



ULTRACAPACITORS: TRANSFORMING THE GRID

POWER GRID CASE STUDIES

Maxwell ultracapacitors are ideally suited to meet the performance and lifetime demands of grid applications around the world. Today, ultracapacitor energy storage provides a wide range of benefits to independent energy generators and utilities alike, including traditional fuel energy generation and renewable generation such as solar and wind. These case studies are a few examples of our expertise in applying ultracapacitor energy storage systems for power grid applications worldwide. Additionally, combining the power of ultracapacitors with the energy of batteries provides superior performance, operating range and life.*

*Results may vary. Additional terms and conditions, including the limited warranty, apply at the time of purchase. See the warranty details and datasheet for applicable operating and requirements.



Maxwell Ultracapacitors for Wayside Energy Efficiency and Frequency Regulation:

Southeastern Pennsylvania Transportation Authority Light Rail System

ISSUE

More than 80% of the nearly 500,000,000 kW consumed by the Southeastern Pennsylvania Transportation Authority (SEPTA) rail system is used as propulsion power for its rail lines. Recovery of braking energy otherwise lost as waste heat could lead to significantly lower electricity costs.

SOLUTION

Maxwell ultracapacitors were employed in a hybrid ultracapacitor-battery energy storage system to accomplish two critical functions:

Brake energy recovery.

The ultracapacitors capture excess braking energy from the trains by detecting a rise in the line voltage on an overhead catenary system. These braking events occur several thousand times a day and can last up to 15 to 20 seconds.

Load modulation to provide frequency regulation on the PJM energy market.

An average of 90 minutes per day is spent on capturing train braking energy, and the balance of the time is spent providing this secondary function.

RESULTS

- Reduction in SEPTA rail vehicles' consumption of grid-supplied electrical energy by 10-20%
- 800 kW of fast response load modulation support to the grid operator. This is a paid service which can provide greater than \$200,000 in annual revenues to SEPTA.



Maxwell Ultracapacitors for Power Stabilization:

Yangshan Deep Water Port

ISSUE

Located near Shanghai, Yangshan Deep Water Port's 23 quay cranes have enough power draw to cause significant voltage fluctuations on the local grid for 10 to 15 seconds at a time. The port is located at the end of a 20-mile bridge, and increasing the transmission line capacity was deemed too costly.

SOLUTION

Maxwell ultracapacitors were selected for their high cycle and design life and employed in a 3 MW/17.2 kWh energy storage system with 20 seconds of reserve power that mitigates voltage sag caused by crane operation. The solution made it possible to avoid costs associated with installing a larger transmission line.

RESULTS

- Ultracapacitor energy storage system fully operational for two years
- 38% reduction in peak demand grid energy
- Estimated \$2.9 million in energy savings over lifetime[†]
- Estimated \$41 million in savings over lifetime[†] related to improved efficiency and reduced maintenance on transmission lines



Maxwell Ultracapacitors for Solar Firming:

California Energy Commission

ISSUE

As an increased amount of intermittent solar and wind renewable energy penetrates the grid, output becomes increasingly unstable. Utilities increase peak power reserves to handle increased intermittency, which leads to increased costs for the utility and/or the ratepayer. Fast-responding energy storage can decrease the need for more peak power infrastructure.

SOLUTION

An ultracapacitor energy storage system was designed to demonstrate the capability of filling in short-term solar power intermittencies and providing ramp rate control for longer intermittencies.

RESULTS

To stabilize solar output for five minutes of ramp rate grid regulation, only 20 to 30 seconds of energy storage is needed to ensure local power quality at solar penetration levels of 50%. Ultracapacitors are an ideal solution for this function. Given the fast response of ultracapacitors, the system can also deliver other power reliability and quality services.

[†]Cost savings based upon economics of the particular case study and assumes operation for 1 million cycles, 8,000 hours, 10 years; actual results may vary, including, notably, due to varying economics of operation at different locations throughout the world as well as varying operating and use models for different projects.