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**General Specification for Mobile Energy Storage Power
Station**

移动式储能电站通用规范

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General Specification for Mobile Energy Storage Power Station

1 Scope

This document specifies the classification and architecture, service conditions, appearance and mechanical properties, basic functions, electrical properties, environmental protection and safety, main equipment, testing, operation and maintenance, as well as marking, transportation and storage requirements for mobile energy storage power stations.

This document is applicable to the design, manufacturing, testing, detection, operation, maintenance and overhaul of mobile energy storage power stations adopting electrochemical cells, super capacitors and flywheels as the electric energy storage media, and with voltage levels of 10 kV and below.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the normative references in the text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 1413 Series 1 Freight Containers - Classification, Dimensions and Ratings

GB/T 4208 Degrees of Protection Provided by Enclosure (IP code)

GB 4793.1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

GB/T 5338 Series 1 Freight Containers - Specification and Testing - Part 1: General Cargo Containers for General Purposes

GB/T 7251.1 Low-voltage Switchgear and Controlgear Assemblies - Part 1: General Rules

GB/T 12326 Power Quality - Voltage Fluctuation and Flicker

GB/T 13729 Remote Terminal Unit Equipment

GB/T 14549 Quality of Electric Energy Supply - Harmonics in Public Supply Network

GB/T 15543 Power Quality - Three-phase Voltage

GB/T 15945 Power Quality - Frequency Deviation for Power System

harmonic distortion rate of the AC side output voltage of the mobile energy storage power stations shall not exceed 3%.

8.8 Voltage Unbalance Degree

Under the conditions of three-phase unbalanced rated resistive load of the mobile energy storage power stations, the output voltage unbalance degree shall be less than 2% and shall not exceed 4% in the short term.

8.9 Dynamic Voltage Transient Range

Under the conditions of three-phase balanced resistive load, when the load suddenly rises from 20% to 100% or drops from 100% to 20%, the output voltage transient value of the mobile energy storage power stations shall be less than 10%.

9 Environmental Protection and Safety

9.1 Requirements for Environmental Protection

9.1.1 When the battery electrolyte in the mobile electrochemical energy storage power stations accidentally leaks, the leaked electrolyte shall be disposed of in time, and shall not be directly discharged; the leaked battery shall be recycled.

9.1.2 When the mobile energy storage power stations are operating at rated charging power or rated discharging power, the noise on both sides along the radial direction of the compartment and 1 m behind the compartment, and 1.6 m away from the ground shall not be greater than 70 dB; the noise on both sides along the radial direction of the compartment and 7 m behind the compartment, and 1.6 m away from the ground shall not be greater than 65 dB.

9.2 Safety Requirements

9.2.1 Fire extinguishing system

The fire extinguishing system shall satisfy the following requirements:

- a) The mobile energy storage unit shall be equipped with at least one Class E fire extinguisher, and the extinguishing medium filling quantity of each Class E fire extinguisher shall comply with the stipulations of GB 50370;
- b) The requirements for the automatic fire alarm system shall comply with the stipulations of GB 51048;
- c) The mobile energy storage unit should be equipped with an automatic fire extinguishing device.

9.2.2 Temperature rise

The temperature rise of the equipment in the mobile energy storage unit shall comply with the stipulations of GB/T 36545.

9.2.3 Grounding for lightning protection

The grounding design for lightning protection of the AC electrical equipment in the mobile energy storage power stations shall comply with the stipulations of GB/T 50065.

9.2.4 Insulation

The insulation design of the mobile energy storage power stations shall comply with the relevant stipulations of GB/T 50064.

10 Main Equipment

10.1 Mobile Platform

The mobile platform shall satisfy the following requirements:

- a) The dimension and rated mass of the compartment adopt the dimension and rated mass specified in GB/T 1413;
- b) The mass of the mobile energy storage power station does not exceed the load limit of the mobile platform;
- c) The structural strength of the compartment complies with the relevant stipulations of the design requirements in GB/T 5338.

