Phocos Any-Cell IEC 61427-1 Lab Test Results

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Prepared by:

Jonah Saidian (jsaidian@rejouleenergy.com)
Hugo Leduc (hleduc@rejouleenergy.com)
Anish Sinha (asinha@rejouleenergy.com)
Eduardo Fonseca (efonseca@rejouleenergy.com)
Steven Chung (schung@rejouleenergy.com)

This test report covers the results of the tests performed on the Phocos Any-Cell ESS-L-5kWh-48V up to three full Stage A and two full Stage B cycles - a total of 450 loops. The Any-Cell shows a decrease of 2.90% from the 1st Reference Performance Test (RPT) based on the voltage limits of 50V - 55.5V.

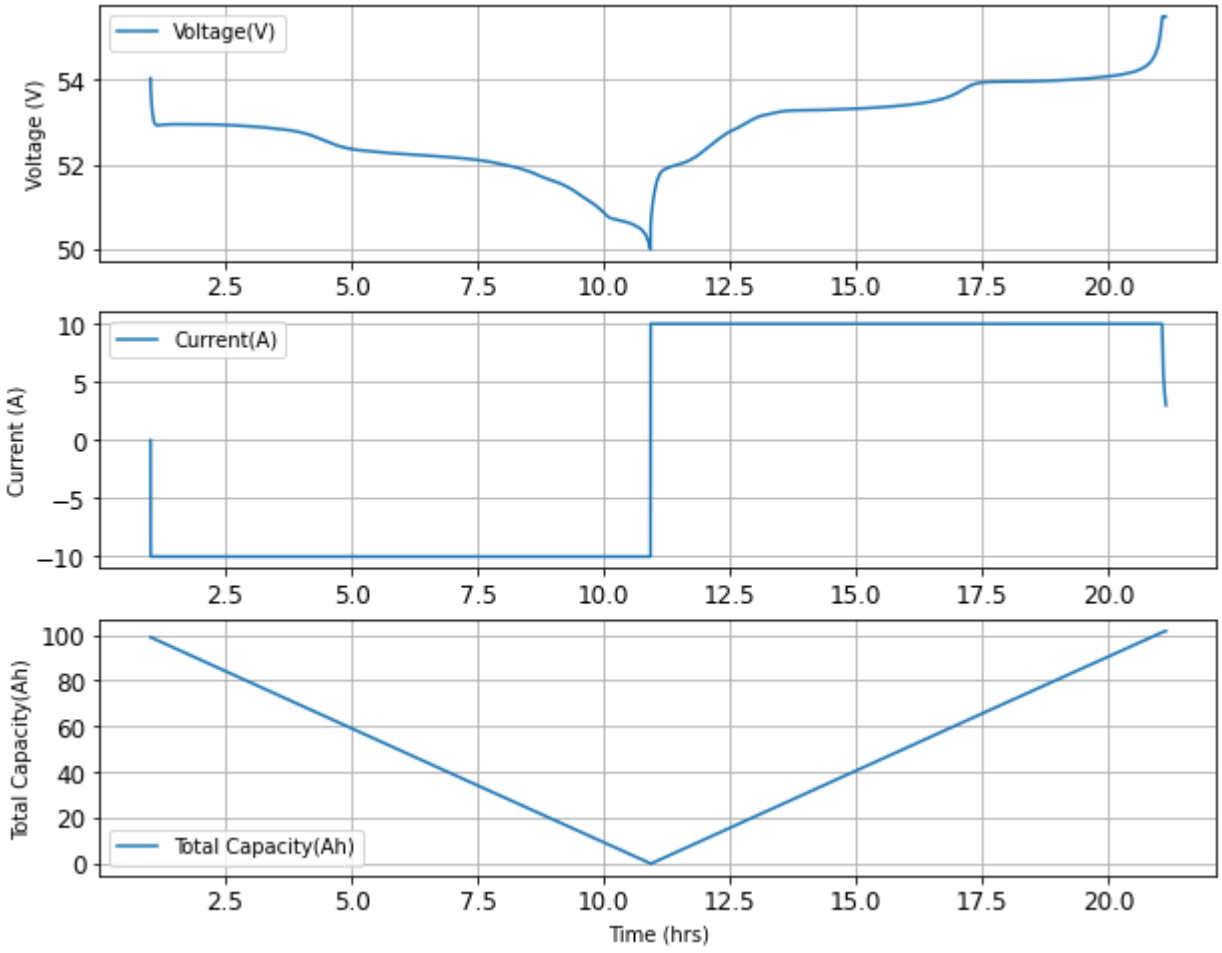
Section 1 summarizes the results from the RPTs along with plots of both the RPTs and the charge/discharge loops. Section 2 describes the test procedure, section 3 shows the ambient temperature conditions in ReJoule's lab, section 4 is a summary of the Any-Cell performance in relation to IEC 61427.

