Specification

Vanadium Flow Battery

DOCUMENT FOR TENDER

2025

Contents

1. Battery module general requirements

1.1 Design life

The Battery module is intended to operate for 25+ years and as such design life for all works shall be 25+ years. It can be accepted that components such as batteries and power electronics may require maintained or replaced at shorter intervals than the design life and, as such, tenderers shall provide details of the expected component life/maintenance schedule of all key components over the full 25+ year design life.

Battery module shall be designed to meet the functional requirements of this specification and guaranteed performance over 25 years. Battery module with minimal maintenance shall be required.

1.2 Battery module

Batteries used shall be of identical make, model, voltage, power output and storage capacity. Batteries shall be mounted and housed in thermally managed weatherproof house with temperature control to maximize the performance and life of the batteries, the battery module shall be capable of waterproof up to 1.4 meters.

The battery module shall be of a modular design, facilitating single door entrance, the overall outsize dimension shall not be more than 0.9m width and 2.1m height, and the total weight of each modular battery shall be less than 3 tons for easy site transport and movement.

The electrolyte used by the battery must be stayed in the battery module which avoid any touch or site treatment process during transportation and after battery arrival.

The self-discharge of battery shall be not more than 2% for long time.

Supplier shall provide solution to minimize the maintenance time for components such as pumps, sensors and fans that their life is less than 25+ years, those each component must be replaced within 15 minutes to maximize the efficiency and productivity.

The energy value of the required battery module shall not be less than 24kWh/m^2 to optimize the space of battery installation.

Any faults that arise shall only impact on individual cell performance without affecting the system operation.

The batteries shall be supplied with a Battery Management System (BMS) which shall monitor the operational and fault status of the system for all parameters required to ensure safe operation of the batteries. It is expected that parameters such as State of Charge (SOC), State of Health (SOH), voltage, current, power limits, and temperatures shall be monitored. Levels of monitoring for each parameter shall be undertaken at each and every battery module. Respondents shall provide a description of the BMS monitoring philosophy proposed at each level of battery module, including rationale for the level of monitoring provided.

The BMS shall be integrated with the Facility Control and Monitoring System, also known as Energy Management System (EMS), and appropriate status indications and alarms made available through the remote HMI. The event data shall be of sufficient detail and stored on the SCADA System to enable a majority of fault tracing to be conducted remotely to reduce the time spent at the Site and/or inside the Battery house for personnel safety. The layout of the batteries within a house shall be designed for ease of access and operations, and shall comply with the safety requirements (including clearance for egress) of IEC standard or/and country regulation.

1.2.1 Simple, efficient heat management

The battery is endothermic on charge, cooling down as it stores energy. This is required for solar + storage applications as it virtually eliminates auxiliary heat management loads during the day as solar energy

is stored in the battery. In addition, the thermal mass of the battery stabilizes day/night temperature swings. The combination of endothermic charging and thermal mass eliminate typical air conditioning requirements up to 50°C ambient temperatures. Boost cooling for conditions exceeding 50°C need only reduce air temperatures to 40°C.

1.2.2 Capable of long duration with 100% SOC access

The battery module stores and release energy according to demands, via vanadium redox reactions that exhibit excellent reversibility and thus cyclability. Battery modules store energy in liquid electrolytes rather than solid materials. This eliminates the structural disintegration in electrodes, thus enabling performance without degradation, allowing 100% access to rated energy in whole life.

It can be operated with multiple cycles a day for a long life.

1.2.3 Flexible and resilient

The battery modules shall be placed in series and possess 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.

1.2.4 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.

1.2.5 Plug and Play (Pre-charged to 50% SOC for easy site commissioning)

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 working load.

1.2.6 No augmentation

There is no augmentation required to save overall cost. There is no capacity fade in 25+ years. Battery module shall not require additional space to add more batteries every few years to maintain rated capacity.

1.2.7 Big data monitoring and battery diagnosis

The energy management system shall be based on 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.

1.2.8 End-of-Life recycling with positive net value

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.

1.2.9 Standard compliance

The battery module must be IEC 62932

Document Version	Release Date	Revision History
V1.0	2025-04-16	**Official Launch (V1.0)**