

ICS 29.180  
CCS K 41

**DL**

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

**DL/T 2043-2019**

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**Technical specification for 1100kV UHVDC converter  
transformers**

**(English Translation)**

**Issued on: June 4, 2019**

**Implemented on: October 1, 2019**

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**Issued by: National Energy Administration**

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### Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1-2009 "Guidelines for Standardization Work Part 1: Standard Structure and Compilation".

This standard was proposed by the China Electricity Council.

This standard is under the jurisdiction of the High Voltage Direct Current Transmission Technology Standardization Technical Committee of the Power Industry.

Drafting organization of this standard. State Grid Economic and Technical Research Institute Co., Ltd.

### 1 Scope

This standard specifies the operating conditions, rated values and performance requirements, basic requirements for converter transformers used in  $\pm 1100\text{kV}$  UHV DC transmission systems.

Parameters, component requirements, other requirements and technical conditions for testing.

This standard is applicable to single-phase dual-winding converter transformers for DC transmission systems with dual 12-pulse converters in series.

## 2 Normative references

The following documents are indispensable for the application of this document. For dated reference documents, only the dated version applies to this document.

For undated references, the latest version (including all amendments) applies to this document.

GB 1094.1 Power Transformer Part 1: General Rules GB 1094.2 Power Transformer Part 2: Temperature rise of liquid immersed transformer GB/T 1094.3-2017 Power Transformer Part 3: Insulation Level, Insulation Test and External Insulation Air Gap GB/T 1094.4 Power Transformer Part 4: Lightning Impulse and Operation Impulse Test Guide for Power Transformer and Reactor GB 1094.5 Power Transformer Part 5: Ability to withstand short circuit GB/T 1094.7 Power Transformer Part 7: Load Guidelines for Oil-immersed Power Transformer GB/T 1094.10 Power Transformer Part 10: Sound Level Measurement GB 2536 Unused mineral insulating oil for electrical fluid transformers and switches GB/T 2900.33 Electrical Engineering Terminology Power Electronic Technology GB/T 4109 Insulating bushings with AC voltage higher than 1000V GB/T 5273 Standardization of terminal size for high voltage electrical appliances GB/T 7354 Partial discharge measurement GB 10230.1 Tap Changer Part 1: Performance Requirements and Test Methods GB/T 13498 Terminology for High Voltage Direct Current Transmission GB/T 16927.1 High Voltage Test Technology Part 1: General Definition and Test Requirements GB 50150 Electrical equipment installation engineering electrical equipment handover test standard DL/T 596 Preventive test procedures for electrical equipment

## 3 Terms and definitions

The terms and definitions defined in GB/T 2900.33 and GB/T 13498 apply to this standard.

## 4 Symbols

The following symbols apply to this document.

f<sub>1</sub>. Rated frequency, namely the fundamental frequency f<sub>x</sub>. frequency used to determine the distribution of eddy current loss f<sub>h</sub>. frequency of h harmonic FSE. additional coefficient of stray loss in structural parts FWE. additional coefficient of winding eddy current loss h. harmonic order I<sub>1</sub>. Rated current I<sub>x</sub>. Load loss test current at frequency f<sub>x</sub> I<sub>LN</sub>. The root mean square value of the load current when the winding under consideration is running I<sub>h</sub>. h harmonic current I<sub>eq</sub>. The root mean square value of the sinusoidal current equivalent to the load loss of the winding in operation I<sub>12R</sub>. Resistance loss under rated current k<sub>h</sub>. the ratio of current I<sub>h</sub> to rated current I<sub>1</sub> N. The number of six-pulse bridges connected in series from the neutral point of the DC line to the rectifier bridge connected to the transformer P<sub>1</sub>. Total load loss under fundamental frequency (50Hz) P<sub>N</sub>. total operating load loss P<sub>x</sub>.

Load loss measured at frequency  $f_x$  PSE1. Stray loss in structural parts (excluding windings) at the fundamental frequency PWE1. Winding eddy current loss at fundamental frequency R. DC resistance of windings including internal leads SR. Rated capacity U1. Rated voltage Uac. Externally applied AC test voltage of the valve side winding (root mean square value) Udm. the highest DC voltage of each valve bridge Udc. applied DC test voltage of the valve side winding Um. the highest system voltage of the grid side winding Upr. Polarity reversal test voltage of valve side winding (DC voltage) Uvm. the maximum phase-to-phase AC working voltage of the valve side winding of the converter transformer Note. "Valve side" and "Grid side" indicate the external wiring of the converter transformer windings. The grid-side winding refers to the winding connected to the AC grid, while the valve-side winding refers to the winding Connect to the winding of the converter valve or converter.

## 5.1 General provisions

The converter transformer in this standard should meet the conditions of use specified in GB 1094.1, but it is obviously not applicable to converter transformers or Unless otherwise specified in this standard. Unless otherwise stated, it is assumed that the converter transformer is operated in an approximately symmetrical three-phase system.

## 5.2 Altitude

The altitude should not exceed 1000m, and should be corrected in accordance with the relevant requirements in GB 1094.1 when it exceeds.

## 5.3 Ambient temperature

The ambient temperature of the transformer should meet the following requirements.

- a) Maximum temperature. +40°C;
- b) Average temperature of the hottest month. +30°C;
- c) The highest annual average temperature. +20°C;
- d) Minimum temperature. -45°C (applicable to outdoor converter transformers).

## 5.4 Ice thickness

The transformer should be able to be used at a height of 10m from the ground under the condition of ice thickness that is once in 50 years.

## 5.5 Wind speed

The transformer should be able to be used at a height of 10m above the ground and an average wind speed of 10min.

## 5.6 Sunlight intensity

The transformer should be able to be used under the sunshine intensity condition when the wind speed is 0.5m/s.

## 5.7 Installation environment

The installation environment of the transformer should meet the following conditions.

- a) Pollution level. d and below;
- b) Ground acceleration caused by the earthquake. the horizontal direction is less than  $3\text{m/s}^2$ ; the vertical direction is less than  $2\text{m/s}^2$ .

## 5.8 System conditions

The system conditions should meet the following requirements.

- a) The waveform of the grid-side power supply voltage is similar to a sine wave. At the same time, the total harmonic content in the distorted waveform is not more than 5%, and even harmonics contain the amount is not more than 1%.
- b) Refer to Appendix A for the recommended values of system conditions.

## 5.9 Special conditions of use

### 5.9.1

Special conditions of use other than the specified normal conditions of use shall be stated in the inquiry and ordering (see GB 1094.1).

### 5.9.2

Under special conditions of use, the rated value and test rules of the converter transformer are specified as follows.

- a) The temperature rise in higher ambient temperature or high altitude environment should refer to the corresponding regulations of GB 1094.2;
- b) External insulation in high altitude environments should refer to the corresponding regulations in GB/T 1094.3.

## 5.10 Load current

The current flowing through the converter transformer contains fundamental wave, harmonic and DC bias current. The converter transformer should be able to provide the harmonic components and direct Use under the condition of the magnitude of the bias current.