1. Reference Performance Test Results Summary

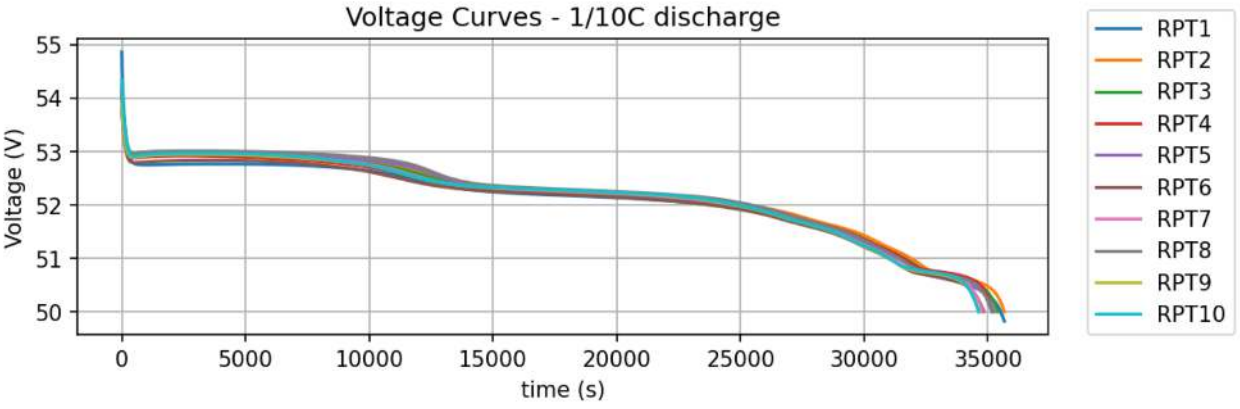
A reference test will be performed to measure the discharge capacity of the Any-Cell at regular intervals every 50 loops. The table below shows the results from the initial reference point to the conclusion of the test.

Stage	Loop #	RPT	Date	Capacity (Ah)	% drop	Volt (V) max/min
0	0	1	Feb 21, 2022	98.87	-	55 / 50
1-A	50	2	Mar 16, 2022	98.88	0%	55.5 / 50
1-B	100	3	Mar 26, 2022	98.12	0.76%	55.5 / 50
1-B	150	4	Apr 8, 2022	97.64	1.25%	55.5 / 50
2-A	200	5	Apr 29, 2022	97.70	1.18%	55.5 / 50
2-B	250	6	May 17, 2022	96.57	2.33%	55.5 / 50
2-B	300	7	May 31, 2022	96.43	2.46%	55.5 / 50
3-A	350	8	June 20, 2022	97.46	1.43 %	55.5 / 50
3-B	400	9	July 5, 2022	96.04	2.86 %	55.5 / 50
3-B	450	10	July 19, 2022	96.01	2.90 %	55.5 / 50

