

VRB-ESS[®]

Sustainable, Scalable and
Safe Energy Storage

PRODUCT OVERVIEW : VRB-ESS GEN3-1000







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 LCOE.
-  **Recyclable**
The electrolyte can be fully recycled at end of project lifetime, saving cost and avoiding the expensive disposal costs of other
-  **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.
-  **Flexibility**
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 70ms.

LCOE Matters

25,000+

PRODUCT LIFE CYCLES AT
FULL CAPACITY

100%

DEPTH OF DISCHARGE
(DOD)

30+

YEARS OF
OPERATIONAL LIFE

SYSTEM DESCRIPTION

The VRB-G3 Power Modules have a nominal rating of 1000 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

SYSTEM CHARACTERISTICS – SINGLE VRB® POWER MODULE

CHARACTERISTIC	VRB-G3-1000	NOTES
Nominal Output, AC	1000 kW AC	
Nominal output, DC	1080 kW DC	
Output, AC @ 95% SOC	1000 kW AC	Active power only; see below for reactive component
Output, AC @ 5% SOC	1000 kW AC	
DC voltage	500-810 V	Can be adjusted per site requirement
DC current	0-2500 A	Discharge current
Power factor	0.9	Nominal output at this power factory
AC connection voltage range	315-480 V, 3-Phase	+/-10% variation allowable; voltages below nominal may limit power capacity
Response time	50 to 100ms	Excluding signal latency, fast response option available
Efficiency	up to 85% DC, 75% AC	Nominal AC-in to AC-out, round-trip; efficiency varies as a function of operating conditions
AC connection frequency	50 / 60 Hz	± 5% variation allowable
AC current harmonics	Compliance with EN62103, IEEE519	
Operating ambient temperature	0°C to 50°C	Internal temperature regulated by active thermal management system to 42°C max
Calendar life	25 years	Refurbishment package available
Cycle life	25,000+	Minimum value
Availability	97%	Minimum value

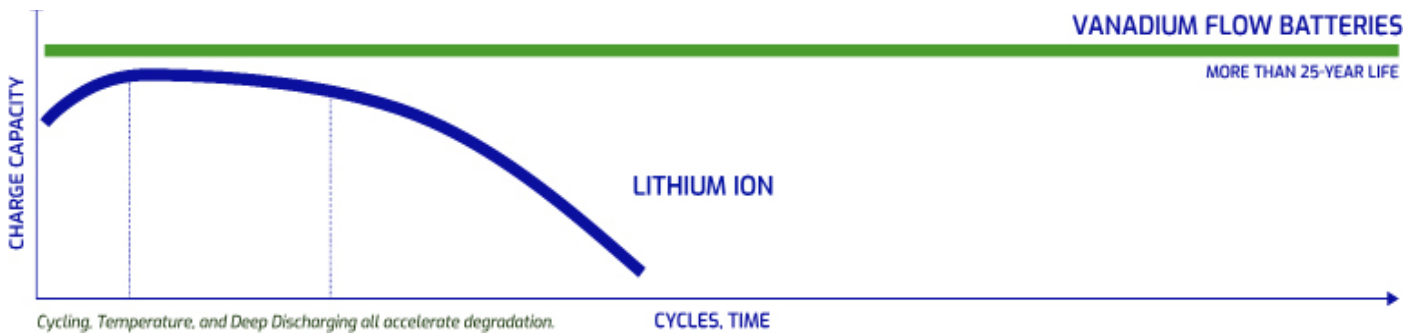
This document provides indicative performance figures only.
Actual figures will depend on the intended application, environmental conditions, and options required at a particular site.

SUPPORT & WARRANTY

- On-site support for assembly and installation of 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 in compliance with European system quality and 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's VRB® technology can be discharged over an almost unlimited number of charge and discharge cycles without wearing out. This is an

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



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