

# Specification

## Vanadium Flow Battery

DOCUMENT FOR TENDER

2025

# Contents

- 1. Battery module general requirements ..... 3
  - 1.1 Long-Life Battery Module | 25+ Year Performance Guarantee ..... 3
  - 1.2 Battery Module Specifications ..... 3
  - 1.3 Intelligent Thermal Management System ..... 错误! 未定义书签。
  - 1.4 Unrestricted Energy Access with Zero Degradation ..... 4
  - 1.5 Flexible and resilient ..... 5
  - 1.6 Inherent safety ..... 5
  - 1.7 “Plug and Play” deployment ..... 5
  - 1.8 No augmentation ..... 5
  - 1.9 Big data monitoring and battery diagnosis ..... 5
  - 1.10 Green and net positive recycling ..... 5
  - 1.11 Standard compliance ..... 5

# 1. Battery module general requirements

## 1.1 Long-Life Battery Module | 25+ Year Performance Guarantee

### Engineered for Endurance

The Battery Module is designed to deliver reliable power for **25+ years**, meeting all functional and performance requirements throughout its lifespan.

### Optimized Maintenance Design

- Built for **minimal maintenance** without compromising longevity
- Critical components (e.g., batteries, power electronics) include scheduled maintenance/replacement plans
- Full **transparency** on expected component lifecycle costs

### Reliability You Can Trust

- 25-years expected service life backed by robust system architecture
- Detailed maintenance schedules provided for all key subsystems
- Compliance with stringent durability standards

**For Tenderers:** Submit complete lifecycle projections and maintenance strategies aligned with the 25-year operational requirement

## 1.2 Battery Module Specifications

### Key Requirements

- **Uniform Battery Configuration:** All batteries must be identical in make, model, voltage, power output, and storage capacity.
- **Waterproof Design:** Standard IP54 rating, with options up to IP65-rated protection, submersible up to **1.4 meters**.
- **Modular & Compact Construction:**
  - Dimensions: **≤ 0.9m (W) × 2.1m (H)** for single-door access compatibility.
  - Weight: **< 3 tons per module** for easy transport and handling.
- **Sealed Electrolyte System:** No leakage risk—eliminates manual handling during transit or installation.
- **Low Self-Discharge:** **≤ 2%** over extended periods for sustained reliability.

### Performance & Efficiency

- **High Energy Density:** **≥ 24kWh/m<sup>2</sup>** to maximize space utilization.
- **Fault-Tolerant Design:** Isolated cell failures prevent system-wide disruptions.
- **Predictive Maintenance:**
  - Rapid replacement (**< 15 minutes**) for pumps, sensors, and fans.
  - Supplier-provided solutions to minimize downtime for sub-25-year components.

### Advanced Battery Management System (BMS)

- **Real-Time Monitoring:** Tracks **SOC, SOH, voltage, current, power limits, and temperature** at the module level.
- **Proactive Alerts:** Integrated with **Energy Management System (EMS)** for remote HMI visibility.
- **Remote Diagnostics**

- Detailed event logging on SCADA for **90%+ fault resolution without on-site intervention**.
- Enhances personnel safety by reducing battery house entry frequency.

**Supplier Compliance:** Respondents must detail their BMS monitoring approach, including rationale for parameter prioritization.

- **Key Improvements**

1. **Structured Hierarchy:** Clear sections (Requirements, Performance, BMS) with bullet points for quick scanning.
2. **Technical Precision:** Retains all specs while simplifying jargon (e.g., "submersible" instead of "waterproof up to").
3. **Safety Emphasis:** Highlights remote diagnostics and sealed electrolyte as risk-mitigation features.
4. **Actionable Compliance:** Directs suppliers to justify BMS design choices.

This format balances technical rigor with customer-friendly readability, ideal for bids or marketing materials. Let me know if you'd like further adjustments!

