CELL-LEVEL CONTROL TRANSFORMS STATIONARY BATTERY ENERGY STORAGE

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Why is Cell-level Control Technology Revolutionary For Stationary Battery Energy Storage?

Stationary battery energy systems have been built by combining two separate systems: the battery bank and a bi-directional inverter that converts the battery's Direct Current (DC) to grid-compliant Alternating Current (AC).

The impact of Cell-level control technology can revolutionize the industry - equivalent to the transition from a horse and buggy to a motor car.

Similar to the transition of the internal combustion engine car to an electric vehicle, cell-level control eliminates subsystems and components while significantly improving outcomes.

Energy storage systems can now be simplified from two discrete systems into one unified system.

How it Works VS

Conventional Systems

The Basics of a Conventional Systems

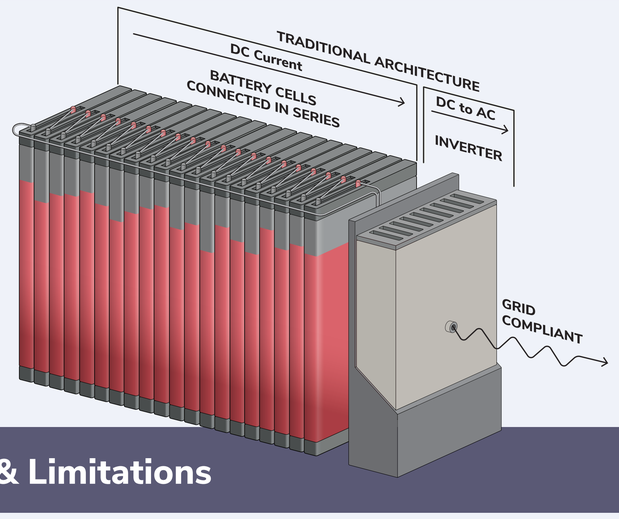
System Architecture

Conventional battery systems rely on bidirectional inverters to create AC from DC provided by the battery and use battery management systems (BMS) to monitor the safety and health of the battery cells. A maze of series and parallel wiring schemes join together the individual cells. These systems are limited by the weakest cell and can be hazardous and short-lived.

DC to AC Conversion

Battery cells are connected in DC "strings." An inverter switches the DC at 20,000 times per second for varying durations (called pulse width modulation 'PWM').

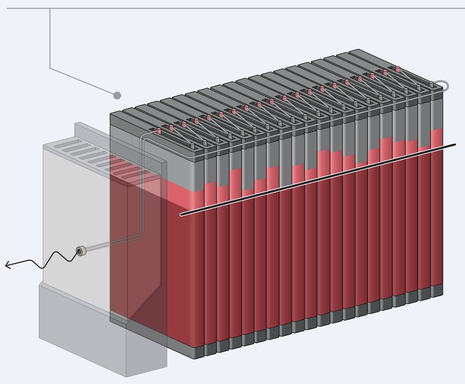
Power conditioning electronics, including large capacitors and inductors, condition the pulses into a smooth, grid-compliant AC sine wave.



Drawbacks & Limitations

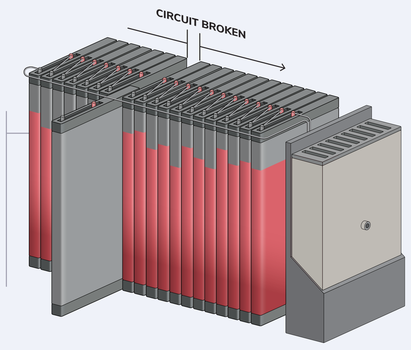
Capacity Utilization

The weakest cell limits the performance of the entire string. Effectively, remaining capacity in other cells cannot be accessed. As cells age, they tend to age unevenly, leaving significant capacity and performance unutilized.



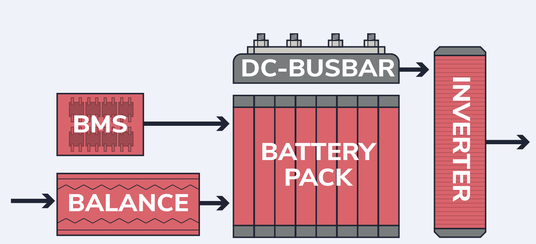
Limitations Due to Cell Health

Cells are connected in an inflexible, permanently connected chain. Any interruption of this chain will lead to system downtime.



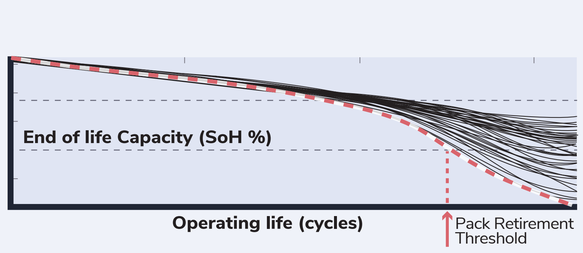
Impact on Cost of Goods

Conventional systems include large and costly power converting and conditioning electronics, including large capacitors and inductors.



Operating Life of Battery

Weak or faulty cells are the limiting factor for longevity and performance.



