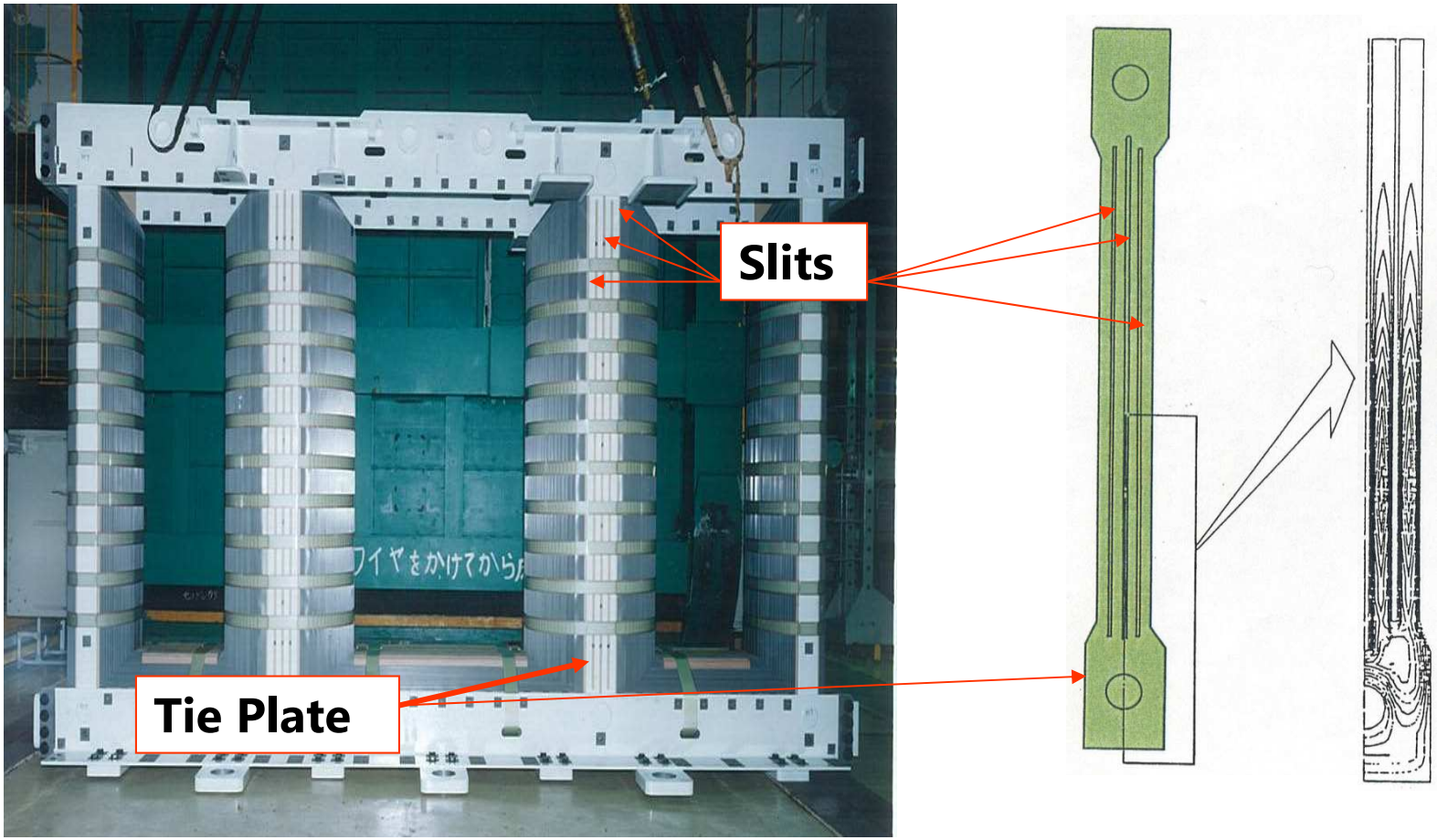
Core Lamination



Only for end steps
(Min. width)

Slit core sheets are applied on end step of the core lamination. Slitting effects to cut eddy current in the core sheets.

