SES 4Ah Li-Metal Cell Data Report

NOVEMBER 2021

SES

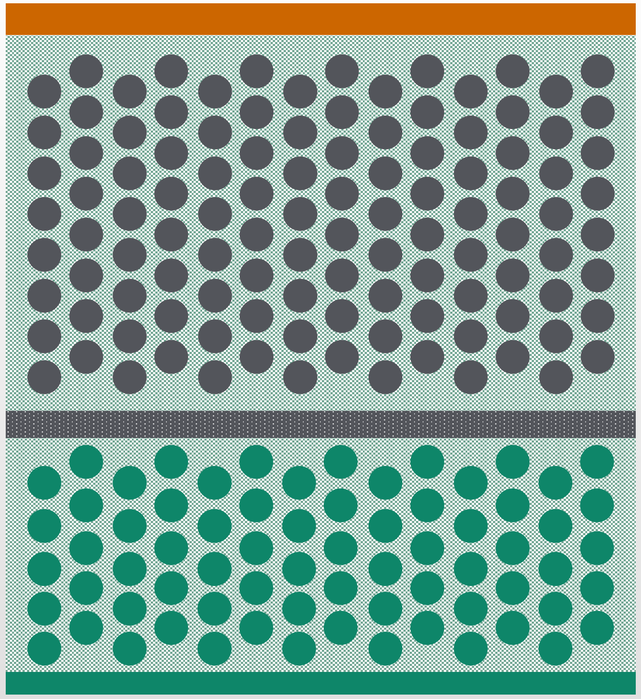
WHY LI-METAL?

Conventional Li-ion

Anode

Separator

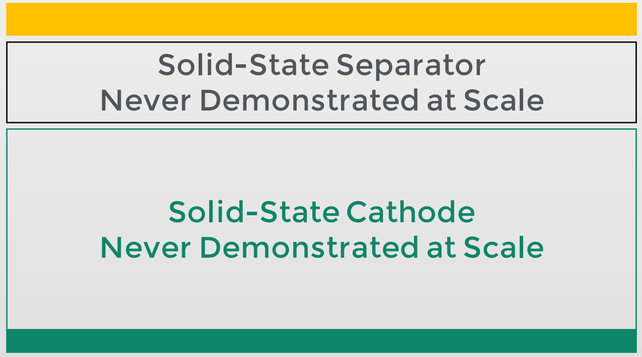
Cathode



✗ Energy Density

✓ Manufacturability

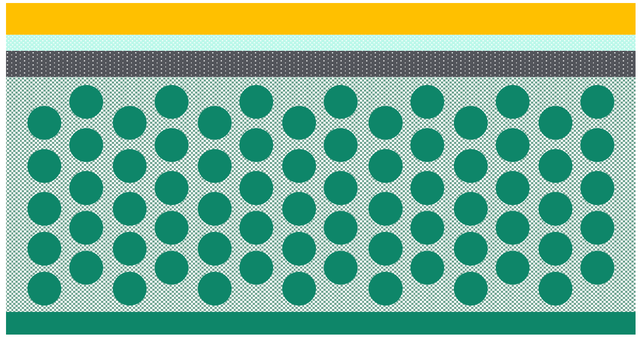
All-Solid-State Li-Metal



✓ Energy Density

✗ Manufacturability

SES Li-Metal



✓ Energy Density

✓ Manufacturability

SES

SES PROPRIETARY ELECTROLYTES ARE SELF EXTINGUISHING

Conventional Lithium-ion Electrolyte:

Flammable

SES Proprietary High Concentration Solvent-in-Salt Electrolyte:

✓ Self Extinguishing

SES VS. LI-METAL PEERS

By Mark Newman and Professor Billy Wu as Consultants to Ivanhoe [1]

		SES	QuantumScape	Solid Power
Room Temperature Energy Density	*Cell type*	*4Ah (25+ layer) at 25°C (Wh/kg)*	*1 layer and 4 layer*	*2Ah (10 layer) and 2 layer at 29°C (Wh/kg)*
	Low power C/20	>375*	n/a	330
	Low power C/10	375	n/a	~264
	Medium power 1C	339	n/a	~33
	High power 5C	321	n/a	n/a
0 °C Low Temperature Energy Density	Low power C/10	324	n/a	n/a
	Medium power 1C	298	n/a	n/a
	High power 5C	282	n/a	n/a
Lifetime	1-2 layer	n/a	1,000 cycles (>80% retention)	>250 cycles (>80% retention)
	3-4 layer	800 cycles (80% retention)[2]**	>450 cycles (>90% retention)	n/a
	10 layer	n/a	n/a	>32 cycles (>80% retention)
	25+ layer	550 cycles (90% retention)**	n/a	n/a
Fast Charging	1 layer	n/a	80% in <15min	n/a
	10 layer	n/a	n/a	n/a
	25+ layer	80% in <15min	n/a	n/a
Safety	Thermal	Electrolyte is stable with Li above Li melting point	Electrolyte is stable with Li above Li melting point	n/a
	Nail	PASS TEST	n/a	n/a
	Overcharge	PASS TEST	n/a	n/a
	External Short Circuit	PASS TEST	n/a	n/a
Manufacturability		✓ *(highly similar process to Li-ion)*	? *(unproven and complex for proprietary separator)*	? *(significant process changes vs. Li-ion)*
Commercialization Timeline		Li-Metal: 2025***	Li-Metal: 2026***	Silicon: 2026 Li-Metal: After 2026?
Source		3rd party test data (Eclipse and Exponent) and SES internal data	Investor presentations; SEC filings	Company update Dec 2020 and company press releases

