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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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Test method for vanadium flow battery system

全钒液流电池系统测试方法

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Table of Contents

Foreword	3
1 Scope	6
2 Normative references	6
3 Terms and definitions	6
4 Test items	6
5 Test preparation	7
6 Test conditions	8
7 Measuring instrument	8
8 Test method	9
9 Test report	15
Appendix A (Informative) Test report	16

1 Scope

This document describes the test method for vanadium flow battery system.

This document applies to the research, development, production, manufacturing, and testing of vanadium flow battery system (hereinafter referred to as "battery").

2 Normative references

GB/T 27418

GB/T 29840-2013

GB/T 50063

3 Terms and definitions

For the purposes of this document, the following terms and definitions, as well as those given in GB/T 29840-2013, apply.

3.1 state of charge; SOC

The ratio of the remaining dischargeable capacity to the rated discharging capacity of a vanadium flow battery.

4 Test items

Table 1 lists the test items for battery.

5.1 General requirements

The following items shall be included in the test plan.

- a) Purpose;
- b) Test specifications;
- c) Tester qualifications;
- d) Requirement for the test uncertainty to be in compliance with GB/T 27418;
- e) Requirements for measuring instruments;
- f) Estimation of the range of test parameters;
- g) Data collection.

5.2 Data collection and recording

The data collection system and data recording equipment shall meet the requirements for collection frequency and speed, and their performance shall be superior to that of the test equipment.

5.3 Temperature check

Before the test, confirm that the battery electrolyte temperature meets the test requirements.

6.1 Environmental conditions

Environmental conditions shall meet the following requirements.

- a) Temperature. $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$;
- b) Relative humidity. 5% ~ 95%;
- c) Altitude. $\leq 2\text{ }000\text{ m}$.

Note. The electrolyte temperature shall be determined by the manufacturer based on the characteristics of the electrolyte.

6.2 DC power supply

The DC power supply shall meet the following requirements.

- a) Permissible deviation of power supply voltage. -10% ~ 10%;
- b) Power supply voltage ripple factor. $\leq 5\%$.

7 Measuring instrument

The measuring instrument shall be within the validity period of its metrological verification and calibration, and shall meet the measurement accuracy specifications specified by the manufacturer. Table 2 specifies the measurement parameters and instrument accuracy requirements.

8.1 Appearance

Visually inspect the appearance.

8.2.1 Rated energy efficiency test

Perform a battery rated energy efficiency test according to the following steps.

- a) Charge the battery to 100% SOC;
- b) Discharge the battery at its rated power until the limited discharging voltage is reached. If the limited discharging voltage is not reached when the battery is discharged to 0% SOC, stop the discharge when the battery reaches 0% SOC.
- c) With no interval required, charge the battery at rated power until the limited charging voltage is reached. If the limited charging voltage is not reached when the battery is charged to 100% SOC, stop the charging when the battery reaches 100% SOC.
- d) With no interval required, discharge the battery at its rated power until the limited discharging voltage is reached. If the limited discharging voltage is not reached when the battery is discharged to 0% SOC, stop the discharge when the battery reaches 0% SOC.
- e) Repeat steps c) ~ d) twice, ensuring the conditions for stopping charging and discharging remain consistent across all three tests;
- f) Record the charging-discharging capacity and auxiliary energy consumption for three charge-discharge cycles [steps c) and d)];
- g) Calculate the rated energy efficiency of the battery after three charge-discharge cycles according to Formula (1), and take the average value as the test result. Where.

η - rated energy efficiency;

E_d - discharging capacity of the battery recorded by the measuring instrument, in kilowatt-hours (kWh);

W_d - energy consumed by all support equipment during battery discharge recorded by the measuring instrument, in kilowatt-hours (kWh);

E_c - charging capacity of the battery recorded by the measuring instrument, in kilowatt-hours (kWh);

Wc - energy consumed by all support equipment during battery charging recorded by the measuring instrument, in kilowatt-hours (kWh).

For systems whose auxiliary energy consumption is supplied by the battery itself, the energy consumed by support equipment is already included in the charging-discharging capacity recorded by the measuring instrument.

8.2.2 Rated charging capacity test

Test the rated charging capacity of battery according to the following steps.

- a) Discharge the battery to 0% SOC;
- b) With no interval required, charge the battery at rated power to the limited charging voltage. If the limited charging voltage is not reached when the battery is charged to 100% SOC, stop the charging when the battery reaches 100% SOC, and skip step c);
- c) Continue charging at a constant limited charging voltage to 100% SOC;
- d) Repeat steps a) ~ c) twice; keep the charging stop conditions consistent across all three tests;
- e) Record the charging capacity and auxiliary energy consumption during three battery charging cycles;
- f) Calculate the charging capacity of the battery three times according to Formula (2), and take the average value as the test result. Where.

Ece - rated charging capacity of the battery, in kilowatt-hours (kWh);

Ec - charging capacity of the battery recorded by the measuring instrument, in kilowatt-hours (kWh);

Wd - energy consumed by all support equipment during battery charging recorded by the measuring instrument, in kilowatt-hours (kWh).