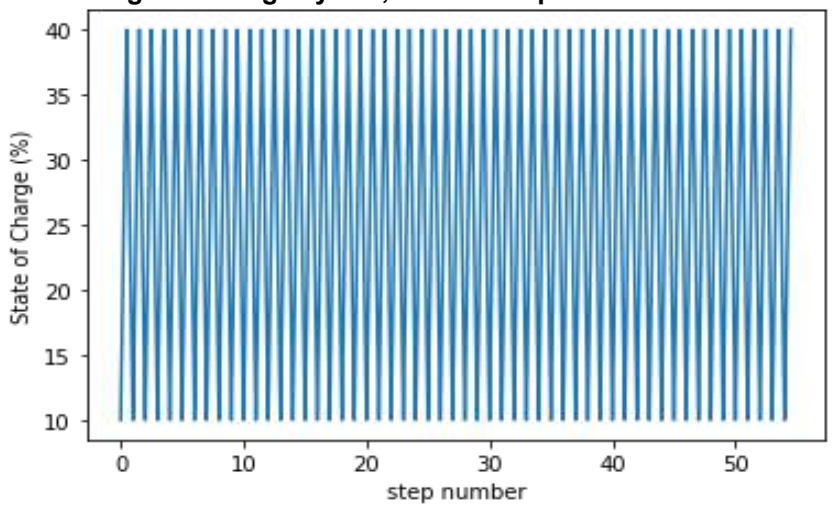
1.1. Reference Performance Test Curves



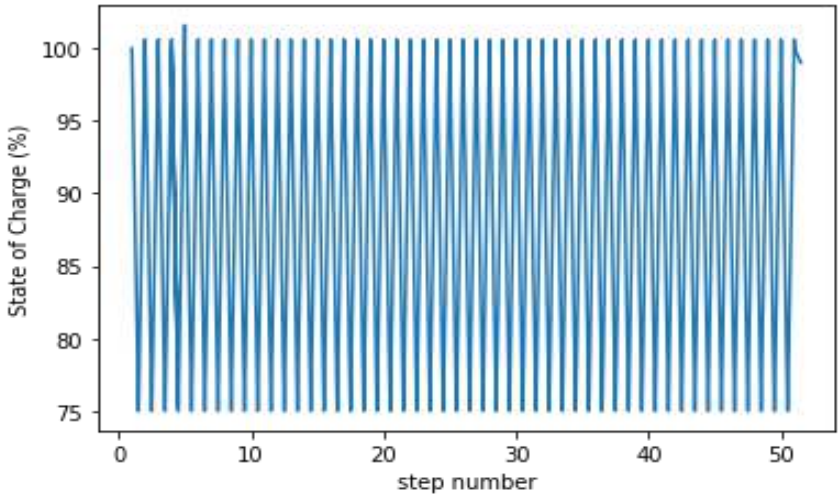
1.2. Progression of voltage curves over course of reference performance tests



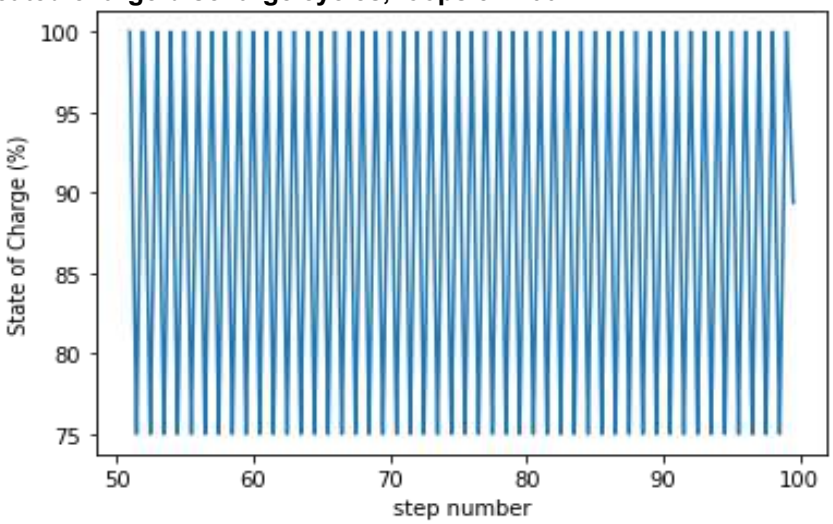
1.3. Stage A repeated charge-discharge cycles, total 50 loops:



1.4. Stage B repeated charge-discharge cycles, loops 1-50:



1.5. Stage B repeated charge-discharge cycles, loops 51-100:



2. Testing Procedure

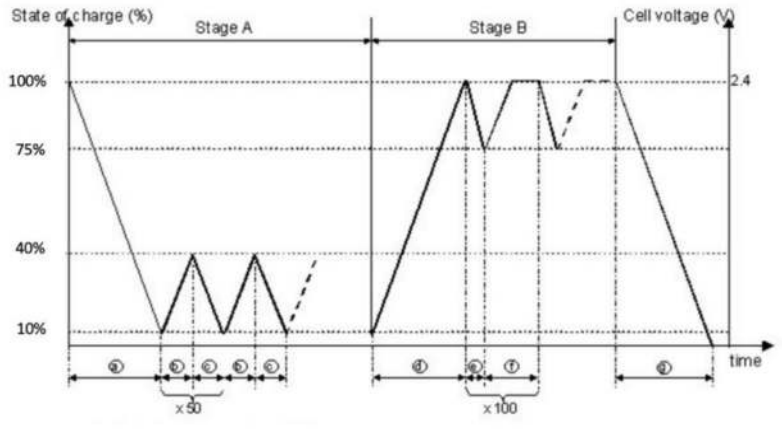
The testing plan is based on the IEC 61427 standards which determine life expectancy of batteries in PV systems. The testing for Off-Grid includes testing the Any-Cell at 40°C.