* Estimated; ** internal test data; *** Represents at-scale post-pilot production (QS-1 Expansion for QuantumScape and Expansion 1 for SES)

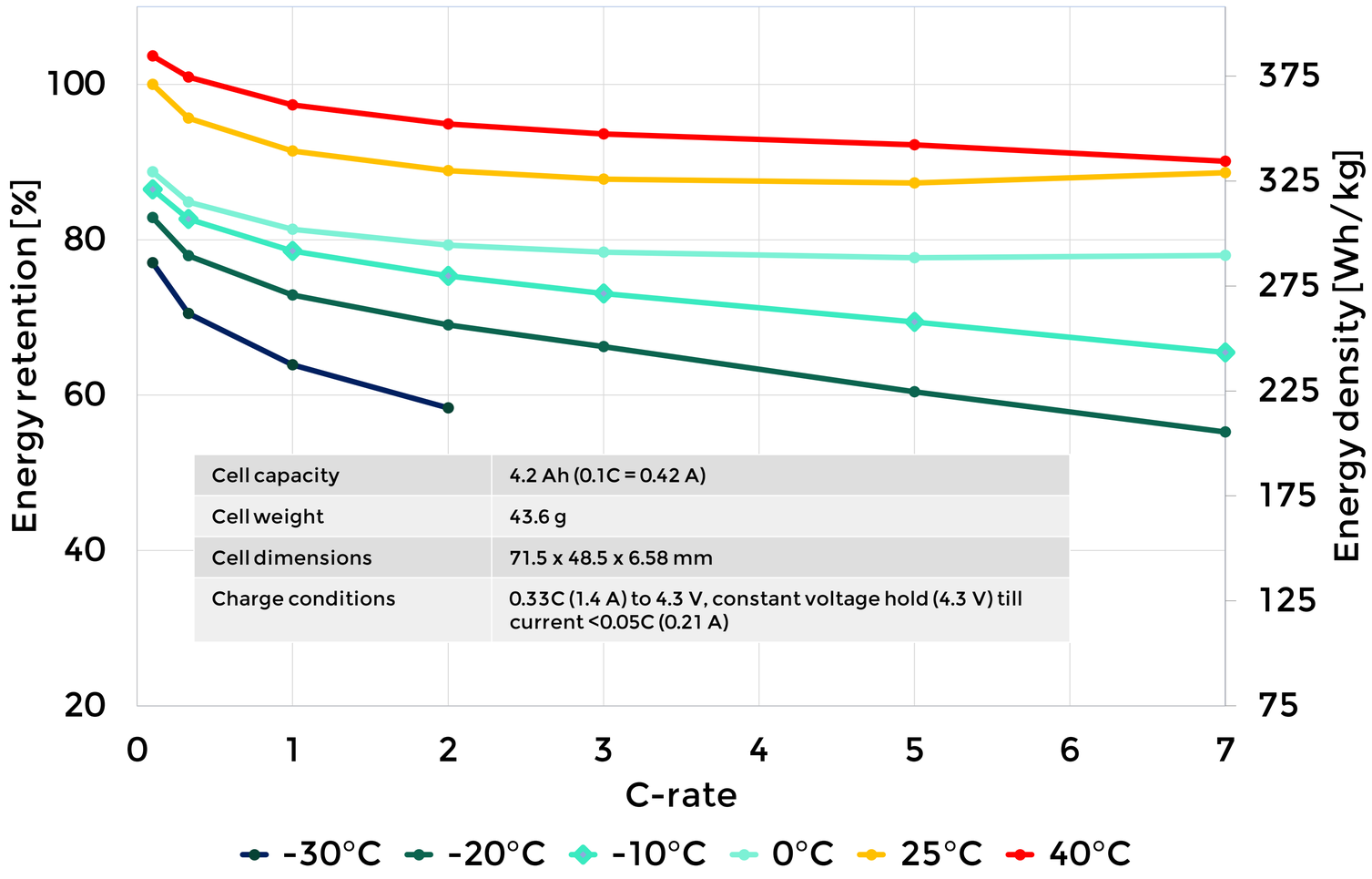
Notes:
1. For additional information on Mark Newman and Billy Wu please see page 7
2. Based on recently updated data