10.2 Electric Energy Storage Equipment

10.2.1 Requirements for electrochemical cells

The electrochemical battery system shall satisfy the following requirements:

- a) When lithium-ion batteries, lead-carbon batteries, lead-acid batteries or all-vanadium redox flow batteries are selected for the battery system, they shall respectively comply with the stipulations of GB/T 36276, GB/T 36280, GB/T 36558 and GB/T 32509;
- b) For the hydrogen fuel cell system, the selection of proton exchange membrane fuel cells shall comply with the stipulations of GB/T 36544; the general safety of the proton exchange membrane fuel cell power supply system shall comply with the relevant stipulations of GB/T 27748.1 and GB/T 27748.3; the hydrogen supply system for proton exchange membrane fuel cells shall comply with the stipulations of GB/T 34872;
- c) The battery management system shall comply with the stipulations of GB/T 34131.

10.2.2 Requirements for super capacitors

10.4.2.2 Active power control

The monitoring system of the mobile energy storage power stations shall be able to automatically receive the active power control commands issued by the dispatching master station system, and reasonably allocate the active power output of the mobile energy storage unit, so as to satisfy the output control requirements of the power stations.

10.4.2.3 Reactive power control

The monitoring system of the mobile energy storage power stations shall be able to automatically receive the reactive power control commands issued by the dispatching master station system, and reasonably allocate the reactive power output of the mobile energy storage unit, so as to satisfy the output control requirements of the power stations.

10.4.2.4 Grid-connected / off-grid switching control

The monitoring system of the mobile energy storage power stations shall be able to control the power stations to switch from the grid-connected mode to the off-grid operation mode, and from the off-grid mode to the grid-connected operation mode.

10.4.3 Alarm

The alarm of the monitoring system shall satisfy the following requirements:

- a) The alarm information includes the name of the alarm point, alarm content, alarm time and confirmation status, which are arranged in chronological order. When an accident alarm is triggered, the screen and audible alarm can be forwarded;
- b) The monitoring system has the function of triggering alarms for status changes, measured value out-of-limit, calculated value out-of-limit and communication interruptions, etc.;
- c) The monitoring system has the function of querying the history of alarm information.

10.4.4 Human-machine interface

The human-machine interface of the monitoring system shall satisfy the following requirements:

- a) The human-machine interface display content of the monitoring system includes system topology diagram, network diagram, operating condition diagram and communication network diagram, etc. The graphical display may include the modes of trend chart, histogram and pie chart, etc.;
- b) The human-machine interface of the monitoring system supports multi-screen display, graphic multi-window, stepless zooming, roaming, drag and drop, hierarchical and graded display, etc.;
- c) The human-machine interface of the monitoring system has a graphic modeling tool

integrated with a graphic model library and a network topology management tool, supports user-defined equipment primitives and interval templates, and supports the copying of various primitives with model attributes.

10.4.5 Report form processing

The report form processing of the monitoring system shall satisfy the following requirements:

- a) The historical data of the monitoring system is stored for no less than 3 months;
- b) The monitoring system has the functions of selecting historical data and generating report forms in different formats and types in accordance with the demands;
- c) The report forms support file export and printing functions.

10.4.6 Self-diagnosis function

The monitoring system shall diagnose the operating conditions of each software and hardware online, and when abnormalities and failures are found, it shall be able to give an alarm and store in time. When various types of equipment with redundant configurations experience software or hardware failures, it shall be able to automatically switch to the standby equipment, and the switching process shall not affect the normal operation of the entire system.

10.5 Auxiliary System

10.5.1 Requirements for power distribution system

The design of power distribution inside the compartment shall comply with the stipulations of GB 50054.

10.5.2 Requirements for vehicle-mounted auxiliary equipment

The vehicle-mounted auxiliary equipment shall satisfy the following requirements:

- a) The mobile energy storage power stations should install an auxiliary support system on the chassis. The support system can carry the maximum total mass of the vehicle and realize manual or electronic control operation. Each support member can be individually adjusted;
- b) The temperature control equipment inside the compartment of the mobile energy storage power stations has manual and monitoring system remote control functions;
- c) The vehicle should be equipped with the necessary power cables and cable winches;
- d) AC and DC lighting systems are set up in the compartment, and there should be lift lighting and site lighting devices on the roof;
- e) When the distance between the compartment and the ground is greater than 600 mm, a boarding ladder is provided at the lower part of the compartment door.

