

Expanding the Future of Energy Utilization

High-capacity Nickel-metal Hydride Battery

GIGACELL®

Compact and High-performance
Offering Vast Possibilities for Energy Use.



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GIGACELL

High-capacity Nickel-metal Hydride Battery GIGACELL®

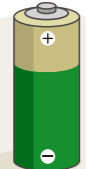
GIGACELL® is a next-generation Ni-MH battery. Designed to be eco-friendly, GIGACELL® commits to the efficient use of energy and carbon footprint reduction.

Received 2009 Japan Minister of the Environment Award for Achievements in Reducing Global Warming

Received the Grand Prize for the 19th Global Environment Award (Hosted by the Fuji Sankei Communications Group)

FEATURE High Scalability


Conventional Battery



AA Type : 2Ah 1.2V 2.4Wh

→ × 2,250

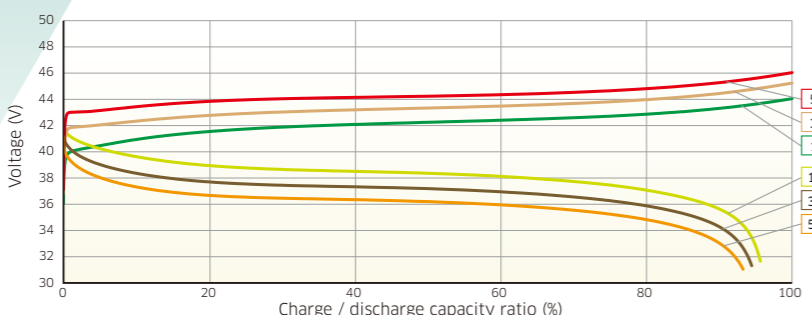
GIGACELL®



150Ah × 36V = 5,400Wh

FEATURE Rapid Charge and Discharge

Low internal resistance enables fast charging and discharging.




500A-running

3000A-50s

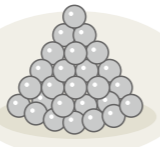
FEATURE Easy to Recycle

No welding used, enabling easy disassembly for recycling.



dismantling


assembly



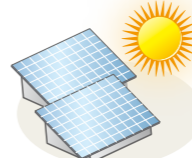
FEATURE Excellent Cycle Durability

Designed to withstand frequent cycles of short, rapid charging and discharging.


Wind power generation



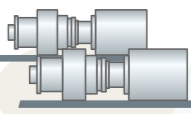
Solar power generation



Railway








Gas turbine






FEATURE Environmentally Friendly

No lead, mercury, cadmium or other toxic materials are used.

Lead	Lead oxide	Cadmium	Mercury	Sulfuric acid
No	No	No	No	No
				

FEATURE Simple and Safe

Low operating temperature; water-based electrolyte eliminates risk of fire.

organic solvent	metallic oxide	Lithium hexafluorophosphate
No	No	No
		

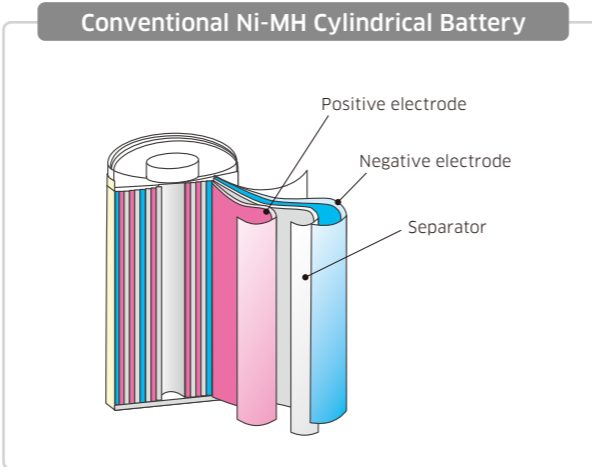
Innovative Design

Bipolar enables GIGACELL®'s high capacity and rapid charging

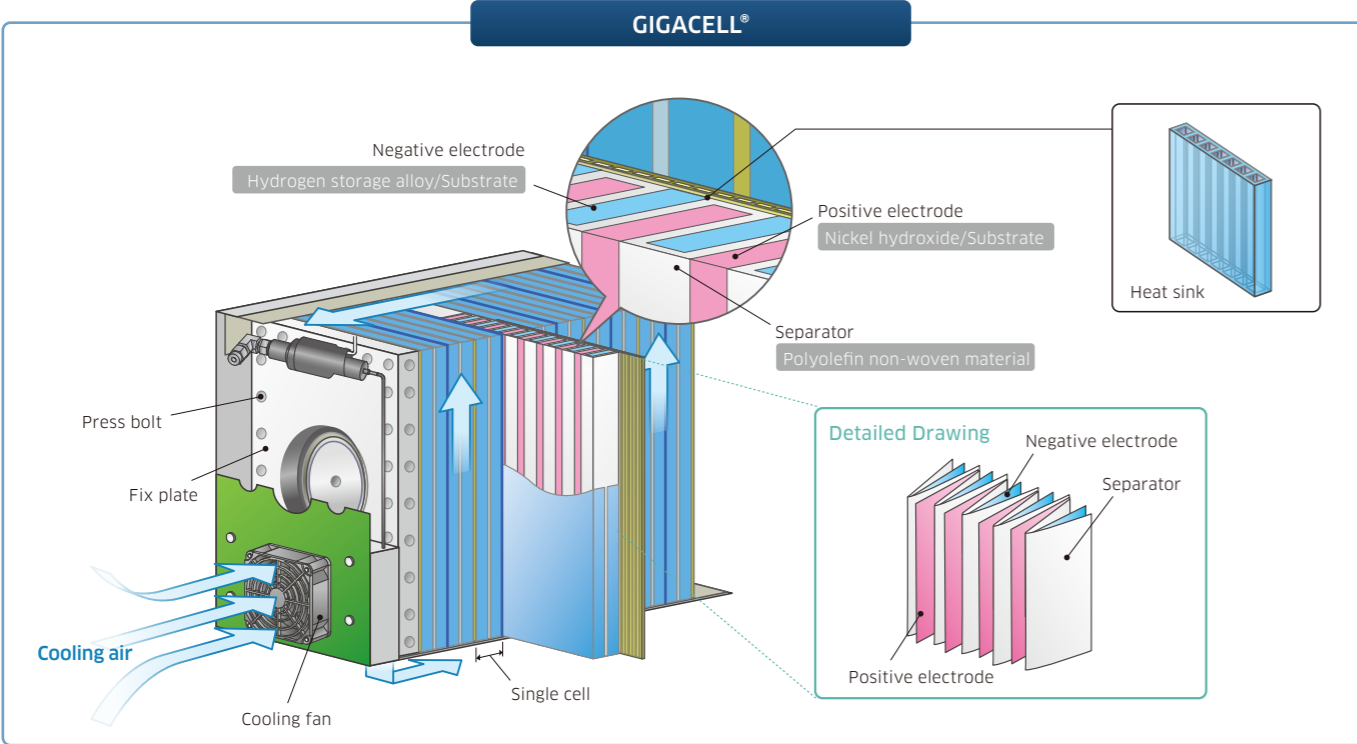
Conventional cylindrical Ni-MH batteries consisting of rolled electrodes and separators heat up during rapid charges and discharges. These batteries also have limited scalability due to the energy loss created in their connections. In addition, their welded structure complicates recycling procedures.