UNPARALLELED ENERGY DENSITY ACROSS ALL TEMPERATURE AND POWER RATINGS IN A LI-METAL BATTERY

Expected to enable long vehicle range and high acceleration in all climates

~90% energy retention at 25°C for C-rates up to 7C

Note: all data from 3rd party testing



Source: 3rd party testing data. See ses.ai/investors for detailed test reports

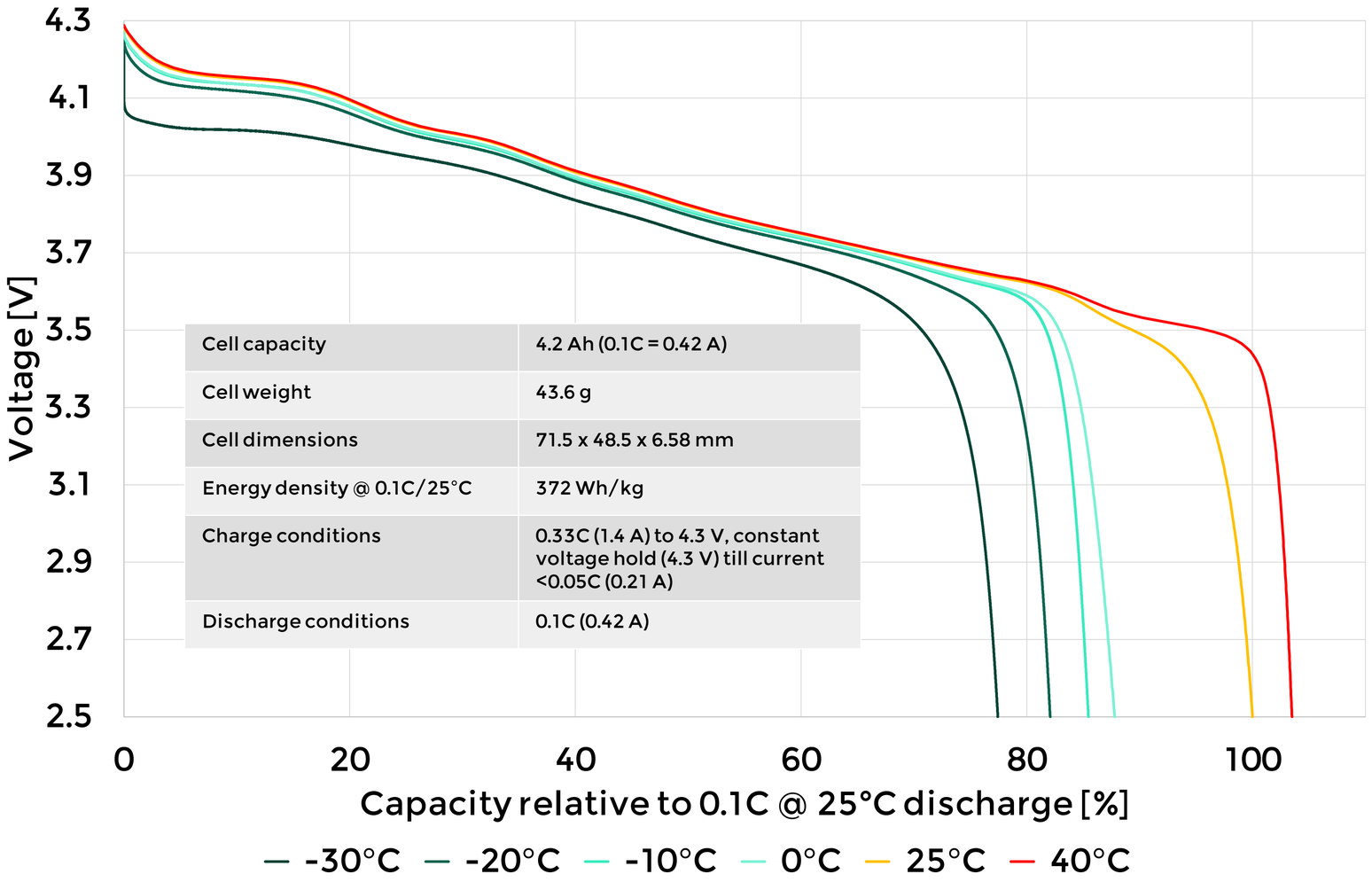
BEST-IN-CLASS LOW TEMPERATURE LI-METAL BATTERY PERFORMANCE

Excellent performance in cold weather climates

Low resistance even at sub-zero temperatures

Retains almost 80% capacity (0.1C@25°C) even at -30°C

Note: all data from 3rd party testing



Cell capacity	4.2 Ah (0.1C = 0.42 A)
Cell weight	43.6 g
Cell dimensions	71.5 x 48.5 x 6.58 mm
Energy density @ 0.1C/25°C	372 Wh/kg
Charge conditions	0.33C (1.4 A) to 4.3 V, constant voltage hold (4.3 V) till current <0.05C (0.21 A)
Discharge conditions	0.1C (0.42 A)

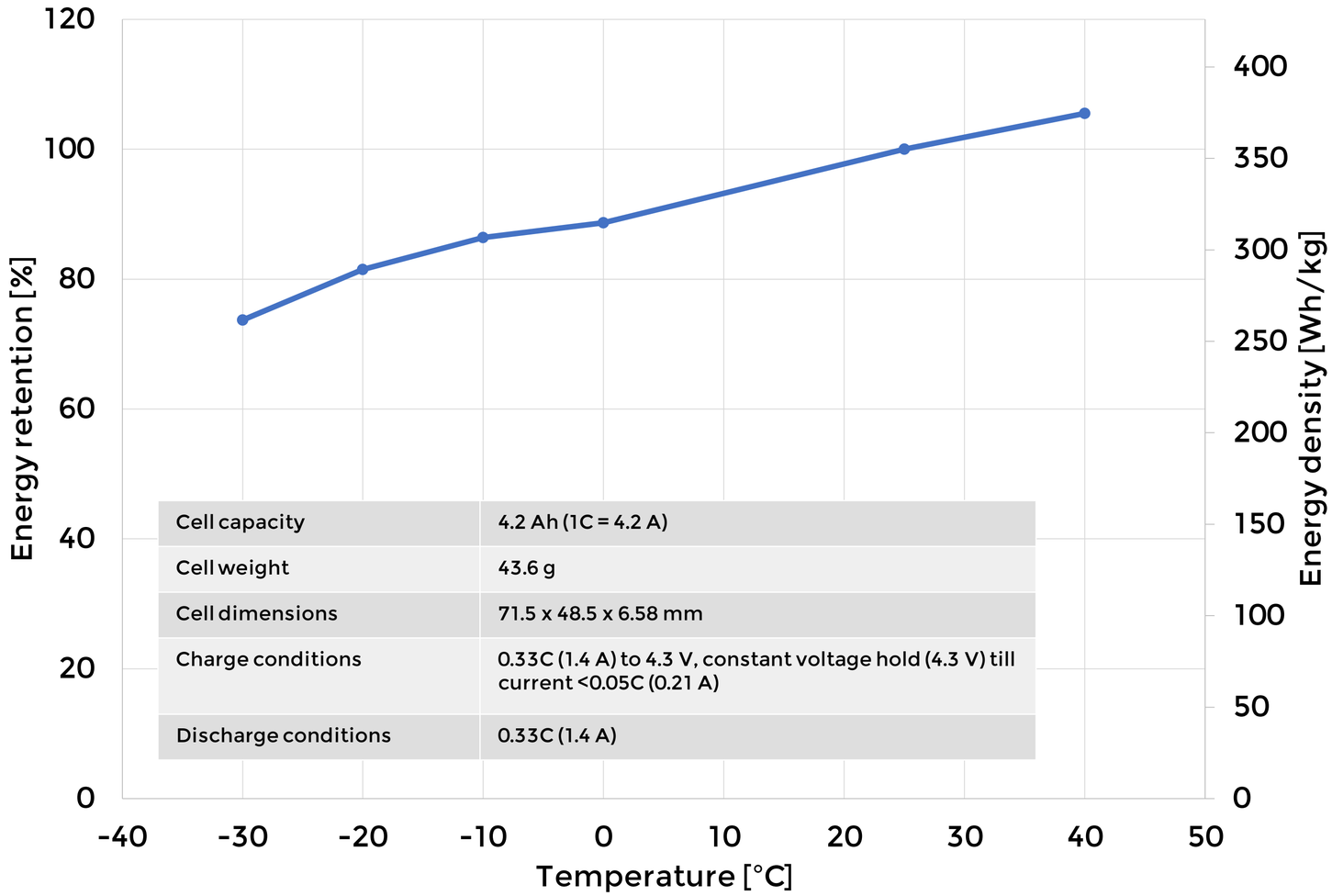
Source: 3rd party testing data. See ses.ai/investors for detailed test reports