The details of the testing plan are in the document provided by Phocos. The plan is reproduced below:

Stage A: Shallow Cycling at low SOC			
Step	Discharge time, hrs	Charge time, hrs	Current, A
A	9		0.1 I_t(A)
B		3	0.103 I_t(A)
C	3		0.1 I_t(A)

Stage B: Shallow Cycling at high SOC			
Step	Discharge time, hrs	Charge time, hrs	Current, A
A	2		0.125 I_t(A)
B		6	0.1 I_t(A)

Cycling Phase Procedure @ 40°C



a) 90% discharge at 0.1 I_t(A) (9 hours)
b) 30% recharge at 0.103 I_t(A) (3 hours)
c) 30% discharge at 0.1 I_t(A) (3 hours)

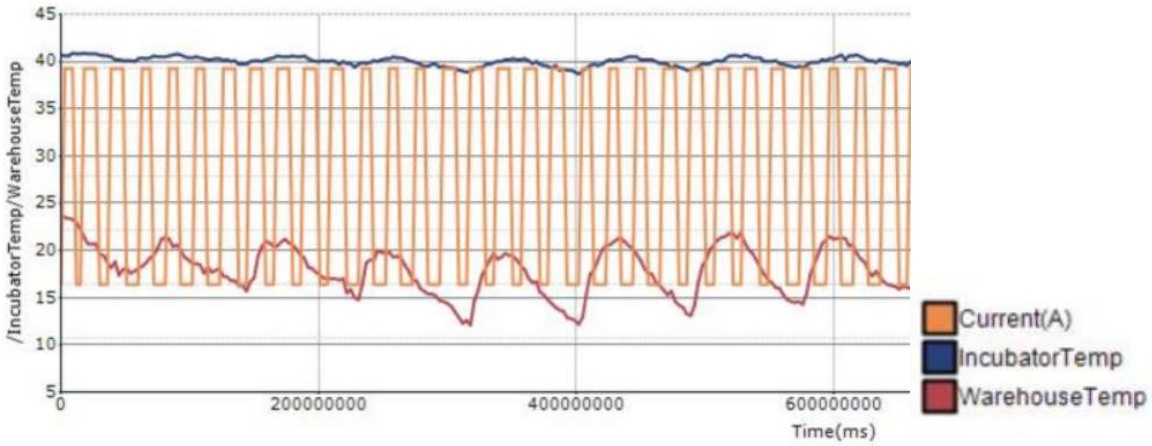
Repeat b) and c) 49 times

d) full recharge at 0.1 I_t(A)
e) 25% discharge at 0.125 I_t(A) (2 hours)
f) recharge at 0.1 I_t(A) for 6 hours

Repeat e) and f) 99 times

g) Coold down battery to ambient temperature. Measure residual capacity by discharging at I10 until cut-off

3. Test Setup Data



Sample data zoomed out over many days, showing the Any-Cell at 40 ±3 °C chamber temperature while warehouse temperature fluctuates day by day

4. Summary of IEC 61427 Standard Performance

The Phocos Any-Cell ESS-L-5kWh-48V lost only 2.90% of the initial measured discharge capacity after 3 successive rounds of IEC 61427 defined cycles: the test plan provided by Phocos follows the IEC requirement of 50 shallow cycles at low SOC (10-40%) followed by 100 cycles at high SOC (75-100%) at the required controlled temperature of 40C.

One IEC 61427 cycle (stage A + stage B) represents the equivalent of 1 year of life in a PV application. Therefore, according to IEC61427, the Any-Cell ESS-L-5kWH-48V is expected to lose less than 3% of its original capacity after 3 years in service. End of life for the Any-Cell (80% of original capacity) was not reached in the IEC 61427 testing but is expected to occur well after 10 years in service based on the results of the 3 applied IEC 61427 cycles.