In the GIGACELL®, cooling fans that send air through the structure prevent overheating. The bipolar structure minimizes energy loss between cells and actualizes greater capacity. GIGACELL® is highly recyclable because of its non-welded structure.

Comparison of Conventional Ni-MH Battery and GIGACELL®



- Cooling Fan** Powerful and efficient cooling enables charging / discharging at high amperages.
- Non-welded** With no welding processes during its production, disassembly and recycling processes are facilitated.
- Fully Sealed** The GIGACELL® is fully sealed, needing no maintenance.



Bipolar

GIGACELL® modules are composed of individual cells that are connected in series by their cell walls, with the front and rear surfaces becoming positive and negative electrodes, forming the bipolar structure. The thin cell walls provide a large cross-sectional area that minimizes energy loss, which occurs when the cells are connected. Therefore, the large capacities of modules can be accomplished by increasing the number of cells connected in the bipolar structure.

Safety Tests

Overcharge Test

Battery for power storage system(JEAC 5006-2010) table 3-6-2 in Articles 3 to 6
2.5.3 Overcharge test based on Development of Energy Storage System for Grid-connection with Renewable Energy Resources
—Basic research for the fundamental study by NEDO

Vibration Test

JIS Z-0200/JIS Z 0200
UN38.3 TestT.3Vibration(38.3.4.3.2)
2.5.7 Vibration Test based on Development of Energy Storage System for Grid-connection with Renewable Energy Resources
—Basic research for the fundamental study by NEDO

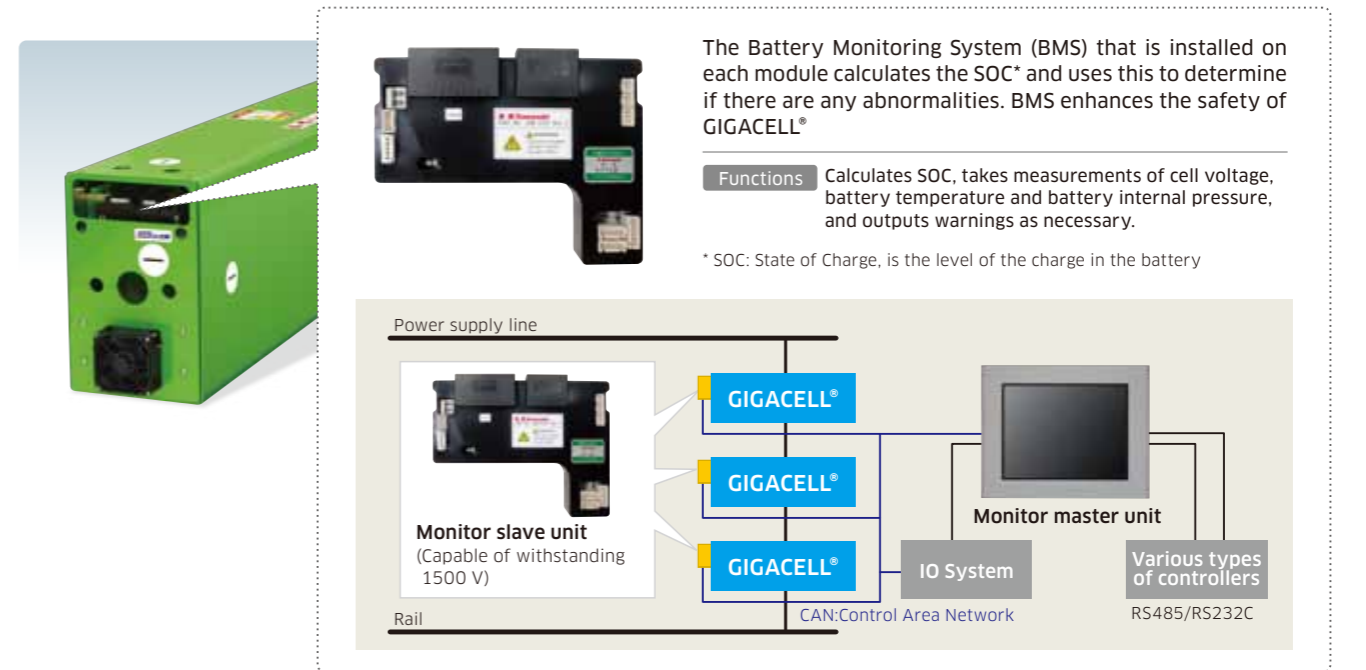
Drop Test

JIS C 8714 (Safety Tests for Portable Lithium-Ion Secondary Cells and Batteries For Use In Portable Electronic Applications)