BEST-IN-CLASS LOW TEMPERATURE LI-METAL BATTERY PERFORMANCE

Excellent performance in cold weather climates

~75% energy retention at -30°C relative to 0.33C discharge and 25°C

Note: all data from 3rd party testing



Source: 3rd party testing data. See ses.ai/investors for detailed test reports

SES

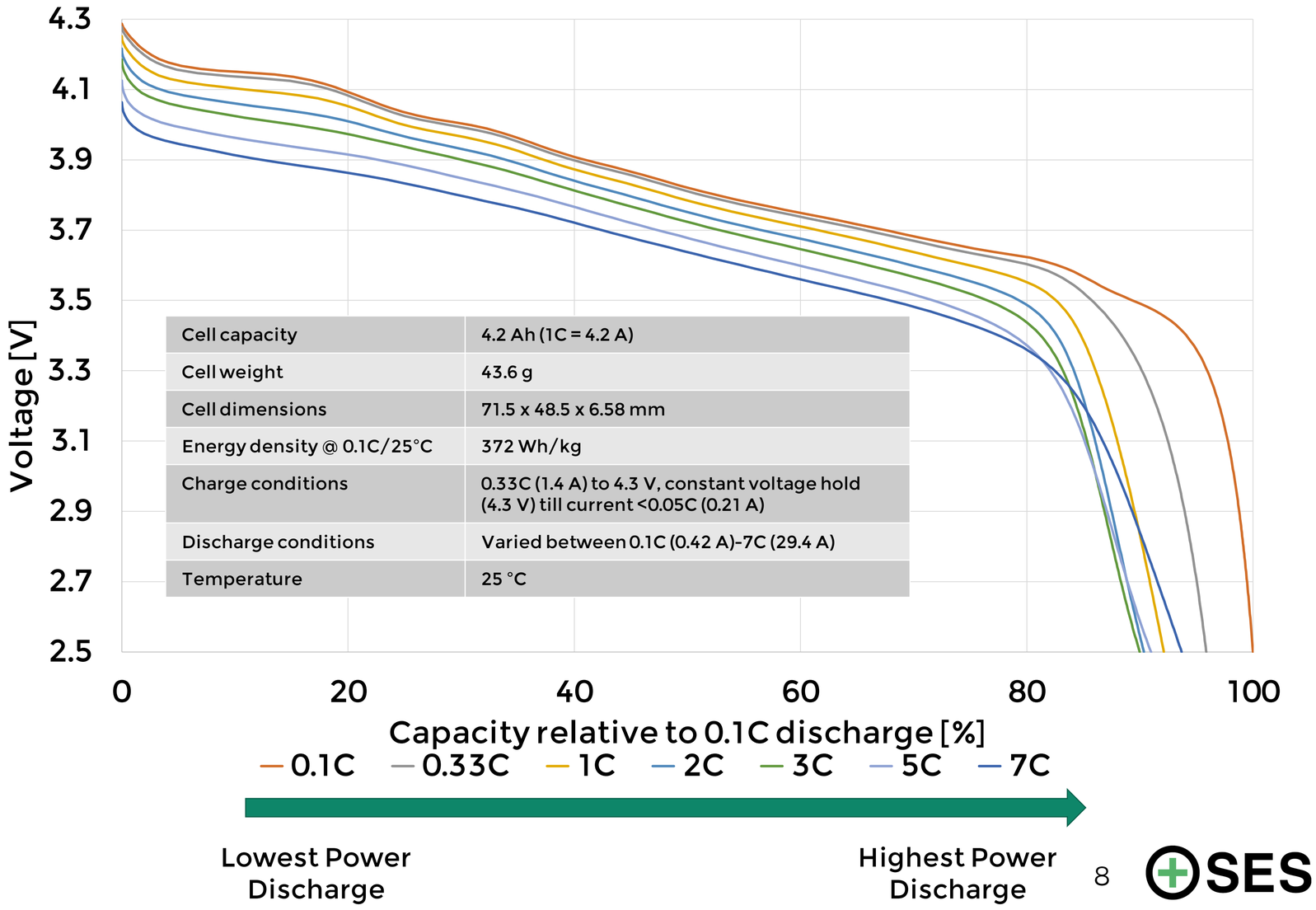
HIGH ENERGY DENSITY AT ALL POWER REQUIREMENTS

