Hitachi’s experience in developing Smart Grids

Shin-ichi INAGE
Renewable Energy & Smart Grid Division, Hitachi Ltd.
Hitachi has a lot of experiences based on our products and technologies for Smart Grids.

Smart Grid
Optimal operation of power grid
By control of Demand/Supply
Mega Solar Plant & Bifacial PV Panel

13MW-class Solar Plant for TEPCO

Application of Bifacial PV Panel

- **PCS**

<table>
<thead>
<tr>
<th>Harmonic order</th>
<th>Content %</th>
<th>Limit value</th>
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<tr>
<td>13</td>
<td>5</td>
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</tbody>
</table>

**CELL Efficiency (%)**

- 2005: 18%
- 2006: 20%
- 2007: 22%
- 2008: 24%
- 2009: 26%
- 2010: 28%

Limit value: Present (red), Predecessor (gray)

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Lead Acid Battery

<table>
<thead>
<tr>
<th>Specifications</th>
<th>LL1500W-S</th>
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</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>8V</td>
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<tr>
<td>Energy Capacity</td>
<td>12kW</td>
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<tr>
<td>Expected life time</td>
<td>17 years</td>
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<td>SOC range</td>
<td>30-90%</td>
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<tr>
<td>Recycle rate</td>
<td>&gt;90%</td>
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</tbody>
</table>

Energy storage model

Battery room

Wind Power-Kuroshio

Load Shifting System
Heat Pump Water Heater System

- Reduction of CO₂ emissions of water heater
- Applicable to demand response or load shifting

Overview of system

Comparison of relative CO₂ emissions

Heat pump: 0.31
Gas-firing: 0.52
Oil-firing: 0.78
Electric: 1.0

Comparison of relative operation cost

Heat pump: -69%
Gas-firing: 1.0
Smart Grids Trial at Rokkasho Village

Rokkasho-Demonstration Project
• This project evaluates system functionality and energy optimization by using closed

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PHV (Plug-in Hybrid Vehicle)
PCS (Power Conditioning System)

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Surveillance and Control Information Exchange

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Energy Service Information Exchange

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Grid Side Supply and Demand management and control (include HEMS functions)
• Demand side power generation and storage control (HEMS)
• Energy Service Integration
• Grid Side Supply and Demand management and control (include HEMS)
Overview of PV

Futamata Window Power Generation Site (JWD)

Inter-connection Point
PV (100kW)

Photovoltaic (Hitachi)
Hub Battery (250kW)

Charge/Discharge
NAS Battery (NGK)

Control Center

Overview of Solar Power System (100kW)

Multi family housing
Smart house (Panasonic)
Smart House (JWD)
Smart House (Toyota)

PHV Charger
PHV
Over view of the Community

Futamata Window Power Generation Site (JWD)

Inter-connection Point
PV(100kW)

Photovoltaic (Hitachi)

Hub Battery (250kW)

Charge/Discharge

NAS Battery (NGK)

Control Center

Smart house (Panasonic)

Smart House (JWD)

Smart House (Toyota)

Inter-connection Point

Smart meter

Heat Pump

Multi family housing

Smart house (Panasonic)

Smart House (JWD)

Smart House (Toyota)

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The self-sustenance ratio is 88%

-88% of the total energy consumption was provided by the electric power of PV (HUB, Rooftop PV) generation with HUB Power storage.

Operation Results:

- PV+Hub Storage support ratio is
  \[ 95.9\% = \frac{(iv)}{(i) + (ii)} \times 100\% \]

- PV surplus ratio is
  \[ 56\% = \frac{(iv)}{(iii)} \times 100\% \]
Conclusions

Through actual demonstration projects in Japan, US and other areas, Hitachi is contributing to R&D of Smart Grids technologies. The concept of Smart Grids should vary in each country and customer. Hitachi is willing to respect the existing power grid, utilities and technologies of the customers. We are intending to contribute to achieve "Best Mix" of the customers' existing power grids and our leading-edge technologies as WIN-WIN solution.
Thank you for your attentions