Water Immersion Test (fresh water and salt water)

2.5.9 Immersion Test based on Development of Energy Storage System for Grid-connection with Renewable Energy Resources
—Basic research for the fundamental study by NEDO

Battery Monitoring System



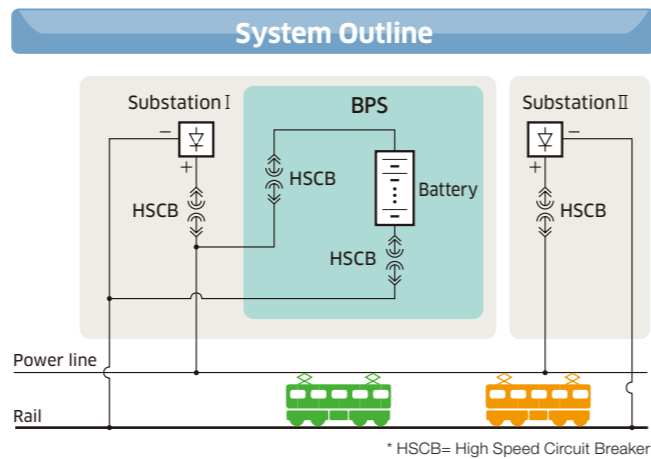
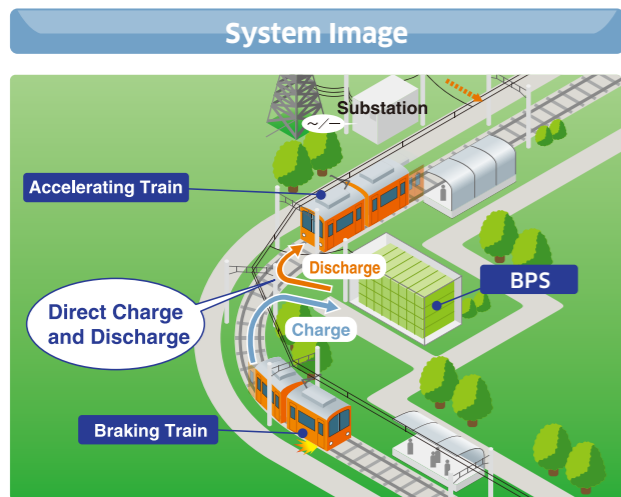
CHANGING THE FUTURE WITH NEW APPLICATIONS

A Combination of Safe, Reliable Rail Transport and Efficient Use of Energy

Battery Power System (BPS) for Railways

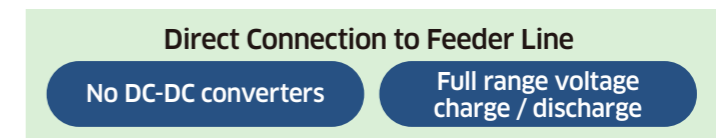
BPS can provide all functions simultaneously

<p>Energy Saving</p> <p>Reducing overall energy consumption by encouraging regenerative braking and then "recycling" it.</p>	<p>No Regeneration Cancellation</p> <p>Stabilized line voltage prevents regenerative braking failure.</p>
<p>Peak Shaving</p> <p>Power discharged from the BPS reduces power demand at all times, including rush hours.</p>	<p>Emergency Runs</p> <p>Batteries will power trains to the nearest station during a power outage.</p>
<p>Line Voltage Stabilization</p> <p>Charging and discharging stabilizes line voltage.</p>	<p>Alternative to Substations</p> <p>The BPS can serve as an alternative where substations are difficult to install.</p>