Expected to enable long vehicle range and high acceleration

43% higher energy density than leading lithium-ion batteries (260 Wh/kg)

Retains ~90% capacity at up to 7C discharge rates

Note: all data from 3rd party testing



Cell capacity	4.2 Ah (1C = 4.2 A)
Cell weight	43.6 g
Cell dimensions	71.5 x 48.5 x 6.58 mm
Energy density @ 0.1C/25°C	372 Wh/kg
Charge conditions	0.33C (1.4 A) to 4.3 V, constant voltage hold (4.3 V) till current <0.05C (0.21 A)
Discharge conditions	Varied between 0.1C (0.42 A)-7C (29.4 A)
Temperature	25 °C

Source: 3rd party testing data. See ses.ai/investors for detailed test reports

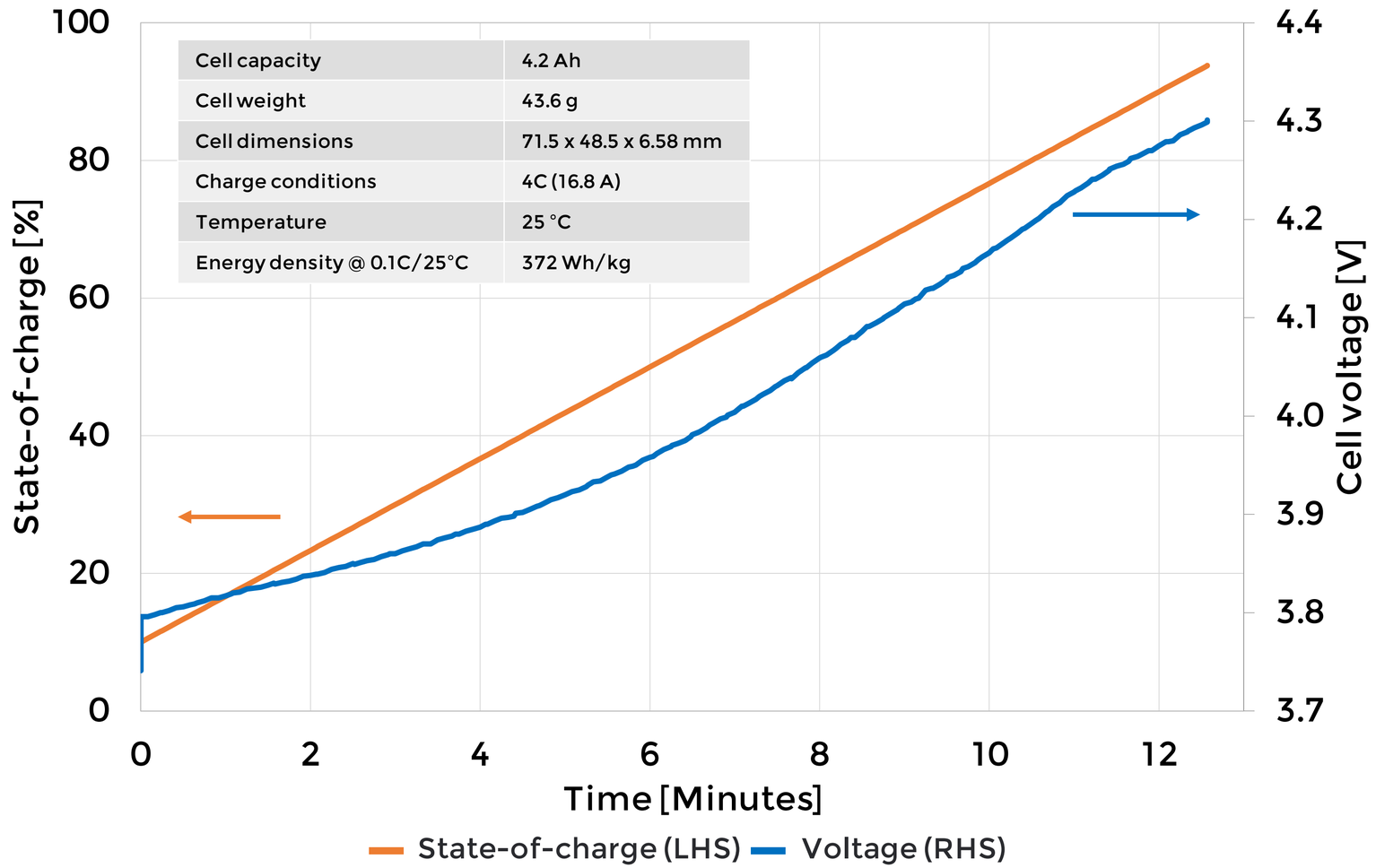
SES

UNPARALLELED FAST CHARGING LI-METAL BATTERY

Able to charge from 10 to 90% in 12 minutes

Cell remains < 4.3 V (safe limit) during fast charging

Note: all data from 3rd party testing



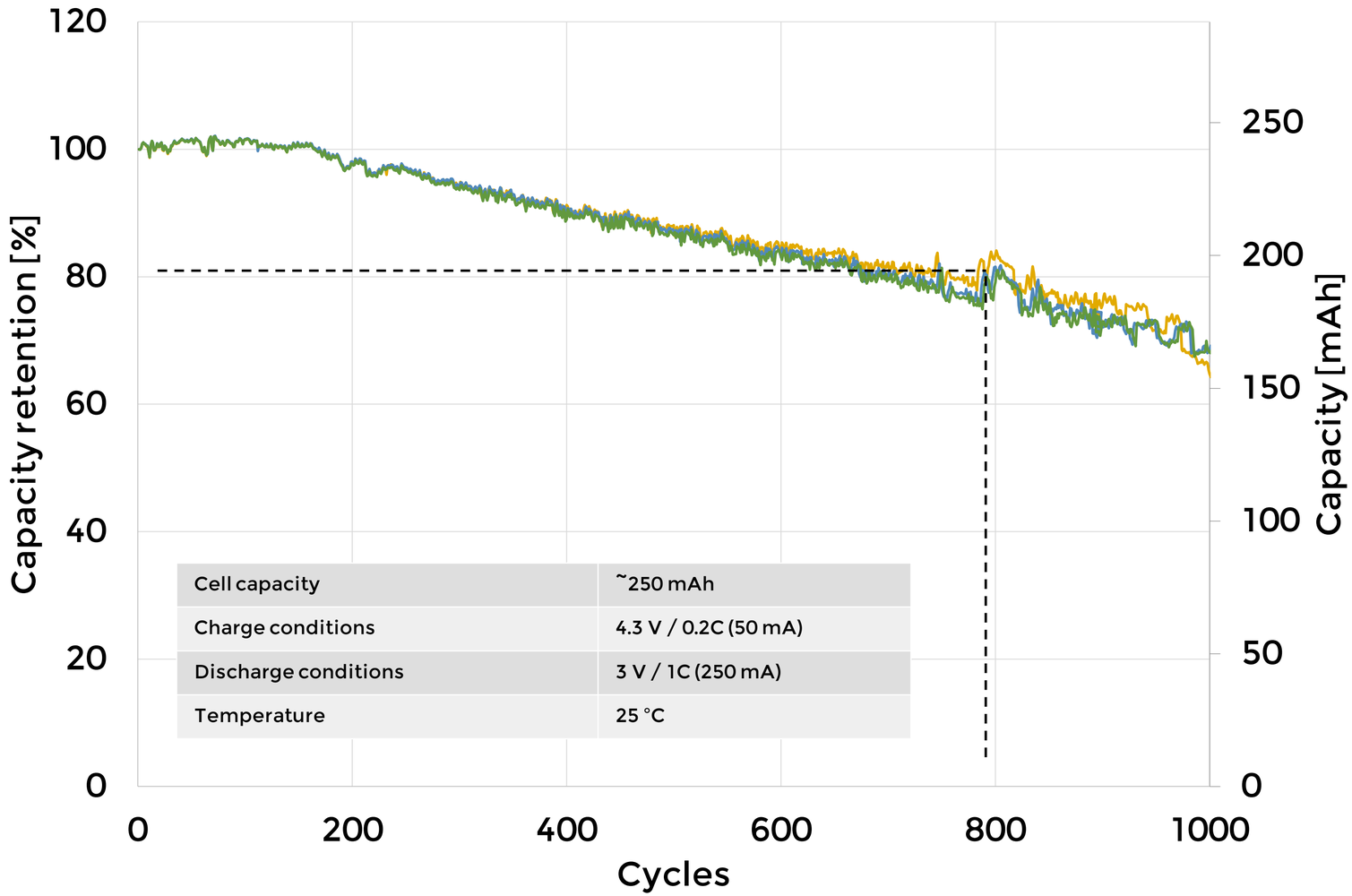
Source: 3rd party testing data. See ses.ai/investors for detailed test reports

SES

LONG LIFETIME (3/4 LAYER ~250 mAH CELL)

>800 cycles to 80% capacity retention (1)

>300,000 implied lifetime miles (2)

