VRB-ESS®

Sustainable, Scalable and Safe Energy Storage

Product Review: VRB-ESS Gen3 - 100kW

About VRB-ESS

VRB Energy's VRB-ESS is an electrical energy storage system based on the patented vanadium redox battery (VRB®) that converts chemical to electrical energy. Energy is stored chemically in different ionic forms of vanadium in an electrolyte.

The electrolyte is pumped from storage tanks into cell stacks where one form of electrolyte is electrochemically oxidized and the other is reduced on either side of an ion exchange membrane. This creates a current that is collected by electrodes and made available to an external circuit.

The reaction is reversible, and the electrolyte never wears out, allowing the battery to be charged, discharged, and recharged a nearly infinite number of times.

VRB-ESS® DISTINGUISHING FEATURES

Low LCOE
100% depth of discharge with no degradation yields low levelized cost of energy (LCOE).

Recyclable
The electrolyte can be fully recycled at end of project lifetime, a significant value that avoids expensive disposal costs other batteries present.

System Safety
Systems are non-flammable and operate at low temperature and low pressure.

Reliable
Proven performance and robust design yield high availability and low maintenance costs.

Flexible
Operation at partial states of charge (SOC) has no impact on life, allowing effective upward and downward ramp control.

Fast Response
Fast dynamic response for transition between charge and discharge or between operating power levels as fast as 50ms.

LCOE Matters

25,000+
PRODUCT LIFE CYCLES AT FULL CAPACITY

100%
DEPTH OF DISCHARGE (DOD)

25+
YEARS OF OPERATIONAL LIFE

SYSTEM DESCRIPTION

The VRB-G3 Power Modules have a nominal rating of 100 kW AC and have charge and discharge characteristics suitable for heavy duty, full-cycle energy management. Each Power Module can be combined with almost any volume of electrolyte, according to the requirements of a particular application. Typical configurations use four to eight hours of storage depending on the project economics.

SYSTEM CHARACTERISTICS - SINGLE VRB® POWER MODULE

PERFORMANCE

AC Output Voltage	400Vac or 480Vac
Rated Grid Frequency	50/60 Hz
Rated Charging AC Power	100 kW
Rated Discharging AC Power	100 kW
Max. Charging AC Power	120 kW (15min.)
Max. Discharging AC Power	120 kW (15min.)
Energy Storage Capacity	100kW - 4 Hours 100kW - 6 Hours 100kW - 8 Hours
Depth of Discharge	0 - 100%
Cycle Life	> 25,000 cycles
Annual Capacity Degradation	< 0.5% per year
Max. DC Round Trip Efficiency (RTE)	83%
Annual DC RTE Degradation	< 0.1% per year
Battery Management System, Fault Protection, DC Disconnect	Integrated
Response Time at DC Terminals	<50 ms

AUXILIARY REQUIREMENTS

Communications Interface	Modbus TCP
Auxiliary Input	External AC Supply
UPS Equipped	Yes
AC Auxiliary Supply	400Vac or 480V
Auxiliary Power, Nominal	HVAC 20 kW(max.) Pumps 5kW(max.) DC-DC, BMS & Others 500W

ENVIRONMENTAL

Ambient Operating Temperature	-20°C to 45°C / -4°F to 110°F
Cooling	Air-Cooled Scroll-Compressor Chiller
Operating Humidity	0 to 95% RH
Enclosure Rating	IP 54
Maximum Elevation	4,000 m / 13,000 ft above sea level
Wet/Seaside Location Rating	Yes
Hydrogen Gas Detection	Yes
Fire Alarm System	Yes
Secondary Containment	Integrated

STANDARD COMPLIANCE

Cell Stack Listing	UL 1973
DC Module Listing	UL 1973
Compliance	CE, IEC 62932, UL 9540, NFPA 855