## 1.3 Hybrid Thermal Management (Passive + AC Cooling)

### Passive Cooling Advantage

- **Endothermic Charging Process:** Batteries naturally cool during energy storage, eliminating active cooling needs during solar charging cycles
- **Thermal Mass Stabilization:** Battery modules buffer temperature fluctuations between day/night cycles

### Climate-Adaptive Performance

- **Zero Active Cooling Required:** Maintains optimal operating temperatures in environments up to **50°C ambient**
- **Minimal Energy Use:** Only requires supplemental cooling when ambient exceeds 50°C, with modest cooling to 40°C

### System Benefits

- **Reduced Energy Consumption:** Eliminates >90% of traditional battery cooling loads
- **Enhanced Reliability:** Passive thermal regulation extends component lifespan
- **Simplified Installation:** No complex liquid cooling infrastructure required

**Design Note:** Thermal management system designed specifically for solar+storage applications where daytime charging coincides with peak ambient temperatures.

## 1.4 Unrestricted Energy Access with Zero Degradation

### Advanced Vanadium Redox Technology

- **100% State-of-Charge (SOC) Utilization:** Full rated energy capacity available throughout entire service life
- **Liquid Electrolyte Storage:** Energy stored in liquid phase eliminates electrode degradation common in solid-state batteries
- **Infinite Cyclability:** Vanadium redox reactions maintain perfect reversibility across all charge cycles

### Unmatched Operational Flexibility

- **Multi-Cycle Daily Operation:** Supports unlimited charge/discharge cycles without performance penalties

- **Non-Degrading Chemistry:** No capacity fade or power deterioration over time
- **Consistent Energy Delivery:** Maintains full power output regardless of discharge depth

#### System Advantages

- **True Long-Duration Storage:** Enables extended discharge periods at full capacity
- **Lifetime Performance Guarantee:** No energy degradation over 25 years
- **Adaptive Grid Support:** Perfect for applications requiring frequent charge/discharge transitions

**Technical Note:** The liquid electrolyte design fundamentally prevents crystalline structure changes that cause degradation in conventional battery technologies, enabling permanent access to 100% of the installed energy capacity.

### 1.5 Flexible and resilient

The battery modules are linked in series and feature built-in seamless bypass function. This enables in-string redundancy which greatly enhances reliability and flexibility. It covers a large electrical operating range, capable of including both short- and long-duration functions, allowing stacking benefits of multiple applications for a maximized value proposition.

### 1.6 Inherent safety

The battery modules must use non-explosive and non-flammable aqueous electrolytes. Additionally, there is no thermal runaway or spontaneous violent reactions after short-circuit or under other extreme conditions. The safety performance must comply with UL1973 standard and certified by third party.

### 1.7 “Plug and Play” deployment

The battery modules shall be transported pre-charged to 50%, arriving onsite ready for “plug and play” connection.

The battery module shall be low requirement in complicated civil work and foundation, it shall be mounted on gravel or simple foundation to reduce site preparation costs.

### 1.8 No augmentation

There is no augmentation required to save overall cost. There is no capacity fade in 25+ years. Battery installation shall not require additional space to augment the system to maintain rated capacity.

### 1.9 Big data monitoring and battery diagnosis

The energy management system shall be based on a big data platform, through the continuous accumulation, analysis and intelligent learning of big data. This will enable precise control of the processes and parameters of charging/discharging, and analysis of abnormal data in time to avoid compromising reliability or safety.

### 1.10 Green and net positive recycling

The battery modules must be produced with recyclable materials and eventual disposal must be in line with international green policies. The battery module must have a net positive recycling value. The supplier shall be capable of service at end of life to recycle the battery module including electrolyte.

### 1.11 Standard compliance

The battery module must be IEC 62932-2-1 & IEC 62932-2-2.

<b>Document Version</b>	<b>Release Date</b>	<b>Revision History</b>
V1.0	2025-04-16	<b>Official Launch (V1.0)</b>