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**Unified power flow controller -- Part 1: function specifications  
(English Translation)**

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### Foreword

Then drafted.

As the grid load level continues to increase, in order to solve the problem of flexible power flow control, the unified power flow controller (UPFC) will be installed in the power grid.

- Part 1: Functional Specification
- Part 2: System Design Guidelines
- Part 3: Technical specifications for control and protection systems
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- Part 9: Handover Test Procedure
- Part 10: System Test Procedure
- Part 11: Dispatch operation procedures
- Part 12: Equipment maintenance test procedures Supplements or extensions.

Please note that certain contents of this document may involve patents. The issuing agency

of this document is not responsible for identifying these patents.

Appendix A of this standard is an informative appendix.

This part was proposed by the China Electricity Council.

This part is under the jurisdiction of the Power Quality and Flexible Transmission Standardization Technical Committee (DL/T C 40) of the power industry.

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## 1 Scope

This part specifies the system composition, functions, complete system performance, coordination of components and subsystems of the unified power flow controller (UPFC), Test verification and other requirements.

This section applies to the UPFC used in the 220kV and above voltage level power grid, and the UPFC of other voltage levels can be implemented by reference.

## 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 311.1 Insulation coordination Part 1: Definitions, principles and rules GB 1094.1-2013 Power Transformer Part 1: General Rules GB 1094.5 Power Transformer Part 5: Ability to withstand short circuit GB/T 3222.2 Acoustics. Description, measurement and evaluation of environmental noise. Part 2: Determination of environmental noise level GB/T 4824 Industrial, scientific and medical (ISM) radio frequency equipment electromagnetic disturbance characteristic limit and measurement method GB/T 12325 Power quality supply voltage deviation GB/T 12326 Power quality voltage fluctuation and flicker GB/T 13498 Terminology for HVDC Transmission GB/T 14549 Power quality public grid harmonics GB/T 15543 Power quality three-phase voltage unbalance Determination of losses in GB/T 20989

HVDC converter station GB/T 22390.1 High voltage direct current transmission system control and protection equipment Part 1: Operator control system GB/T 24337 Power Quality Interharmonics in Public Grid GB/T 26216.1 DC current measuring device for high voltage direct current transmission system Part 1: Electronic DC transformer GB/T 26217 DC voltage measuring device for high voltage DC transmission system GB/T 30425 High voltage direct current transmission converter valve water cooling equipment GB/T 30553-2014 HVDC transmission based on voltage source converter GB/T 35702.1 Voltage source converter valve loss for high voltage direct current system Part 1: General requirements GB/T 35702.2 Voltage source converter valve loss for high voltage direct current system Part 2: Modular multilevel converter GB 50062 Design specification for relay protection and automatic device of power installation GB 50064 Design Code for Overvoltage Protection and Insulation Coordination of AC Electrical Equipment GB 50150 Electrical equipment installation engineering electrical equipment handover test standard DL/T 272 220kV~750kV oil-immersed power transformer technical conditions DL/T 837 Reliability Evaluation Regulations for Transmission and Distribution Facilities DL/T 995 Inspection Regulations for Relay Protection and Power Grid Security Automatic Devices DL/T 1129 DC converter station secondary electrical equipment handover test procedures DL/T 1193-2012 Flexible transmission terms

### 3 Terms and definitions

The following terms and definitions defined in GB/T 13498 and GB/T 30553-2014 apply to this document.

**Unified power flow controller UPFC** Connect two (or more) voltage source converters sharing the DC bus into the power transmission system in parallel and in series, and adjust A device that saves the equivalent impedance, voltage amplitude and phase angle of the line to realize power flow control.

**Static synchronous compensator STATCOM** A kind of voltage source converter which is connected in parallel to the system. Its output capacitive or inductive reactive current is continuously adjustable and can be used in the system.

**Reactive power compensation device** in the voltage range that has nothing to do with the system voltage.

[DL/T 1193-2012, definition 4.1.2] **3.3 Static synchronous series compensator SSSC** A device that connects a voltage source converter in series with a transmission line to continuously and quickly control the equivalent impedance of the line.

[DL/T 1193-2012, definition 4.1.5] **3.4 Converter** an electrical device capable of realizing a complete commutation function.

[DL/T 1193-2012, definition 3.3.4] **3.5 Voltage source converter VSC** the commutation function is realized by a switchable device, and the DC side energy storage element is a

capacitor converter.

[DL/T 1193-2012, definition 3.3.8] 3.6 Modular multilevel converter MMC each VSC valve is a multi-level converter composed of a certain number of independent single-phase voltage source converters in series.

[GB/T 30553-2014, definition 3.4.7] 3.7 Converter arm A part of the converter circuit, connected between the AC and DC terminals, has unidirectional or bidirectional conductivity.

[DL/T 1193-2012, definition 3.3.5] 3.8 Power unit it is a basic functional unit packaged by a combination of power and electronic devices and corresponding diodes, auxiliary equipment, control circuits, etc. according to a certain function.

Modular multilevel converter type unified power flow controller MMC based UPFC  
MMC-UPFC A unified power flow controller with modular multilevel converters.

### 3.10

Connection transformer (interface transformer) A transformer that is connected between the voltage source converter and the AC power grid and transmits electrical energy between the voltage source converter and the AC power grid. In UPFC , Including parallel transformers and series transformers.

### 3.11

Shunt transformer

A transformer with two or more windings connected in parallel to the AC grid for operation.

### 3.12

Series transformer

A transformer with a series winding connected in series with the line to change the line voltage value and (or) phase and an excitation winding.

[GB 1094.1-2013, definition 3.1.3] Note. When applied in UPFC, the grid side winding of the series transformer is a series winding, and the valve side winding is an excitation winding.

### 3.13

Valve side winding

Winding directly connected to the inverter.

### 3.14

Grid side winding

Winding directly connected to the grid.