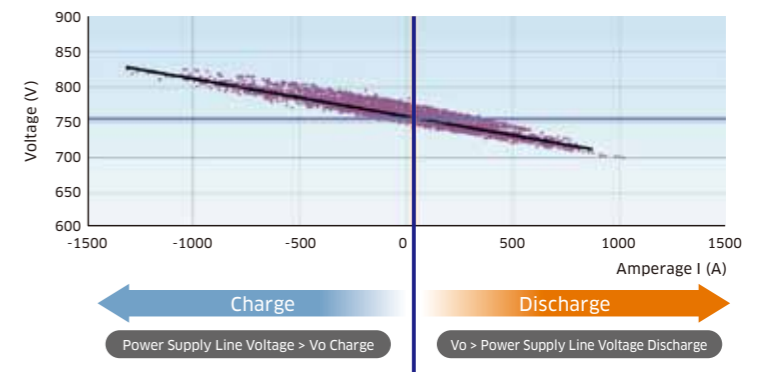


Direct Connection to System

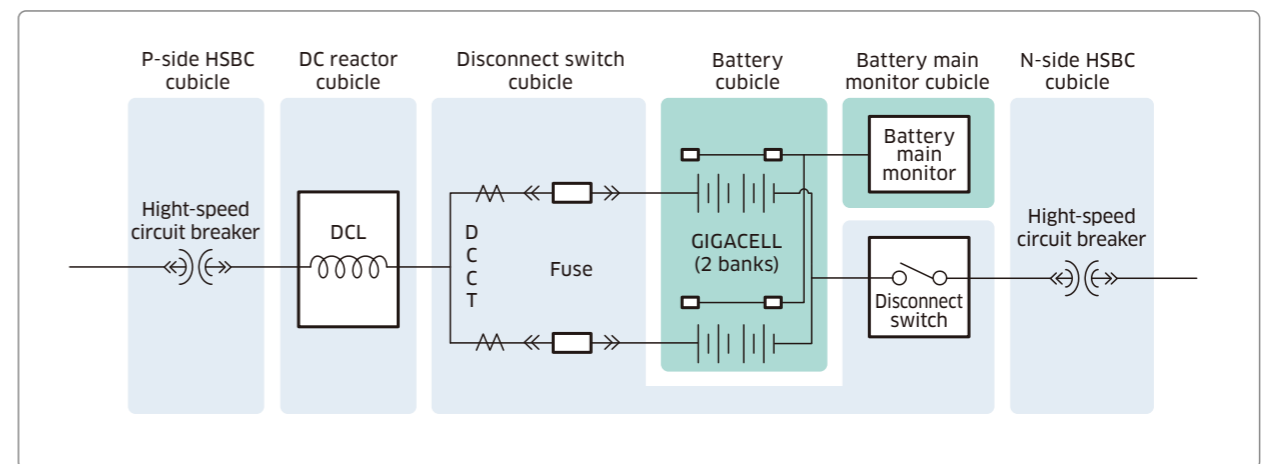
- Low Costs**
No power controllers needed
- High Efficiency**
No loss through controllers
- No Delays and Losses**
Max. use of regenerative energy
- No EMI**
No adverse effects to signal systems