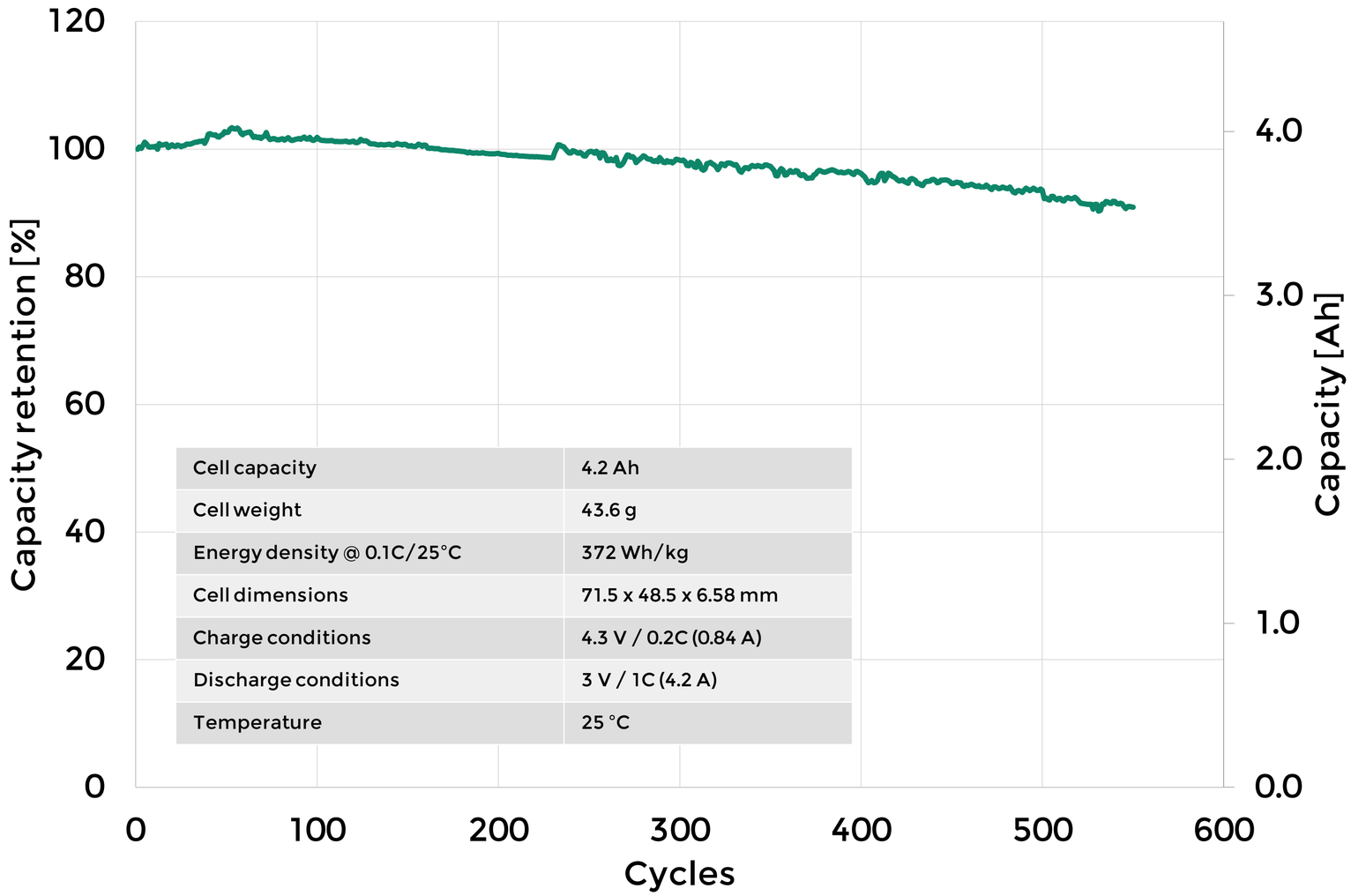


Source: SES internal test data
Notes:
1. Based on recently updated data
2. 540 miles (illustrative BEV range using Li-Metal battery) x 800 cycles = 432,000 miles

LONG LIFETIME (25+ LAYERS 4.2 Ah CELL)

>90% capacity retention after 550 cycles with 4.2 Ah cell

~295,000 implied lifetime miles [1]



Cell capacity	4.2 Ah
Cell weight	43.6 g
Energy density @ 0.1C/25°C	372 Wh/kg
Cell dimensions	71.5 x 48.5 x 6.58 mm
Charge conditions	4.3 V / 0.2C (0.84 A)
Discharge conditions	3 V / 1C (4.2 A)
Temperature	25 °C

Source: SES internal test data
Notes:
1. 540 miles (illustrative BEV range using Li-Metal battery) x 550 cycles = 297,000 miles

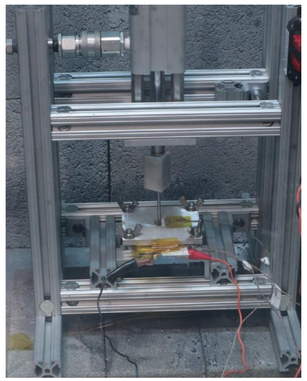
SES

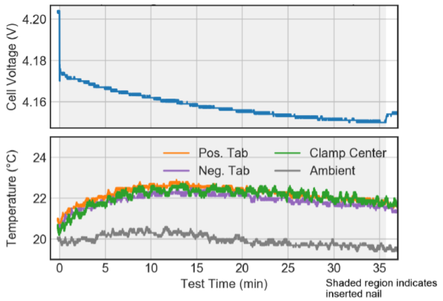
EXCELLENT SAFETY PERFORMANCE

SES Li-Metal batteries passed a range of safety tests [1]