11.3.1 Environmental conditions

11.3.1.1 Indoor test environment

Indoor tests shall be conducted under the following environmental conditions:

- a) Altitude: $\leq 2,000$ m;
- b) Temperature: $20\text{ }^{\circ}\text{C} \sim 30\text{ }^{\circ}\text{C}$;
- c) Relative humidity: $\leq 95\%$.

11.3.1.2 Outdoor test environment

Outdoor tests shall be conducted under the following environmental conditions:

- a) Altitude: $\leq 2,000$ m;
- b) Temperature: $-20\text{ }^{\circ}\text{C} \sim 40\text{ }^{\circ}\text{C}$;
- c) Rainfall: ≤ 8 mm/h;
- d) The longitudinal (front and back) horizontal inclination of the ground carrying the mobile energy storage power stations is not greater than 6° , and the transverse (left and right) horizontal inclination is not greater than 5° ;
- e) Relative humidity: $\leq 95\%$.

11.3.2 Electrical conditions

11.3.2.1 Grid power quality

The grid power quality of the power grid, to which, the mobile energy storage power stations are connected, shall comply with the stipulations of 5.2.

11.3.2.2 Electrical safety

The electrical safety of the test site shall comply with the stipulations of GB 4793.1.

11.4 Test Equipment

11.4.1 Test Instruments and meters

The accuracy levels of voltage and current measuring devices, thermometers, hygrometers, electric energy meters and data acquisition devices shall at least satisfy the requirements of Table 2. The test instruments and meters shall satisfy the following requirements:

- a) The voltage transformer complies with the stipulations of GB/T 20840.3;
- b) The current transformer complies with the stipulations of GB/T 20840.2;

- g) The rated power is not less than 1.2 times the rated power of the mobile energy storage power stations.

11.4.3 Simulated load

The simulated load shall at least satisfy the following requirements:

- a) The resistance value, inductance value and capacitance value are adjustable;
- b) The minimum current change step size generated by adjusting the load is not greater than 0.1 A;
- c) The allowable current at each voltage point is greater than the maximum current of the mobile energy storage power stations;
- d) It has non-linear load and impact load characteristics.

11.4.4 Temperature test equipment

The temperature test equipment shall satisfy the following requirements:

- a) In terms of the storage capacity, all the temperature data during the test can be stored;
- b) The number of channels can satisfy the demands of the temperature measurement points;
- c) The temperature measurement range of the temperature measurement channels at least satisfies $-40\text{ }^{\circ}\text{C} \sim 160\text{ }^{\circ}\text{C}$, and the temperature measurement accuracy is not lower than $0.5\text{ }^{\circ}\text{C}$;
- d) Each temperature measurement channel has a unified time reference signal;
- e) The sampling frequency is not lower than 1 Hz.

11.5 Appearance and Mechanical Properties Test

11.5.1 Appearance

Conduct visual inspection on the integrity of the appearance of the compartment.

11.5.2 Protection degree

The IP protection degree of the compartment shall be tested in accordance with the method specified in GB/T 4208.

11.5.3 Anti-vibration

The vibration test of the mobile energy storage power stations is carried out in accordance with the following driving or transportation conditions. After the driving test is completed, inspect

11.6.2.1 Passive grid-connected to off-grid switching time

The test of the passive grid-connected to off-grid switching time is carried out in accordance with the following steps:

- a) In accordance with Figure 3, connect the test circuit, set the mobile energy storage power station to work under the operating conditions of resistive and inductive load (power factor is 0.8), and the power is 100% of the rated power of the mobile energy storage power stations under test;
- b) Set the mobile energy storage power stations to work under the operating conditions of grid-connected rated power charging;
- c) After the mobile energy storage power stations stably operate, disconnect the grid-connection switch;
- d) Utilize the data acquisition device to measure and record the data and waveforms of the load voltage U_{load} and the grid-side voltage U_{ac} ;
- e) Measure the time interval from when the grid-connection switch is disconnected to when the discharge current I_{F} of the mobile energy storage power stations reaches 90% of the rated current;
- f) Respectively adjust the load power to 30% and 60% of the rated power of the mobile energy storage power stations under test, repeat steps b) ~ e), and record the test results;
- g) Set the mobile energy storage power stations to work under the operating conditions of rated power discharging, and repeat steps c) ~ f);
- h) Set the mobile energy storage power stations to work under the operating conditions of resistive and capacitive load (power factor is 0.8), and the power is 100% of the rated power of the mobile energy storage power stations under test; repeat steps b) ~ g).