A large effect can be obtained by continuous operation

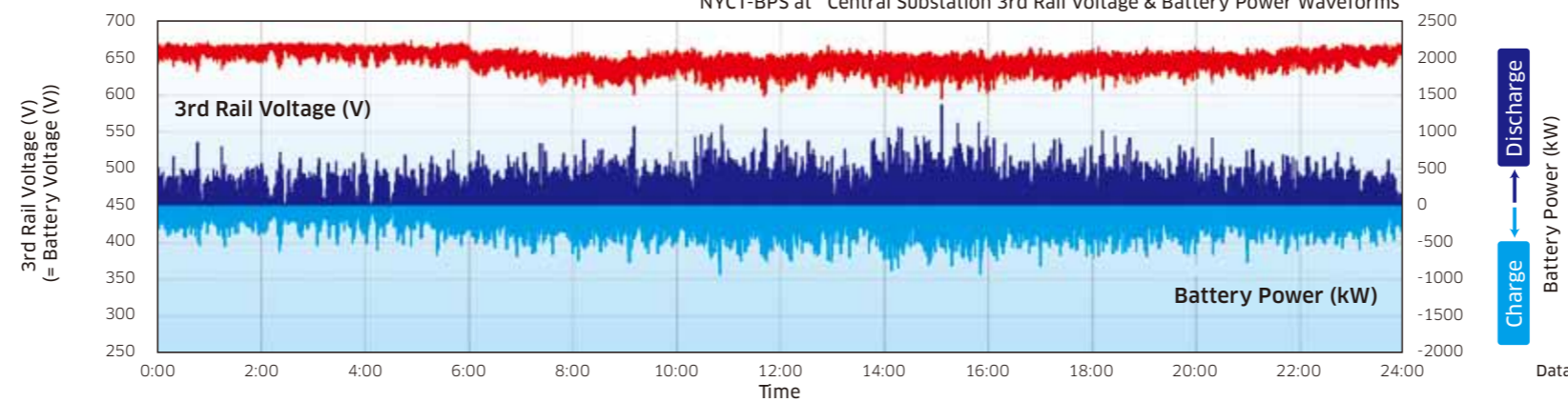


BPS System Diagram

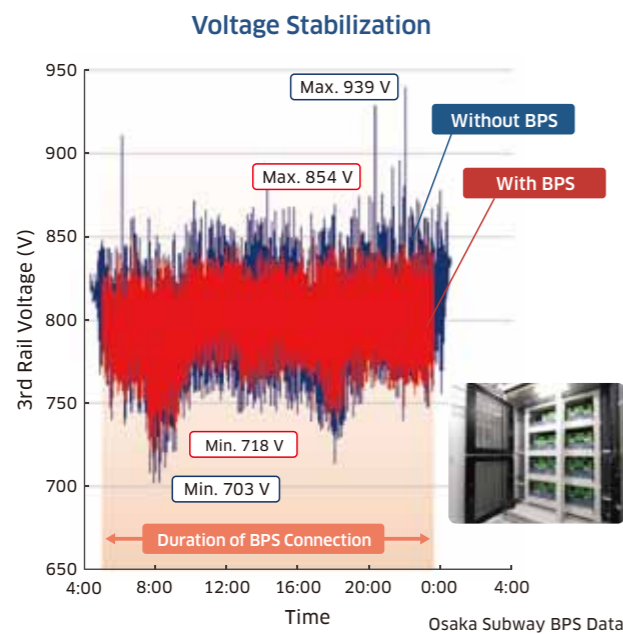


Energy Saving

625 V DC Third Rail Voltage & Battery Power Waveforms



No Regeneration Cancellation, Line Voltage Stabilization

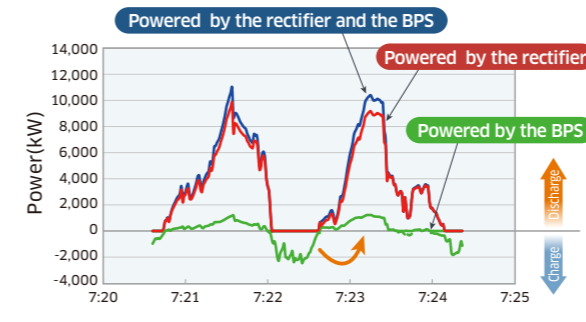


Emergency Runs

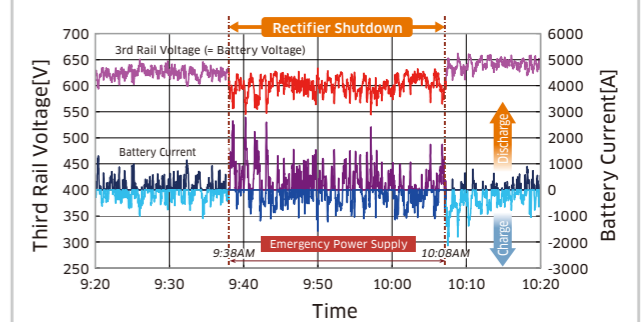
Location of BPS on Tokyo Monorail Line



Peak Shaving



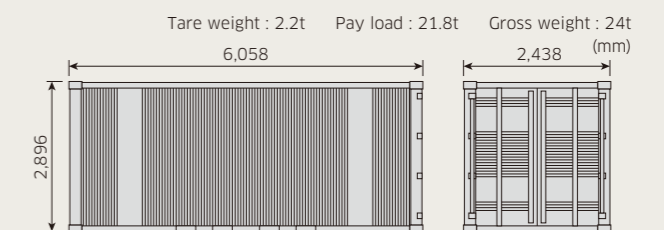
Alternative to Substations



Transportable BPS

It is available as a temporary substation, in case of the construction, maintenance, or expansion of a substation. High tension electric work is not needed, and the construction period can be shortened.

All in two 20ft-containers
 Container A : GIGACELL (forty modules) + Battery Monitoring System
 Container B : Circuit Breaker Panel, Disconnecting Switch Panel, etc



CHANGING THE FUTURE WITH NEW APPLICATIONS

Grid Stabilization

Grid Stabilization

Electrical Power Supply/Demand System with GIGACELL®

Joint Development Kansai Electric Power Co., Inc. (KEPCO) Nisshin Electric Co., Ltd.

A four-year joint development was conducted to study the usage of GIGACELL® for supply/demand control when more renewable energy is implemented in the grid. GIGACELL® was installed at a substation near a 10-megawatt PV generation plant.

System Image

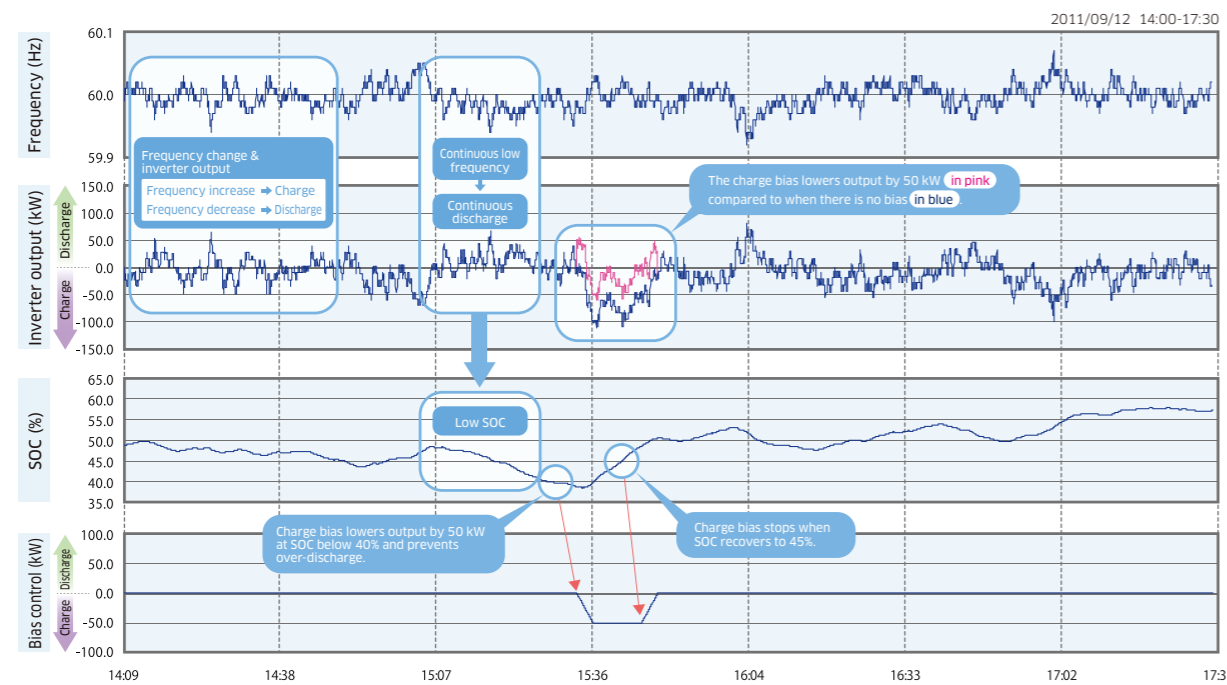
Courtesy of KEPCO
Solar Sakai

Ishizugawa Substation
GIGACELL® Bank

Location	KEPCO Ishizugawa Substation	Rated Voltage	576 V	Battery Capacity	102 kWh
Composition	GIGACELL® (12V-177Ah) × 48 modules	Rated Capacity	177 Ah	Output	250 kW (System output with inverter connected.)

Example of System Operation

Charging and discharging will occur when frequency exceeds or becomes lower than the standard frequency of 60 Hz respectively. At high and low SOC levels, the system will prevent over-charging/discharging of the batteries.



Remote Island Frequency Regulation

NEDO* Subsidized Project Development of a Large-scale Energy Storage System with High-safety and Cost Competitiveness

Installing renewable energy on remote islands with relatively small grid capacity can potentially increase frequency fluctuations. The GIGACELL® system can control these fluctuations, reducing the need for diesel generators to adjust their output.

