Technical Note: Performance and Durability Requirements for Rechargeable Industrial Batteries, LMT Batteries and Electric Vehicle Batteries

CSS-OD Battery Cabinet 102.4 kWh is in accordance with Article 10 of Regulation (EU) 2023/1542

Revision History

Version	Date	Description
1.1	March 2025	Updated title of the document and added CSS-OD Battery Cabinet 102.4 kWh
1.0	September 2024	Initial Version

- **Name:** Outdoor Commercial Storage System (CSS-OD)
- **Model:** CSS-OU-20
- **Ratings:** 102.4KWh
- **Manufacturer:** SolarEdge Technologies GmbH
- **Address: Werner-**Eckert-Straße 6 81829 München, Germany

No.	Technical Parameters	Parameter Value	Test Condition & Test Method
1	Rated Capacity (Ah)	1. At least 100 Ah per cluster. 2. Battery holds 2x clusters	**Test Conditions:** 25±2°C, 0.5C/0.5C **Test Method:** The battery cabinet contains two clusters of 512V/100Ah each. The capacity test procedure below is per cluster. (160 cells / cluster): 1. Fully discharge the battery at a constant current of 50A to a minimum cell voltage of 2.8V_{cell} [448$V_{cluster}$]. 2. Fully charge the battery at a constant current of 50A to a maximum cell voltage of 3.45V_{cell} [552$V_{cluster}$], then charge at a decreasing current (see curve below) to the maximum cell voltage of 3.6 V_{cell} [576$V_{cluster}$]. 3. Repeat step #1 and record the capacity obtained.
2	Capacity Fade (%)	1. 20% at 3500 cycles 2. 30% at 6000 cycles[1]	**Test Conditions:** 25±2°C, 0.5C/0.5C **Test Method:** Similar to the procedure described in item #1.

No.	Technical Parameters	Parameter Value	Test Condition & Test Method
3	Power (W)	Per each Cluster: 25. 6kW @ 0%-100% SoC[2]	**Test conditions:** 0.5C (discharge), -20 to 60°C **Test Method:** 1. Fully discharge the battery 2. Charge the battery @ 0.1C-rate to 20% SoC. 3. Perform a power test: a. Discharge is occurring at constant current b. Calculation is done obtaining $P_{average} = E_{discharge} / t_{discharge}$ 4. Charge the battery @ 0.3C-rate to 80% SoC a repeat the power test from bullet 3.
4	Power Fade (%)	±20% over 10Y (At least 80% of power is available)	**Test conditions:** 0.5C (discharge) **Test Method:** Similar to procedure described in item #3.
5	Internal Resistance (Ω)	0.27±0.05 mΩ/cell @ 30-40% SoC	**Test conditions:** 25±2℃, **Test Method:** 1. Ensure you have an AC signal generator capable of producing a 1 kHz signal. 2. Connect the battery to the AC signal generator. 3. Set the AC signal generator to produce a 1 kHz signal. 4. Use the oscilloscope to measure the RMS value of the voltage across the battery terminals. 5. Measure the RMS value of the current flowing through the battery using the oscilloscope or a current probe. 6. calculate the resistance (R) using the formula: $R = V_{RMS}/I_{RMS}$
6	Internal Resistance increase (%)	1. 2.6% @ 3500 cycles[3] 2. 8.8% @ 6000 cycles[3]	**Test conditions:** 25±2℃, Impedance (1KHz) **Test Method:** The increase in DC internal resistance was measured using the DCR DC internal resistance testing method, and this result is based on one month of storage DC internal resistance DCR test method: adjust the battery to 50% SOC after standing at 25 ℃, and discharge at 0.5C for 30s after standing for 2h.
7	Energy round trip efficiency (%)	93.58% BoL 91% EoL	**Test conditions:** 25±2℃, **Test Method:** Similar to the procedure described in item #1.