Cell-level Control Technology

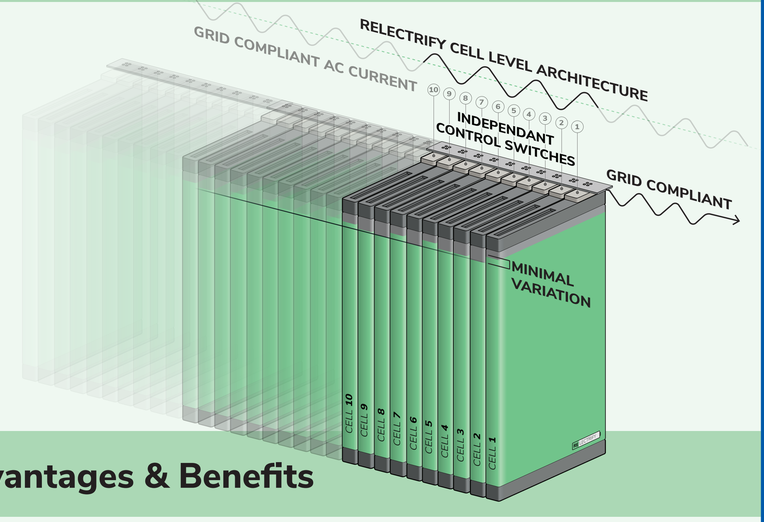
Understanding Systems with Cell-level Control

System Architecture

A system with cell-level control has a single integrated power electronics system that replaces both the BMS and the inverter. This system controls individual cells to generate grid-compliant AC directly from a battery. Cell-level control solves the problem of the weakest cell limiting the performance of the whole system, and can make battery systems safer, cost less, and last longer.

Grid-compliant AC

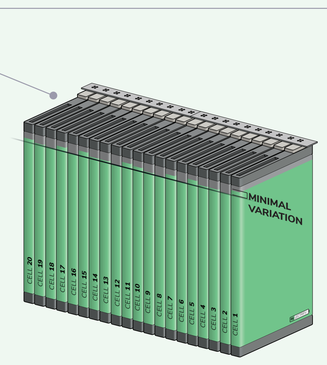
Cell-level power control enables the system to switch individual cells on and off to create a grid-compliant AC sine wave directly from the battery pack.



Advantages & Benefits

Capacity Utilization

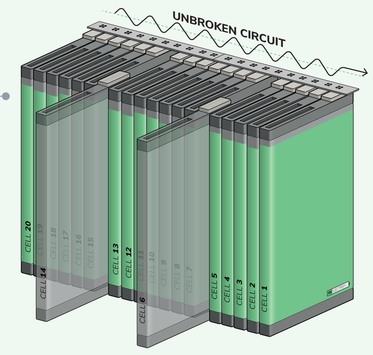
Cell-level control technology allows every cell to be utilized to its fullest extent over its lifetime. The cells are no longer in an inflexible chain and an algorithm decides which cell to "bypass or include" and when. This allows for the system to draw more from strong cells.



No Limitations Due to Cell Health

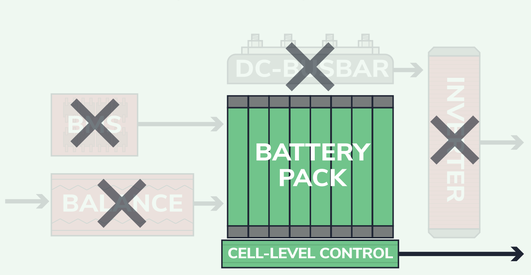
In case of a cell or electronics failure the cell-level power conversion allows for:
- Redirecting the power pathway
- Bypassing the defect or weak cells
- Keeping the system up and running

This robust and resilient system provides system uptime benefits and significantly reduces the need for ad-hoc maintenance call-outs.



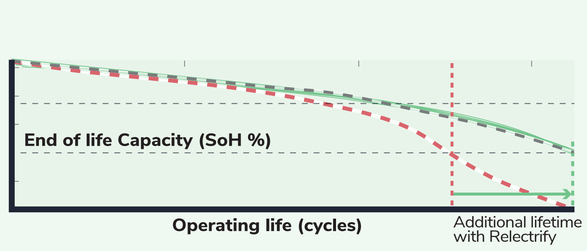
Impact on Cost of Goods

Cell-level controlled systems eliminate the need for the inverter and its heavy-duty power conditioning electronics, leading to reduced costs and improved reliability



Operating Life of Battery

Cells all reach retirement threshold together, fully utilizing each cell's capacity.



Game-Changing Technology

How is cell-level control an environmentally and economically game-changing technology?

- Reduces system costs
- Unlocks unused capacity
- Extends battery cycle lifetime
- Safer & more reliable
- Suits a wide range of battery chemistries and variations in cell state-of-health

Enables utilization of a wide variety of cell types:

Non-lithium chemistries | New lithium chemistries | Second-life lithium chemistries

What are the economic benefits of cell-level control?

- up to 25% Improvement — in system throughput (MWh)
- up to 25% Reduction — in footprint & real estate cost by eliminating the inverter
- up to 30% Reduction — in cost of power electronics
- up to 50% Reduction — in cell costs from using B-grade cells or 2nd life EV cells

What's the impact to the stakeholders when cell-level is used on their project?

This scenario applies to residential, C&I and utility scale systems with underlying benefits to the BESS business model.

Iterate product designs faster with lower risks using a variety of Tier 1 and Tier 2 cells with varying capacities or 2nd life EV cells.

Instead of the standard 10 years of system throughput (MWh), you get 12 or more years of throughput (MWh) at no additional costs.

With cell-level control, predictively augment or repower your system with routine, scheduled preventive maintenance.

For every GWh of deployed energy storage, cell-level control technology can deliver up to 30% improvement in CO_2 reduction.

Decrease your footprint by the elimination of large pieces of AC/DC equipment.

The system is inherently safer due to the ability to detect and bypass the weakest cell, with more uptime and reliability.