Feature 2-(2): Slitting on the Tie Plate

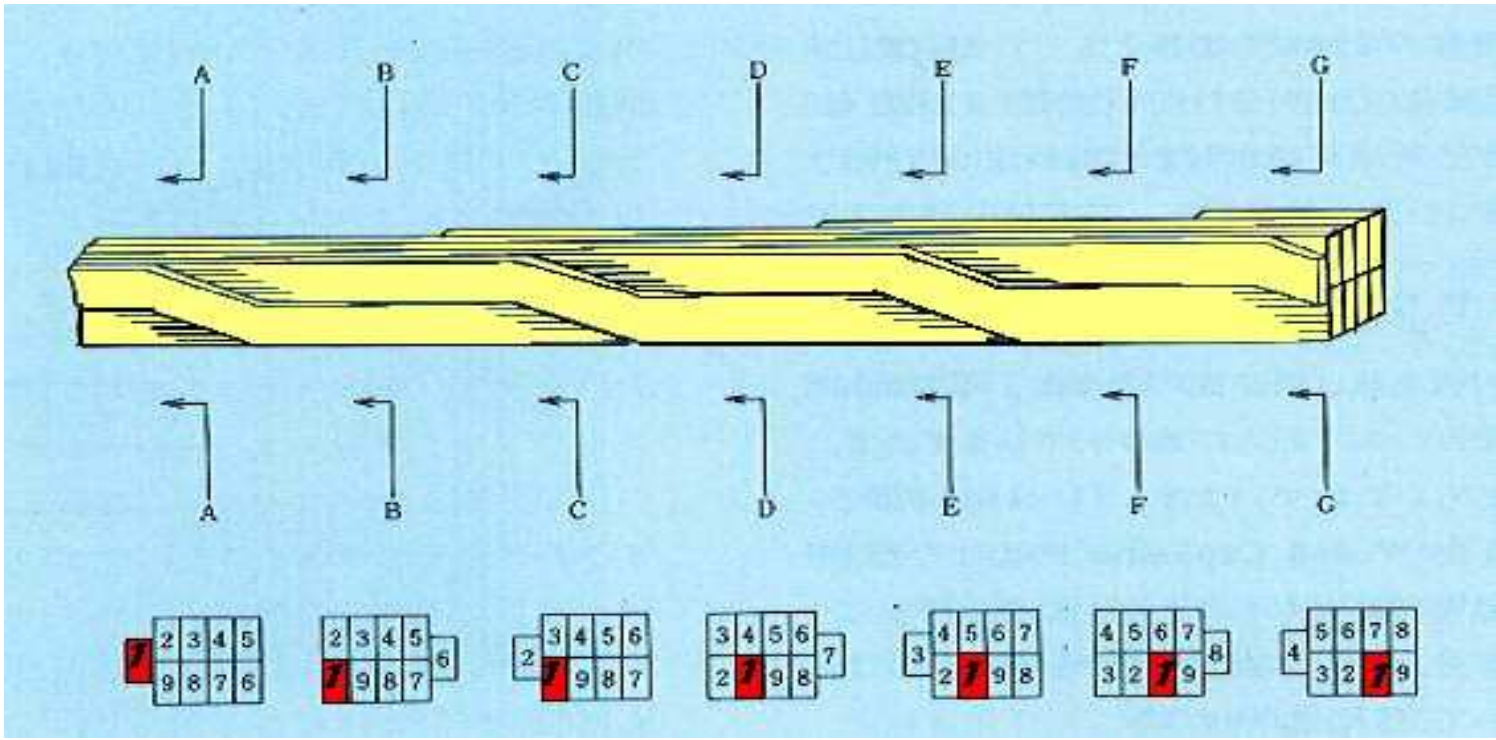


Not only core sheets but also core time plates are also slit to cut eddy current.

