

Sodium-Salt batteries for daily-seasonal hybrid energy storage

The perfect companion to renewable energy!

The proper choice of grid-storage battery is key to achieving reliable and economically attractive renewable energy production. When renewables supply the bulk of electric energy, a properly designed battery back-up solution must be in place to buffer against catastrophic supply failures, such as the nation-wide black-out of Spain during April 2025.



The hybrid operation of our Na-salt battery provides 3 complementing usages:

- ◆ Daily buffer/arbitrage for day-night variations in renewable energy production
- ◆ Seasonal buffer/arbitrage for summer-winter variations in renewable energy production
- ◆ Uninterrupted power supply (UPS) battery capacity to buffer grid failures

Our Sodium-salt battery can be cost-effectively manufactured from locally sourced materials. It provides over 90% efficiency of energy storage, extremely long calendar life, and operability in both hot and cold environments. The following pages introduce its capability for the above scenarios.

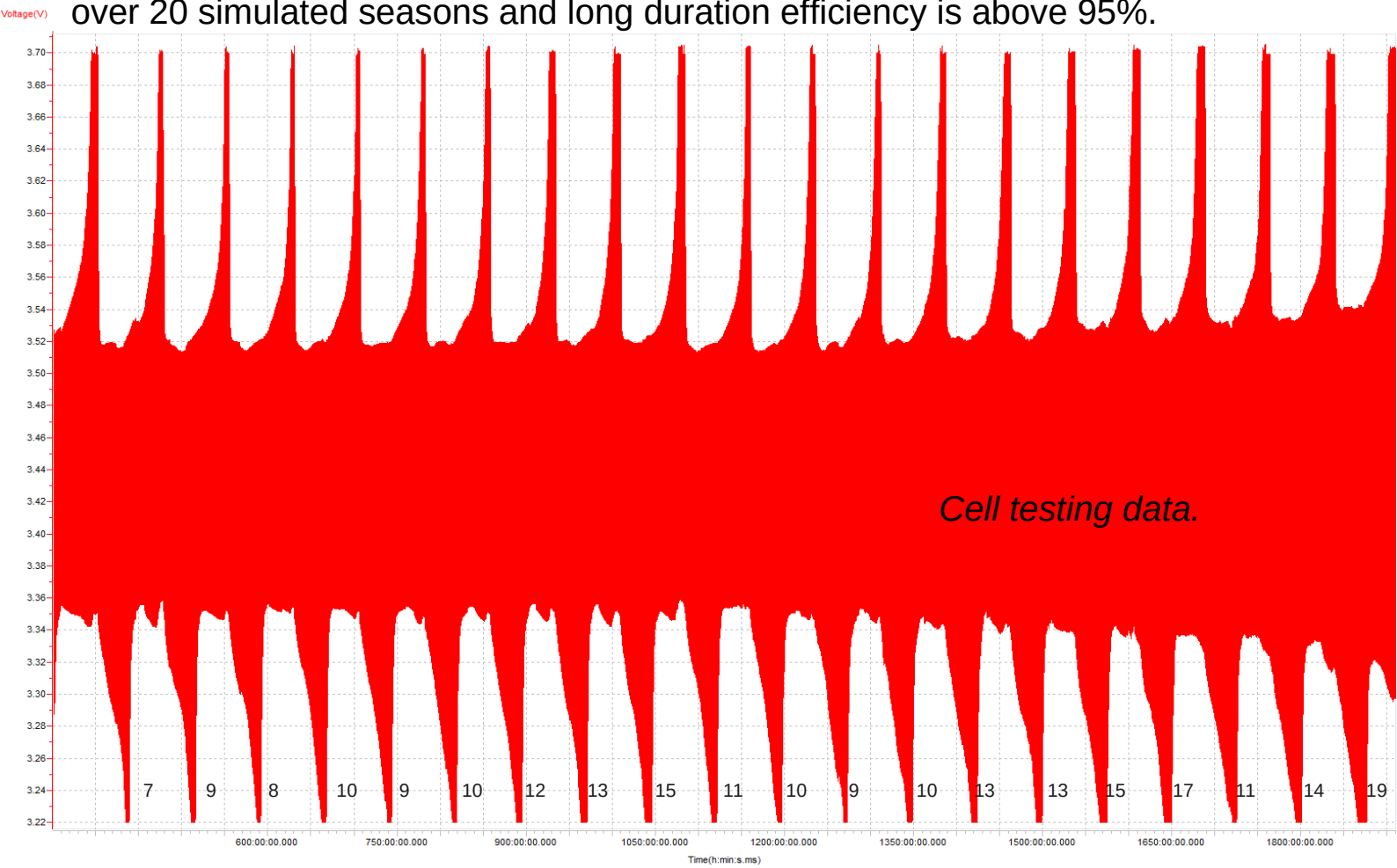
Daily cycling of 5% capacity with Seasonal cycling of 95% capacity

Hybrid daily/seasonal storage use case:

- 3000 daily cycles performed (~5% of total capacity charged/discharged per day)
- “Summer season”: 1% excess charge per day.
- “Winter season”: 1% excess discharge per day.
- “Seasonal” distance between repeating seasonal peaks: 136 daily 5% cycles.