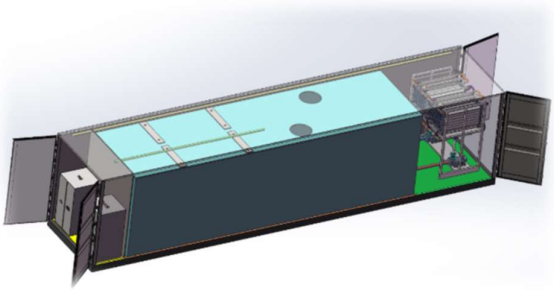
MODULE PHYSICAL

Container Size LxWxH	4 Hours: 30HQ 30'x8'x9.5' 6 Hours: 40HQ 40'x8'x9.5' 8 Hours: 45HQ 45'x8'x9.5'
Weight Shipping/with Electrolyte	4 Hours: 18t / 52t 6 Hours: 20t / 70t 8 Hours: 22t / 90t
Mounting	Pad mount, strip foundation, or equivalent
Rec. Service Clearance	3m / 10" (stack side) 1m / 3.3" (other sides)

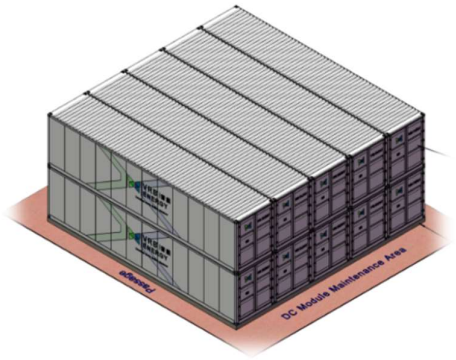
COMMUNICATION

EMS and Third-Party Monitoring	Ethernet or Fiber, TCIP/IP
Inverter Communication	Ethernet or Fiber, TCIP/IP
Monitoring	Cloud or Ethernet

PRODUCT OVERVIEW: VRB-ESS Gen3-100kW



100kW Single Unit View



1MW Double stacked view

SUPPORT & WARRANTY

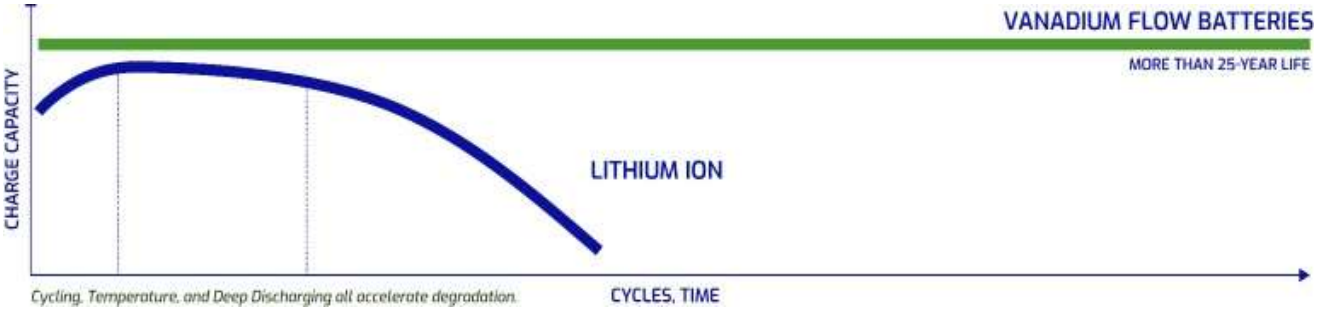
On-site support for assembly and installationof the VRB-ESS, as well as commissioning of equipment by VRB Energy personnel.

Safety and operational training for all on-site personnel and operators.

Ten-year comprehensive warranty covering Capacity, Availability and Efficiency.

QUALITY

VRB-ESS have been reviewed and are following ISO 9001 quality system and UL/NFPA safety guidelines.



VRB® TECHNOLOGY VS. LITHIUM-ION

While lithium-based batteries are well suited to consumer electronics and electric vehicles, their lifetimes can be limited. VRB® Energy'sVRB® technology can be discharged over an almost unlimited number of charge and discharge cycles without wearing out.

To find out more, check out www.vrbenergy.com or contact us by email at sales@vrbenergy.com.

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