Feature 3: Reduction of Coil Stray Losses

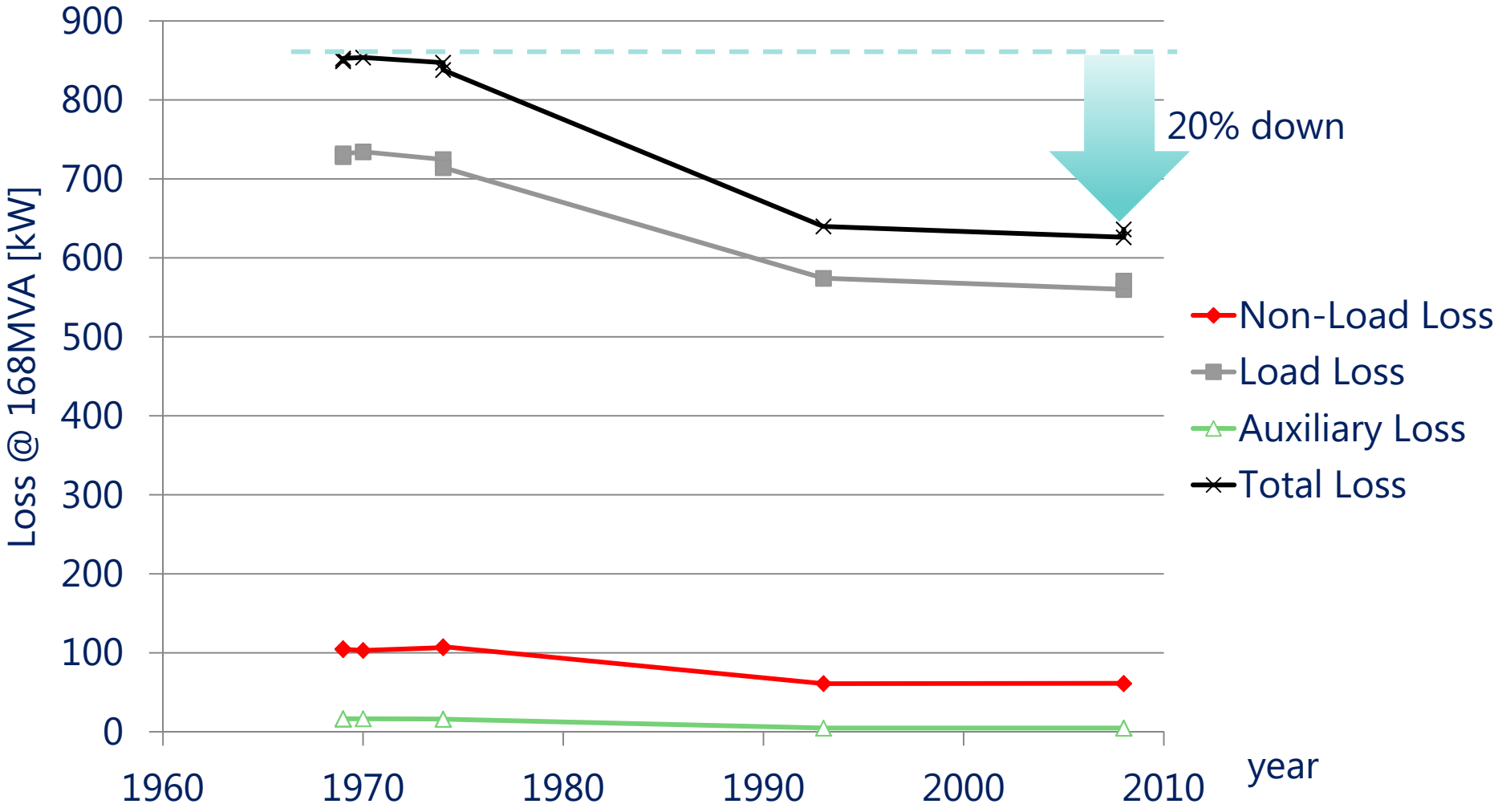
Application of Transposed Cable

* Reduction of Eddy Current Loss of Coil Conductors



Transposed cable is applied to reduce stray loss caused by skin effect and proximity effect.