No.	Technical Parameters	Parameter Value	Test Condition & Test Method
8	Energy round trip efficiency fading (%)	2.74% BoL to EoL[4]	**Test conditions:** 25±2℃, 0.5C (discharge) **Test Method:** Similar to the procedure described in item #1.
9	Expected lifetime in cycle-life	A least 6000 cycles @ ~70% SoH[5]	**Test conditions:** 25±2℃, 0.5C (discharge) **Test Method: SoH Evaluation** 1. Each cluster has the ability to evaluate its SoH 2. Cycling the battery and checking the degradation of the SoH. 3. Conduct a test for a specific timeline. 4. Use the results drawn from tests with reasonable testing times are used for extrapolation.

Reference

[1] **Capacity Fade**

Number of cycles = 6437 – 1 = 6436 cycles.

Capacity retention (%) = (100-71.53)/100 = 28%

Statement is ~30$ @ 6000 cycles.

[CB0Y0]	Cycle	Capacity Retention[%]
Cell 2 BOL	1	100.00
Cell 2 EOL	6437	71.53

[2] **Power**

@ -20 to 60°C

@ 0 – 100% SoC

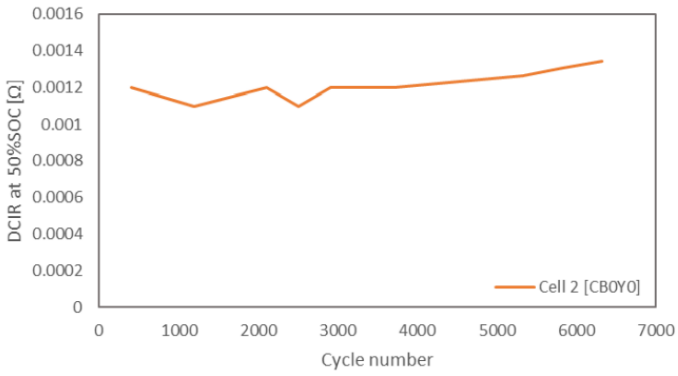
Power output is 320W/cell x 16 cells x 10 Energy Modules x 0.5C = 25.6 kW

*Table represents power @ 1 C-rate.

Cell temperature/℃		- 31	- 30	- 20	- 10	0	15	25	35	45	55	60
SOC	0%~100%	0	80	320	320	320	320	320	320	320	320	320

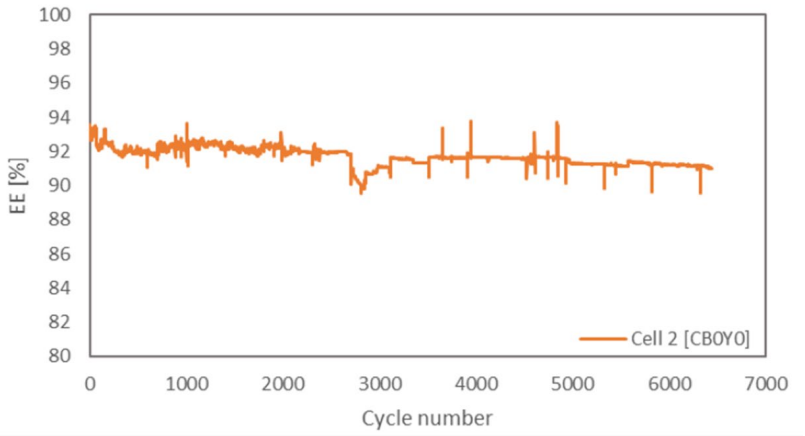
[3] Internal Resistance Increase

Cell 2 [CB0Y0]	
cycle number	DCIR [Ω]
400	0.0012
1200	0.0011
2111	0.0012
2511	0.0011
2911	0.0012
3311	0.0012
3711	0.0012
5328	0.001262
5827	0.001302
6328	0.001343



[4] Energy round trip efficiency fading (%)

(93.58%-91.02%) / 92.58%=2.74%



[CB0Y0]	Cycle	EE [%]
Cell 2 BOL	1	93.58
Cell 2 EOL	6437	91.02

[5] Expected lifetime in cycle-life

[CB0Y0]	Cycle	Capacity Retention [%]
Cell 2 BOL	1	100.00
Cell 2 EOL	6437	71.53