The below data shows 20 repeating seasons

- Round trip energy efficiency in case of 8 h charge + 8 h discharge: 93%
- Metric of degradation: The gradual widening of lower plateau at 3.22 V gauges the number of cycles with reduced capacity near season end. The associated numbers show the cycles that have reached the 3.22 V cut-off, indicating any battery slowing. The data shows a very slowly increasing trend, indicating that the battery has a long remaining cycle life. There is no appreciable capacity loss over 20 simulated seasons and long duration efficiency is above 95%.

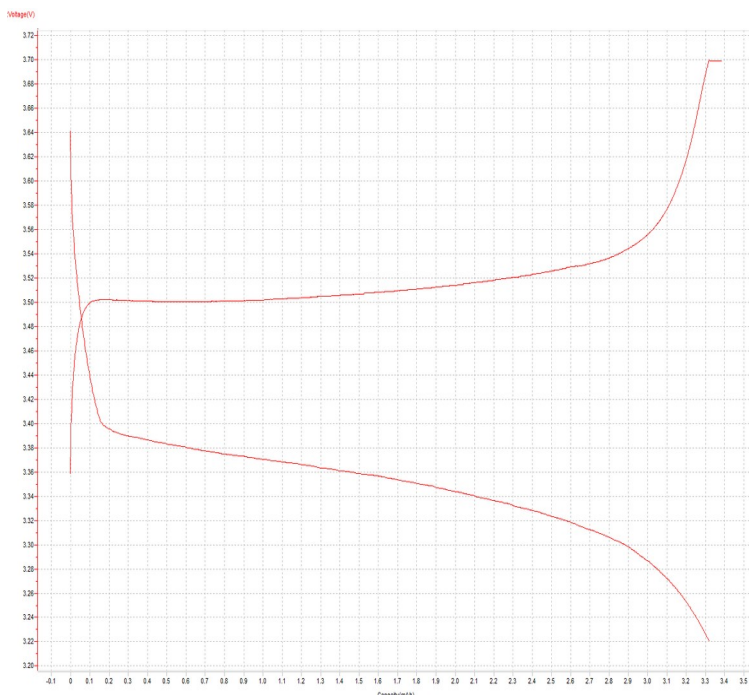


Cycling of 100% capacity within few days when a need for UPS arises

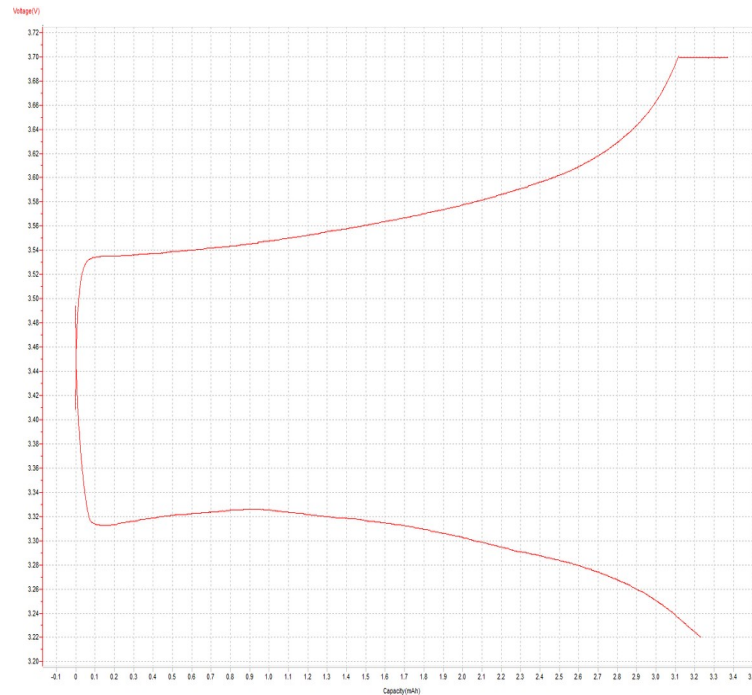
Uninterrupted power supply (UPS) use case:

- In the event of a blackout or grid instability, the full reserve battery capacity can be discharged to maintain power to homes and businesses over extended periods.
- Low cost: Sodium-Salt batteries are the most cost-effective technology for large scale back-up power supply: < 25\$/kWh volume production target cost.
- Versatile: The full battery capacity can be discharged over the course of 1-2 days if required.
- Efficient: UPS mode round trip energy efficiency: > 90%
- Robust: No appreciable loss in capacity and only 1.5% change in discharge voltage after over 20 simulated years of continuous operation

UPS cycle before 3000 daily cycles:



UPS cycle after 3000 daily cycles:



Cell testing data.