A loss transition example according to manufacture years for same rating transformers (168MVA)



The loss has been reduced more than 20% since 1970s.

2. Measures to expand the introduction amount of renewable energies

Power Grid Stabilization by Li-ion Batteries
(TOSHIBA's product: SCiB™)

Power Grid Stabilization by SCiB

Background

- National Program for Renewable Energy（2005-2020）aims to increase percentage of renewable energy in the production of energy so that it should become 20-25 percent by 2020.

Issues

- However, all of the CES (Central Energy System) power supplies are comprised of coal burning generation plants, therefore, the load-following is difficult.
  If massive renewable energy is introduced, the frequency and voltage will be unstable. Therefore, it will be more difficult to adjust supply and demand.

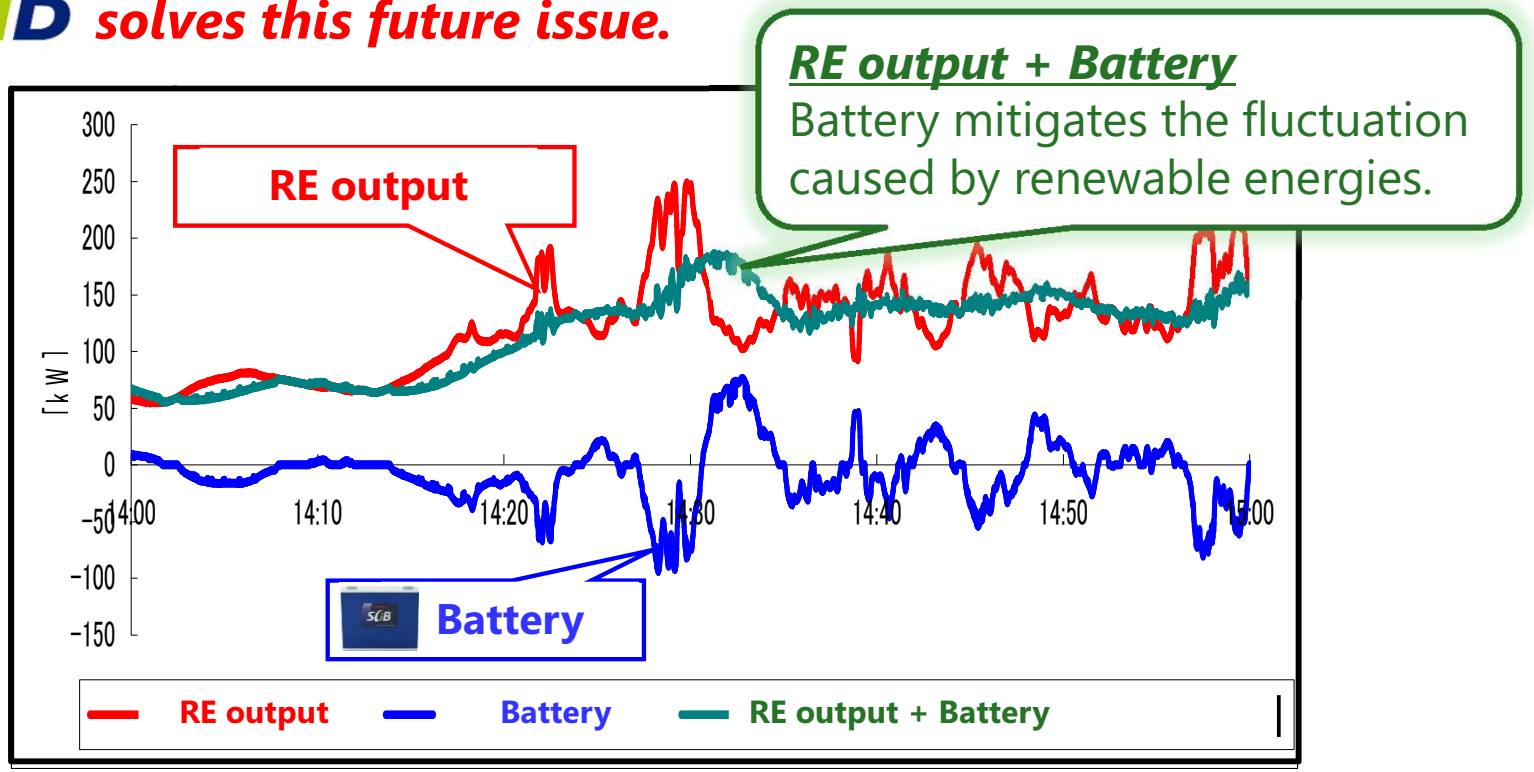
Measures

- The introduction of SCiB™ is necessary.
  → To keep grid stability and massive renewable energies
  → To reduce fuel costs
  → To reduce GHG emissions and air pollution

Future issue for introduction of renewable energies

Renewable energy output is changed rapidly in accordance with weather condition. However, existing power plant (e.g. Coal burning generation) can not follow completely its fluctuation.

➡ SCiB™ ***solves this future issue.***



SCiB™ supports to introduce large amount of renewable energies in the existing Mongolian power grid.