11.6.2.2 Active grid-connected to off-grid switching time

The test of the active grid-connected to off-grid switching time is carried out in accordance with the following steps:

- a) In accordance with Figure 3, connect the test circuit, and disconnect the active grid-connection switch of the mobile energy storage power stations under test;
- b) Set the mobile energy storage power station to work under the operating conditions of resistive and inductive load (power factor is 0.8), and the power is 100% of the rated power of the mobile energy storage power stations under test;
- c) Set the mobile energy storage power stations to work under the operating conditions

of grid-connected rated power charging;

- d) After the mobile energy storage power stations stably operate, disconnect the grid-connection switch;
- e) Utilize the data acquisition device to measure and record the data and waveforms of the load voltage U_{load} and the grid-side voltage U_{ac} ;
- f) Measure the time interval from when the mobile energy storage power stations receive the off-grid command to when the discharge current I_{F} reaches 90% of the rated current;
- g) Respectively adjust the load power to 30% and 60% of the rated power of the mobile energy storage power stations under test, repeat steps b) ~ e), and record the test results;
- h) Set the mobile energy storage power stations to work under the operating conditions of rated power discharging, and repeat steps c) ~ g);
- i) Set the mobile energy storage power stations to work under the operating conditions of resistive and capacitive load (power factor is 0.8), and the power is 100% of the rated power of the mobile energy storage power stations under test; repeat steps b) ~ h).

11.6.3 Off-grid to grid-connected operation

The test of the off-grid to grid-connected operation is carried out in accordance with the following steps.

- a) In accordance with Figure 3, connect the test circuit, disconnect the active grid-connection and off-grid switch, and set the mobile energy storage power stations under test to the off-grid operation mode.
- b) Set the mobile energy storage power station to work under the operating conditions of resistive and inductive load (power factor is 0.8), and the power is 100% of the rated power of the mobile energy storage power stations under test.
- c) Set the mobile energy storage power stations to work under the operating conditions of grid-connected rated power discharging.
- d) After the mobile energy storage power stations stably operate, issue the active grid connection command.
- e) Utilize the data acquisition device to measure the output voltage waveforms and data of the mobile energy storage power stations.
- f) In accordance with Formula (1), calculate the dynamic transient value of the output voltage during active off-grid to grid-connected operation:

and consistent with the actual situation.

11.7.2 Temperature rise

The test of the temperature rise is carried out in accordance with the following steps:

- a) Utilize the temperature test equipment to respectively install at least one measurement point on each of the six surfaces inside the compartment, and respectively install at least three measurement points on the surface of the battery cabinet and the surface of the energy storage converter cabinet inside the compartment;
- b) When the mobile energy storage power stations are under the operating conditions of the rated power, and the surface and internal temperatures of the compartment do not change by more than 1 °C within 15 consecutive minutes, record the current temperature values of each measurement point.

11.7.3 Overload capacity

The test of the overload capacity is carried out in accordance with the following steps:

- a) In accordance with Figure 2, connect the test circuit;
- b) Set the AC port voltage of the mobile energy storage unit as the rated value;
- c) Control the power of the mobile energy storage unit to gradually increase to 110% of the rated power, and maintain stable operation at 110% of the rated power for 10 min;
- d) Control the power of the mobile energy storage unit to gradually decrease to the rated power, and maintain the stable operation at the rated power for 2 min;
- e) Control the power of the mobile energy storage unit to gradually increase to 120% of the rated power, and maintain stable operation at 120% of the rated power for 1 min;
- f) Record the AC port voltage and active power of the mobile energy storage unit during the testing.

11.7.4 Noise

The test of the noise is carried out in accordance with the following steps:

- a) As shown in Figure 4, the background noise value at the measurement point is less than 10 dB below the allowable value of the operating noise at this point; set the mobile energy storage power stations to operate in the rated power charging state;
- b) At 1.6 m from the ground, take A1, A2 and A3 shown in Figure 4 to measure the noise at 1 m, and take the average value;
- c) At 1.6 m from the ground, take B1, B2 and B3 shown in Figure 4 to measure the noise at 7 m, and take the average value;

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Linkin: <https://www.linkedin.com/in/waynezhengwenrui/>

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