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

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**Railway applications-Fixed installations-Energy utilization for
DC traction power supply-Part 1:Energy storage system**

轨道交通 地面装置 直流牵引供电能量利用 第1部分：储存系统

(English Translation)

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1 Scope

This Standard specifies environmental conditions, power supply conditions, system composition, technical requirements, inspection methods, inspection rules and so on of ground system for vehicle braking regenerative energy utilization of urban rail transit.

This Standard is applicable to ground system for vehicle braking regenerative energy utilization of urban rail transit (including feedback-type, storage-type and hybrid-type regenerative braking energy ground utilization system). Similar systems other than rail transit can be implemented by reference.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 1094.3-2003, Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air
 GB/T 1094.10-2003, Power transformers - Part 10: Determination of sound
 GB/T 1094.11-2007, Power transformers - Part 11: Dry-type transformers
 GB/T 2423.1-2008, Environmental testing - Part 2: Test methods - Tests A.

Cold

GB/T 2423.2-2008, Environmental testing - Part 2: Test methods - Tests B.

Dry heat

GB/T 2423.4-2008, Environmental testing for electric and electronic products - Part 2: Test method - Test Db. Damp heat, cyclic (12h+12h cycle) GB/T 2900.1-2008, Electrotechnical terminology - Fundamental terms GB/T 2900.33-2004, Electrotechnical terminology - Power electronics GB/T 2900.95-2015, Electrotechnical terminology - transformers, voltage regulators and reactors GB/T 3859.1-2013, Semiconductor converters - General requirements and line commutated converters - Part 1-1. Specification of basic requirements GB/T 4208-2017, Degrees of protection provided by enclosure (IP code) GB/T 10411-2005, D.C. traction power supply system for urban rail transit GB/T 12325, Power quality - Deviation of supply voltage GB/T 13422-2013, Semiconductor converters - Electrical test methods GB/T 14549-1993, 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 GB/T 18494.1-2014, Converter transformers - Part 1: Transformers for industrial applications GB/T 21413.1-2008, Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules GB/T 24338.6-2009, Railway applications - Electromagnetic compatibility -Part 5: Emission and immunity of fixed power supply installations and apparatus GB/T 25122.1-2010, Railway applications - Power convertors installed on board rolling stock - Part 1: Characteristics and test methods GB/T 32350.1-2015, Railway applications - Insulation coordination - Part 1.

Basic requirements - Clearances and creepage distances for all electrical and electronic equipment JB/T 501-2006, Test guide for power transformers IEC 61881-3:2013, Railway applications - Rolling stock equipment -Capacitors for power electronics - Part 3: Electric double-layer capacitors

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 2900.1-2008, GB/T 2900.95-2015, GB/T 2900.33-2004, GB/T 3859.1-2013, utilization system or dual quadrant converter. For storage-type regenerative braking energy ground utilization system, efficiency refers to the product of charging efficiency and discharging efficiency.

3.9 Energy storage module

Small energy storage unit composed of super capacitors in series and parallel.

3.10 Voltage balancing unit

Used with the module, it mainly completes the voltage equalization function of the super capacitor in the module.

3.11 Control unit of capacitor management system (CMS)

The control and management unit of the energy storage power supply, which mainly completes the control of the voltage equalization unit and external communication functions and so on.

3.12 Energy storage unit

Energy storage component that is composed of CMS control unit and energy storage modules in series and parallel.

3.13 Ripple voltage (on the d.c. side)

The AC voltage component in the DC side voltage of the regenerative braking energy ground utilization system for rectifying operation or releasing electric energy.

4.1 Temperature

The ambient temperature is -10°C~40°C.

The storage and transportation temperature is -25°C~55°C.

4.2 Altitude

The altitude is not higher than 2500m.

4.3 Relative humidity

Daily average value is not more than 95%. Monthly average value is not more than 90% (25°C). Condensation occurs.

system, protection system and so on shall be DC 220V or DC 110V power supply. The auxiliary power required for anti-condensation heating and lighting shall be AC 220V power supply. The auxiliary power supply required by the cooling fan (if any) shall be AC 380V power supply. AC220V power supply shall be used for the auxiliary power supply voltage level required by the transformer thermostat.

6.1 Overview

The ground system for vehicle braking regenerative energy utilization of urban rail transit is divided into.

- feedback-type ground system for vehicle braking regenerative energy utilization;
- storage-type ground system for vehicle braking regenerative energy utilization;
- hybrid-type ground system for vehicle braking regenerative energy utilization.

6.2 Feedback-type ground system for vehicle braking regenerative energy

utilization

The feedback-type ground system for vehicle braking regenerative energy utilization is composed of energy-fed transformer, AC (low voltage) circuit breaker, double quadrant converter, DC isolating switch, DC reactor, measurement and control system and so on. The typical topological structure of the main circuit is shown in Figure 1.

The energy-fed transformer completes the electrical isolation between the double-quadrant converter and the AC grid and the functions of step-up and step-down. AC (low-voltage) circuit breaker realizes protection and isolation between the double-quadrant converter and the energy-fed transformer. The dual-quadrant converter realizes the conversion function of electric energy from AC to DC or from DC to AC. The DC isolating switch realizes the isolation of the double-quadrant converter and the DC negative bus. The DC reactor completes the filtering and current limiting functions with the DC bus. The measurement and control system complete the measurement, protection and control of the entire system.

7.1.1 Energy recovery function

The ground system for vehicle braking regenerative energy utilization shall be able to recover the braking energy generated during regenerative braking of the train to the AC grid or energy storage unit.

7.1.2 Stable DC network voltage function

Within its power range, the ground system for vehicle braking regenerative energy utilization shall be able to stabilize the DC bus voltage at a preset value.

7.1.3 Rectification function

The feedback-type ground system for vehicle braking regenerative energy utilization shall be able to convert AC grid power into DC power for train traction.

NOTE: The rectification function of the feedback-type ground system for vehicle braking regenerative energy utilization is a special requirement. If necessary, it shall be negotiated by both parties.

7.1.4 Communication function

The measurement and control device of the ground system for vehicle braking regenerative energy utilization shall adopt a standard data communication interface. The data communication protocol adopts a good versatility and open protocol.

Example 1. The physical interface is RS485 interface, and the communication protocol is Modbus_RTU.