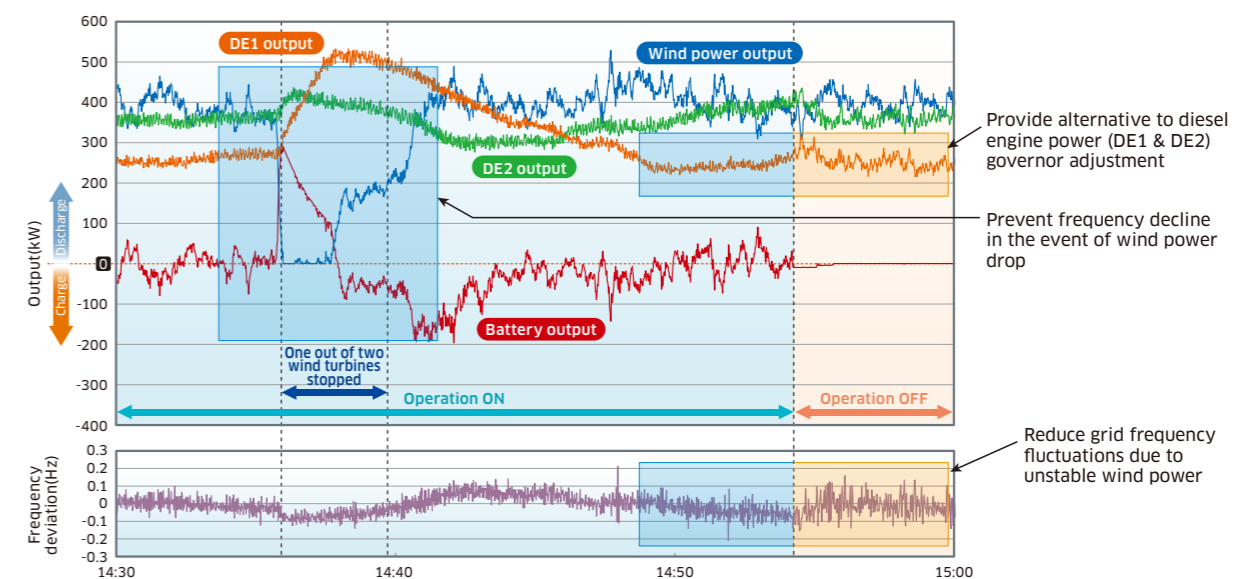
System Configuration

Wind turbine (OEPC)
Battery bank

20-ft containers for system (front: battery container)

Location	Minamidaito, Okinawa Prefecture The Okinawa Electric Power Co., Inc. (OEPC) Minamidaito C.S. & Internal-combustion Power Station	Battery Capacity	122 kWh
Composition	30-K5 GIGACELL® × 12 modules × 2 banks	Start of Operation	March 2013

Demonstration Data & Benefits



* New Energy and Industrial Technology Development Organization

CHANGING THE FUTURE WITH NEW APPLICATIONS

Wind Power Generation

Solar Power Generation

GIGACELL® can be applied for wind integration on the grid. Its smoothing and ramp control functions will reduce the adverse effects of unstable generation output. This leads to further implementation of renewable energy.

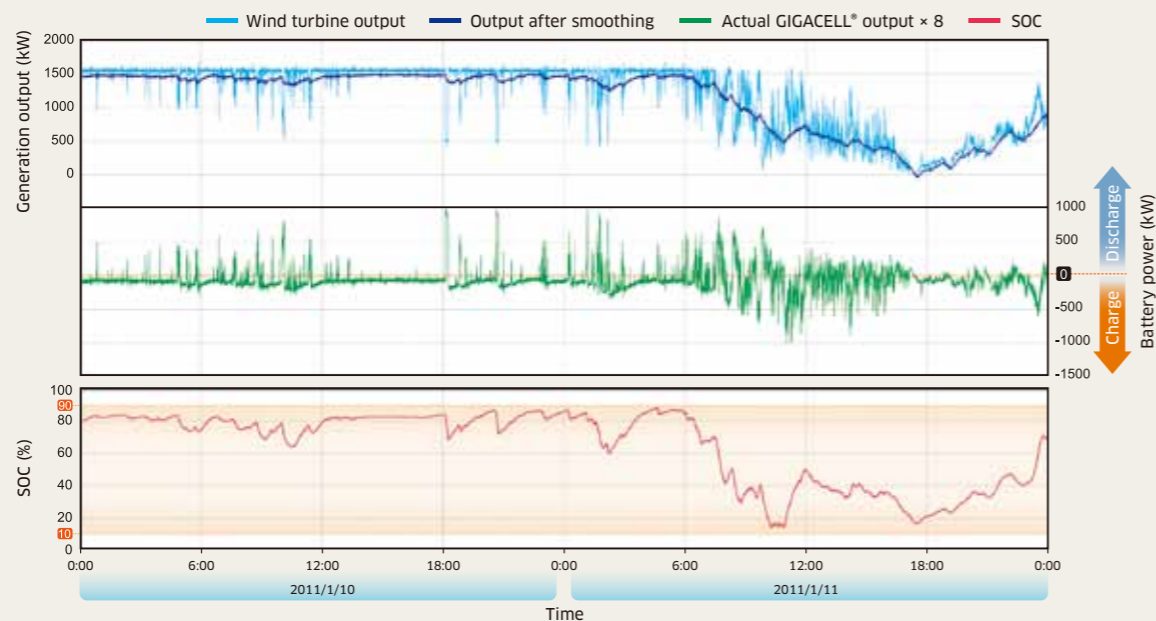
GIGACELL® connected to PV panels can store surplus energy for use during peak demand time. It can reduce peak demand, as well as provide power to essential loads during power outages.