TOSHIBA's energy storage system

Features of SCiB ™

Safety
The possibility of rupturing or ignition is low, even under extreme conditions

Long Cycle Life
Usable for more than 10,000 charge-discharge cycles

Rapidly Rechargeable
Rechargeable in approx. 5 minutes

High Output
Input/Output power density equivalent to a capacitor

Cryogenic Operation
Usable in extremely cold environment (-30℃)

High Effective Capacity
High amount of actual usable energy over a wide range of SOC

SCiB : Rechargeable Super Charge ion Battery
SOC : State of Charge

Battery Energy Storage System

20Ah SCiB ™ Battery Cell

SCiB ™ Module

500kW PCS

Flexible Configuration

Battery Panel(24kWh) (connect up to 160panels)

Battery system

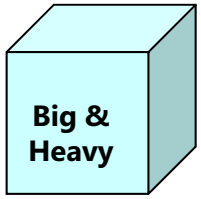
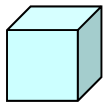
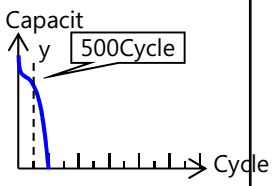
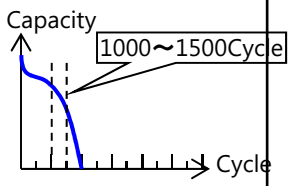
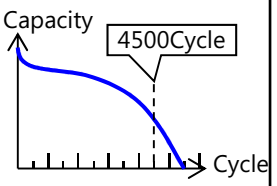
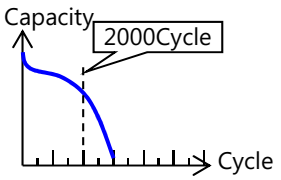
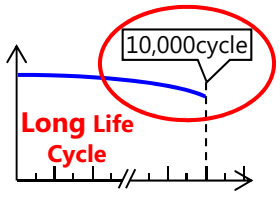
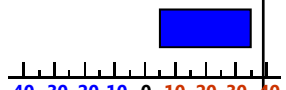
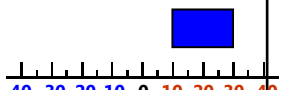
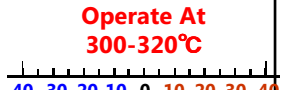
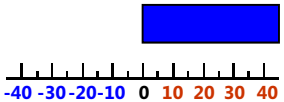
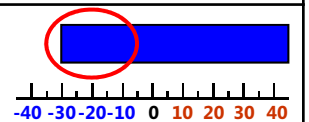
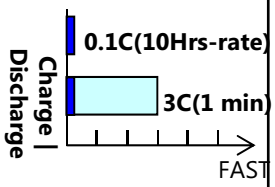
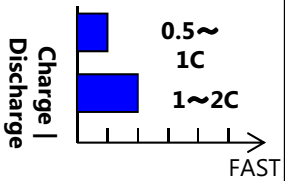
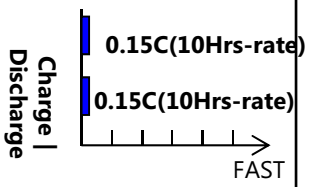
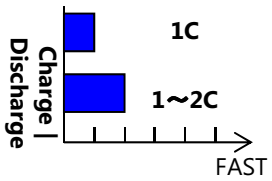
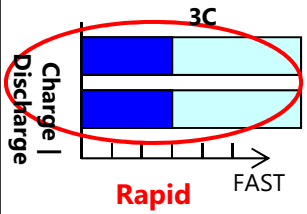
Containerized