Note: all data from 3rd party testing

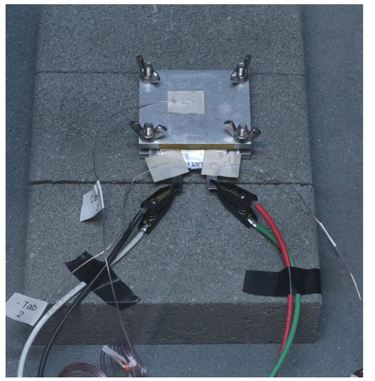
Nail Penetration: ✓PASSED

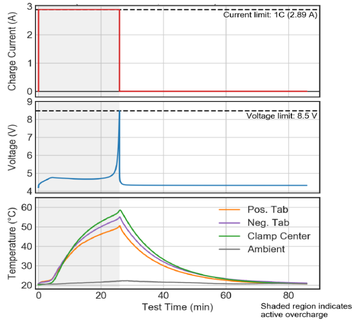




No thermal runaway even with complete nail penetration

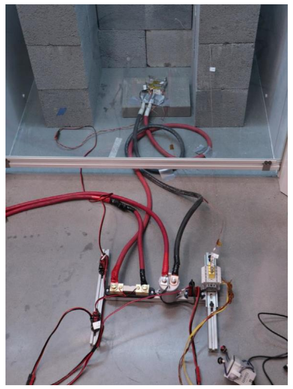
Overcharge: ✓ PASSED

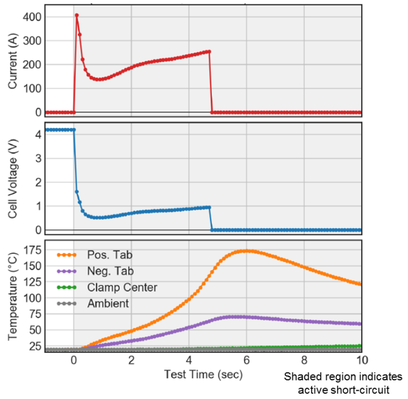




No thermal runaway even when charged to ~2x safe charge limit

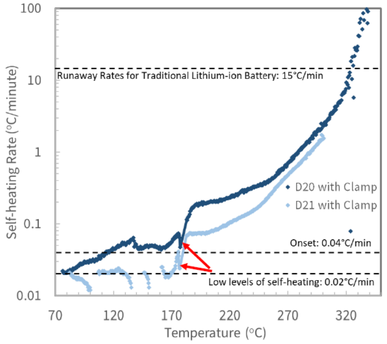
External Short Circuit: ✓PASSED





No thermal runaway even when cell is short circuited

Thermal Stability: ✓ PASSED



SES proprietary electrolyte is stable against molten lithium

Source: 3rd party testing data
Notes:
1. Testing conditions impact test results. Refer to detailed testing conditions in the Test Report Summary

APOLLO: 107 Ah, HIGH ENERGY DENSITY AUTOMATIVE-SCALE CELL TESTING DATA

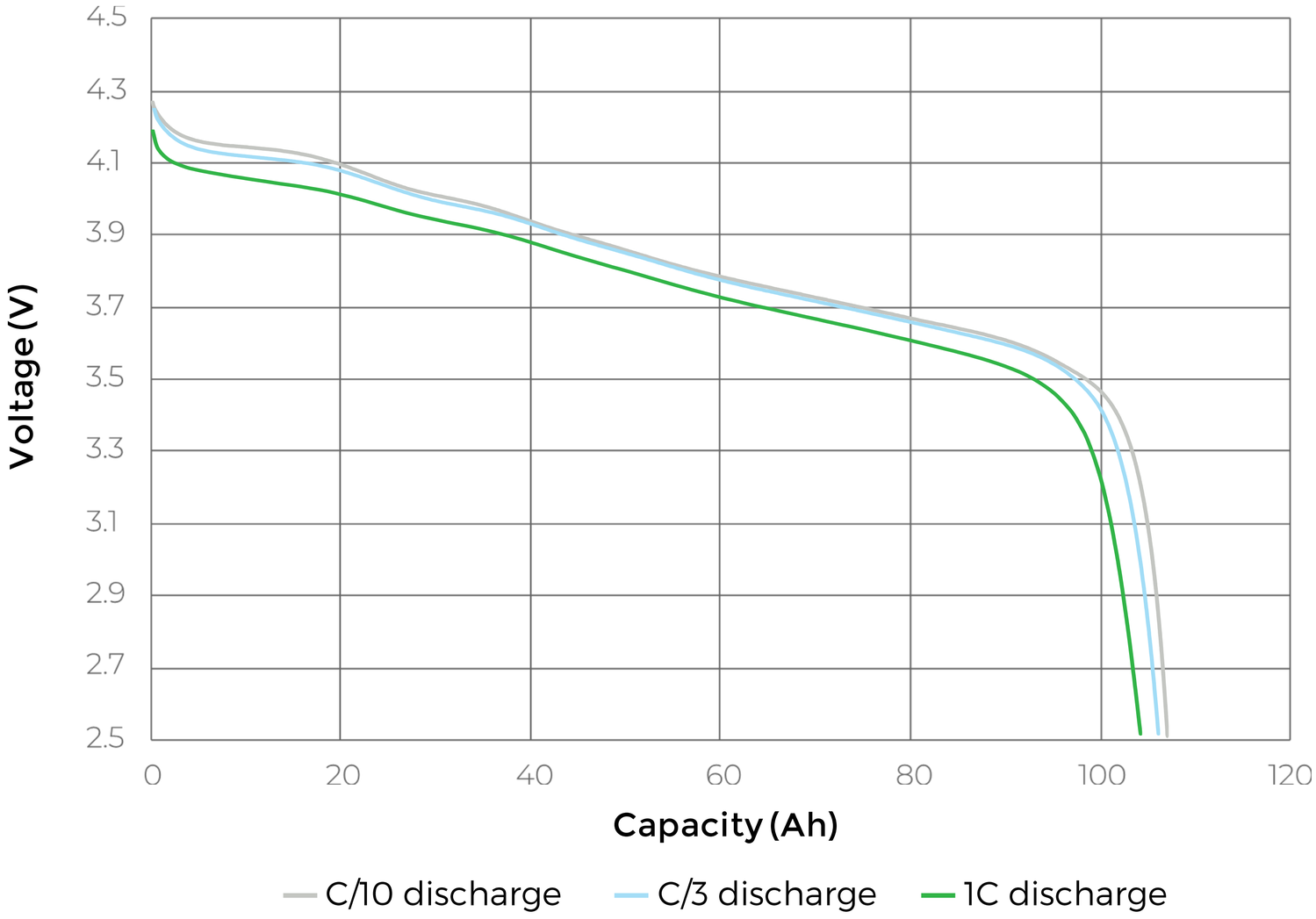
Key Stats:

107 Ah

0.982 kg

417 Wh/kg

935 Wh/L

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S191201A032
SES-SH
SES
S191201A035
SES-SH


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