Wind Power Smoothing Joint Development Fuji Green Power Co., Ltd.

Location	Yurihonjo City, Akita Prefecture (Fuji Green Power Co., Ltd.)
Application	Smoothing and ramp control
Components	GIGACELL® (12V-177Ah) × 48 modules
Battery Capacity	102 kWh
Start of Operation	Above specification completed in April 2010

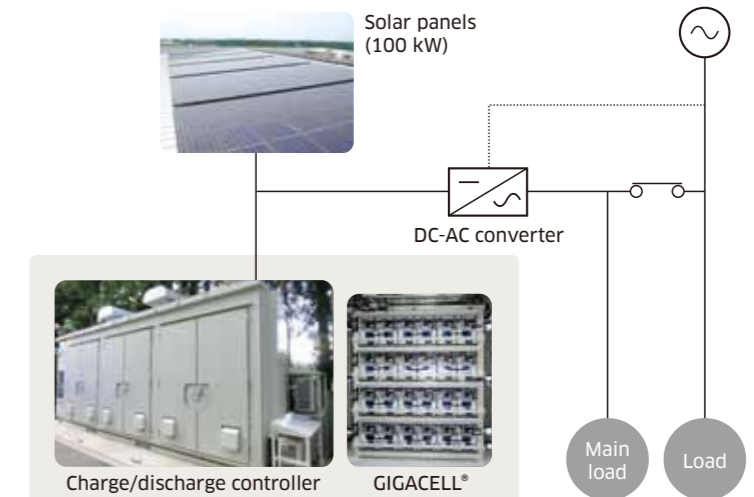


Example of Smoothing Wind Power Generation Output

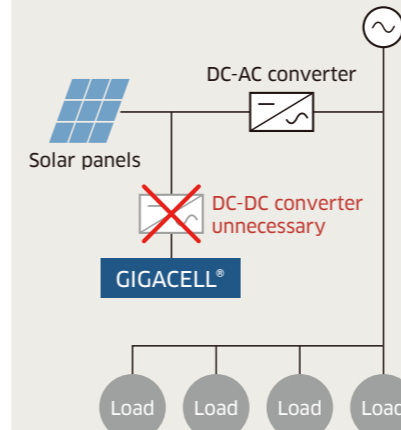


PV + GIGACELL®

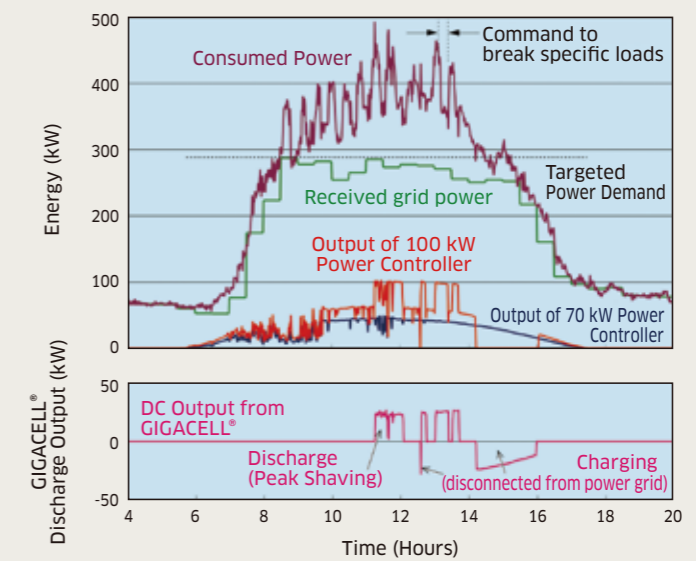
Location	Yachiyo Shoin Gakuen
Application	Peak shaving
Composition	GIGACELL® (12V-182Ah) × 24 modules × 3 banks
Battery Capacity	148 kWh
Start of Operation	August 2006



Because the GIGACELL® offers stable battery voltage when charging and discharging, it can share the same DC-AC converter as the solar panels, and can be directly connected to the DC section, therefore reducing installation costs.