Enhanced Capacity

SCiB™ can charge and discharge the power quickly under low temperature condition.

Comparison of SCiB™ and Other Batteries

TOSHIBA

	Lead-Acid	Ni-MH	NaS	Conventional Lithium-ion	SCiB™
Capacity/Weight (Energy Density)		1／2 of Lead-Acid 	1／3 of Lead-Acid 	1／4 of Lead-Acid 	1／4 of Lead-Acid 
Life-Cycle					
Working Temperature					
Charge/Discharge Performance					

Inherent Safety of SCiB™

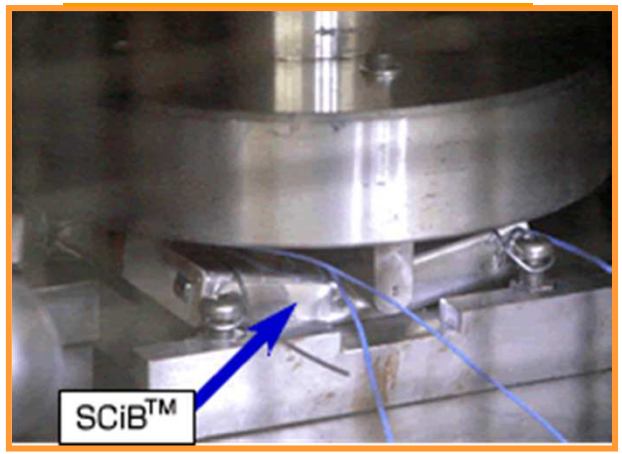
Common batteries

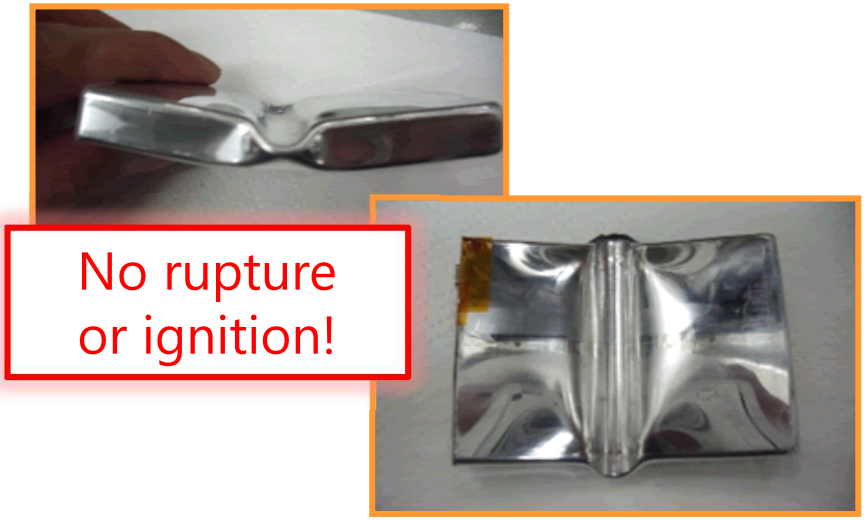
In case of disasters, common batteries have possibility to be damaged and cause the rupture.