Example of Peak Shaving

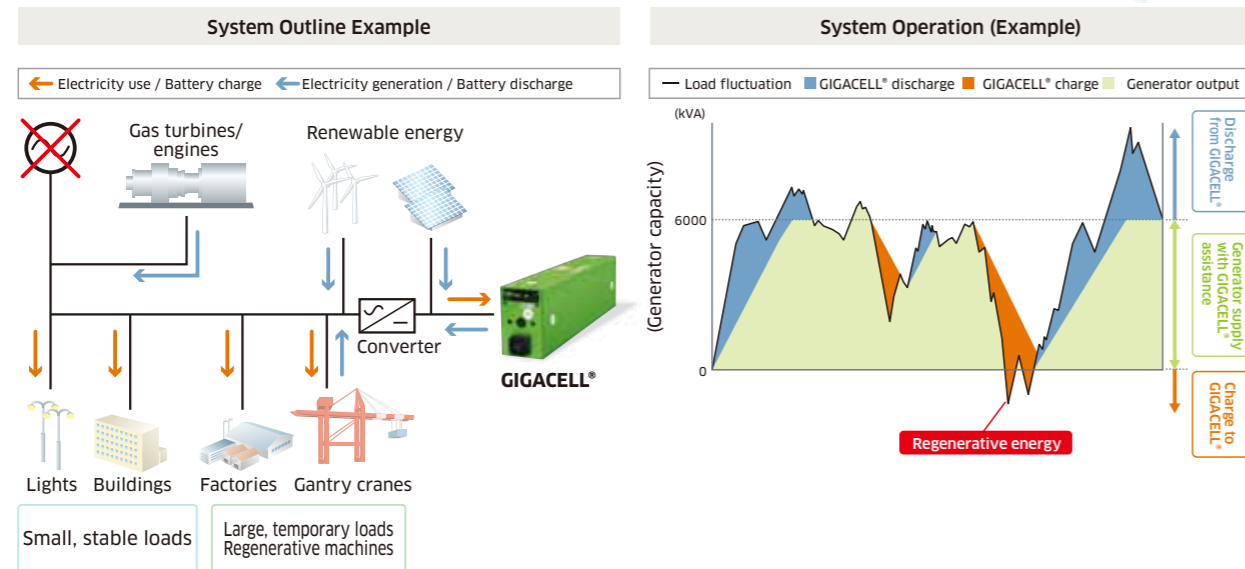


Distributed Energy (Gas Turbines & Engines) + GIGACELL®

CHANGING THE FUTURE WITH NEW APPLICATIONS

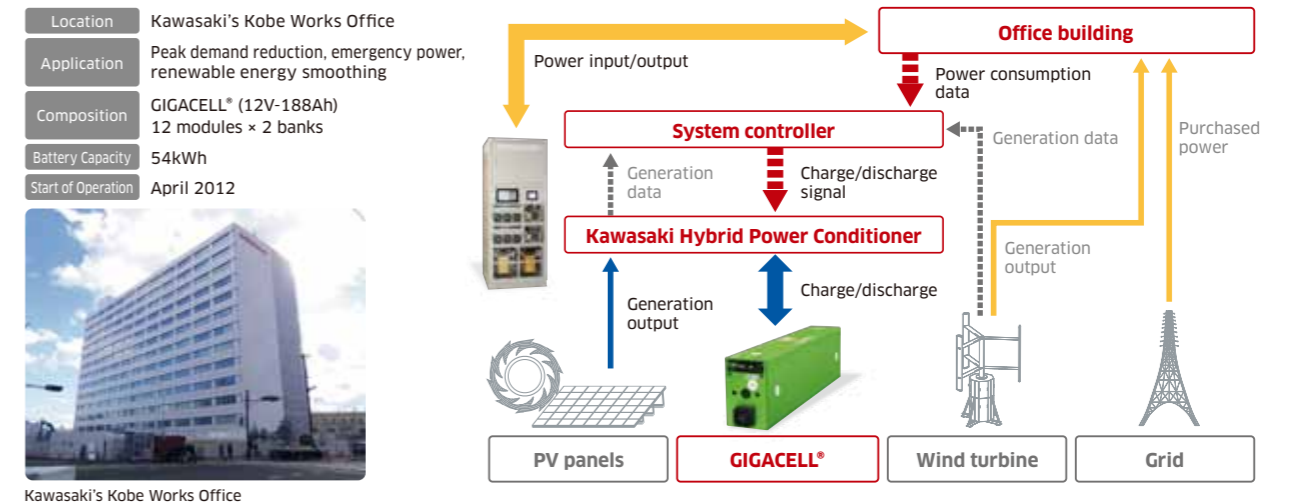
Hybrid Power System

GIGACELL® can be combined with standby generators to provide stable power to fluctuating loads. This can reduce the capacity, cost, and space for emergency standby generators.



○ Kawasaki's Kobe Works Office Building Hybrid Power System

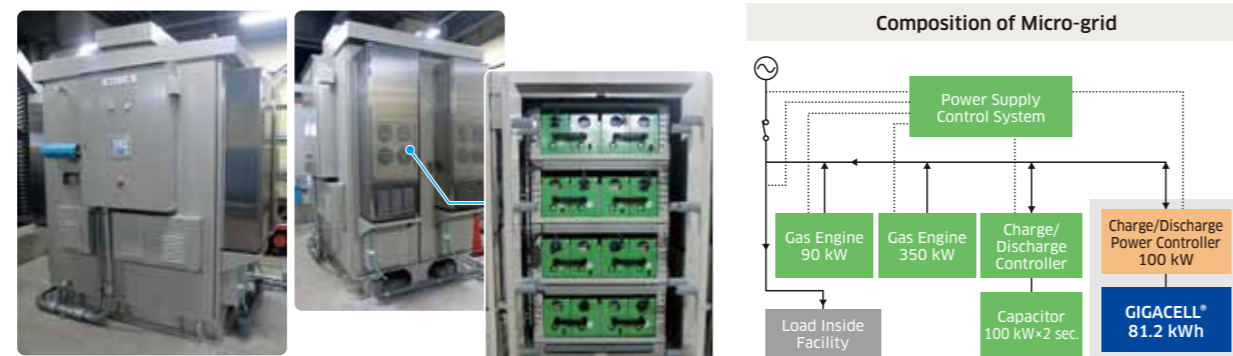
The Hybrid Power System forms a micro-grid system composed of installed wind turbine generator, PV panel and GIGACELL® batteries. The system controller sends optimal charge/discharge signals to the GIGACELL® through the power conditioner based on the generation data of renewable energies and the building's power consumption data and the power conditioner charges/discharges GIGACELL®. Therefore, the system not only stabilizes renewable energies, but also can reduce peak demand, level off power loads and provide emergency power during a blackout.



Distributed Generation/Micro-grid

A network of multiple power sources within a given area forms a micro-grid. The GIGACELL® has the ability to quickly respond to fluctuations in demand loads and generated power. It can ensure safe and dependable power for micro-grids isolated from the power grid.

Location: Shimizu Co. Ltd., Technical Research Center | Battery Capacity: 81.2 kWh
 Application: Stabilization control to fix the amount of power purchased from power grid | Start of Operation: February 2011
 Components: GIGACELL® (36V-141Ah) x 16 modules



Distributed Energy System

Kawasaki continues to develop and disseminate solutions for utilizing renewable energies such as PV, wind, and biomass.