SCiB™

SCiB™ has a structure that assures an extremely low incidence of internal short circuits. A high level of safety in preventing thermal runaway is assured even if an internal short circuit is forced.

Crush test results





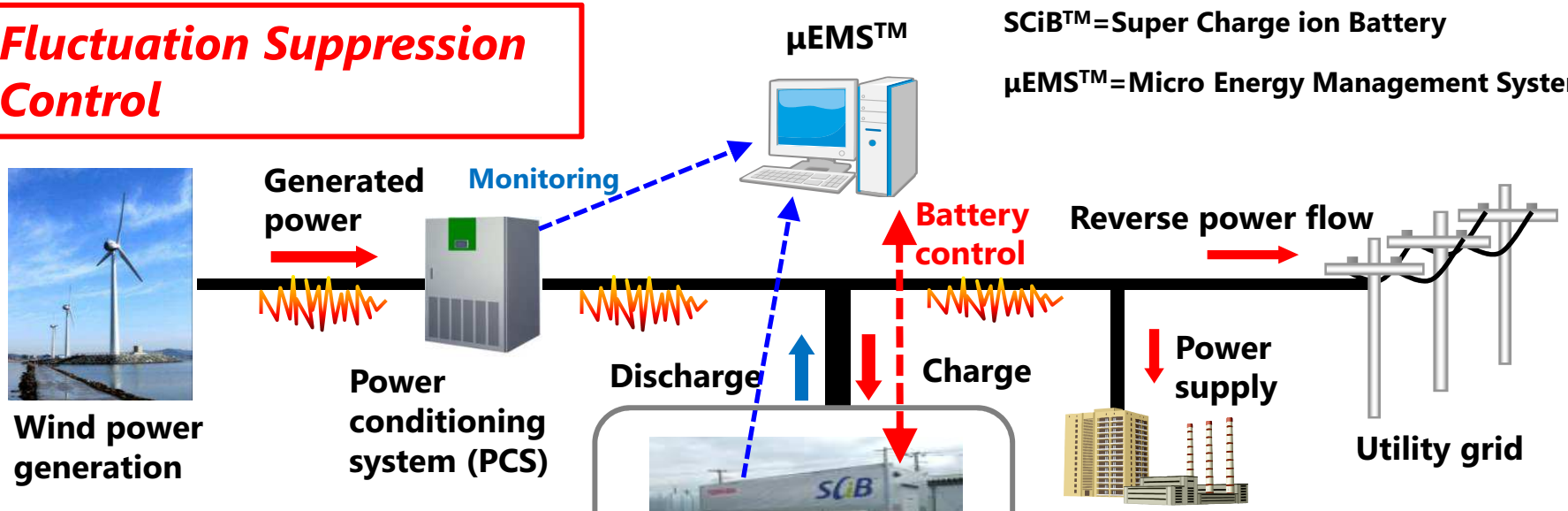
SCiB™ does not cause the secondary disaster after the outside accident.

Solution Example utilizing SCiB(1)

Fluctuation Suppression Control

SCiB™=Super Charge ion Battery

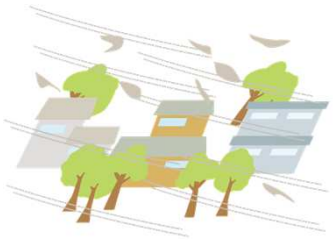
μEMS™=Micro Energy Management System

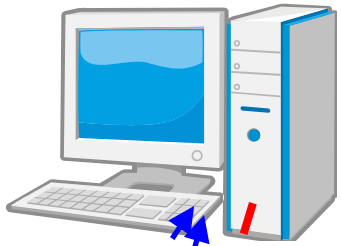


The output of WF is smoothed by controlling a battery system.

Solution example utilizing SCiB(2)

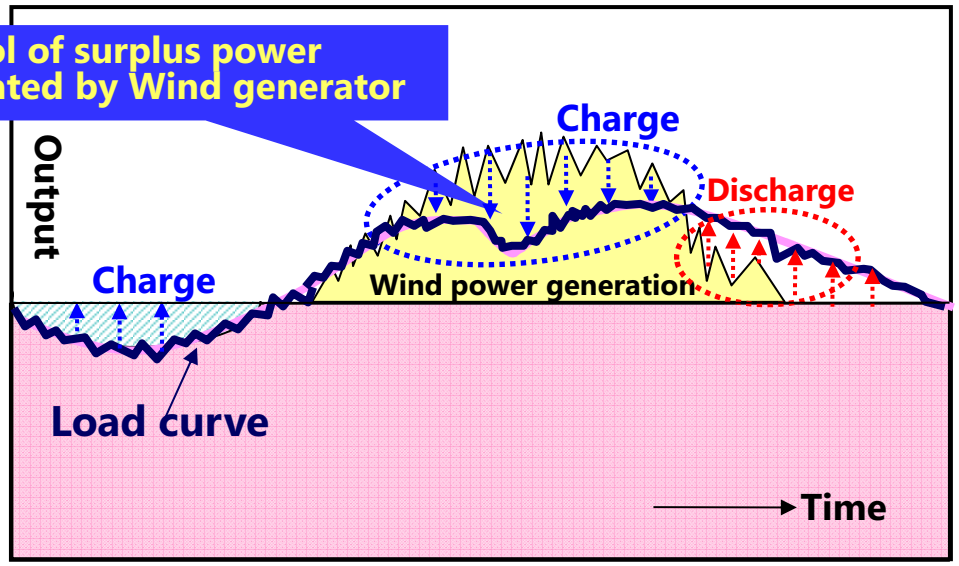
Peak-shift Control





µEMS™

Control of surplus power generated by Wind generator



Wind Generator

Generation

PCS

Battery control

Transmission

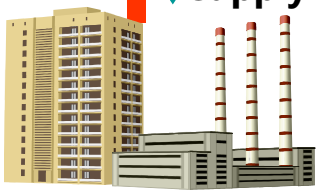
Power supply

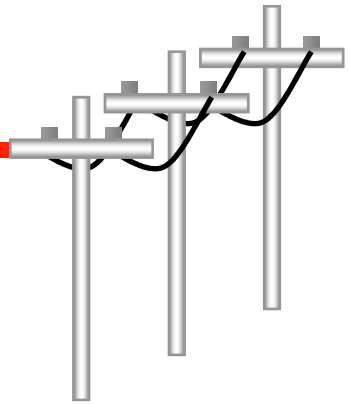
SCiB™

Discharge

Charge

PCS





Electric power system

The surplus power generated by wind generator can be utilized efficiency.

Expected effects

1. Energy Efficiency Improvement by Replacement of aged and deteriorated transformers

- ***Introduction of High Efficiency Transformer***

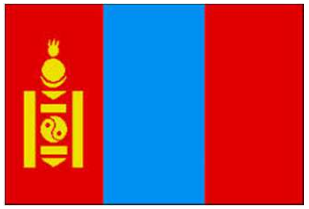
  By reduction transformer losses appropriate generator output capacity is realized to reduce amount of fuel consumption. And GHG will be reduced.

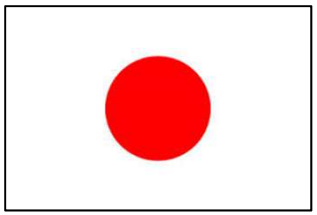
2. Measures to expand the introduction amount of renewable energies

- ***Power Grid Stabilization by SCiB™***

  SCiB™ supports to introduce large amount of renewable energies with grid stabilization.

Thank you for your attention!
Баярлалаа





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