

ICS 29.240.01
CCS F 23

DL

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

DL/T 1795-2017

**Code of operation for VSC-HVDC substation
(English Translation)**

Issued on: December 27, 2017

Implemented on: June 1, 2018

Issued by: National Energy Administration

Table of Contents

Foreword...	3
1 Scope...	4
2 Normative references...	4
3 Terms and definitions...	4
4 Operating mode and DC system state...	5
5 Operating regulations...	7
6 Equipment inspection...	19
7 Equipment malfunctions and troubleshooting...	31
Annex A (informative) Converter operation mode...	41
Annex B (informative) Main equipment parameters...	43
Annex C (informative) List of drawings...	50

1 Scope

This Standard specifies the general requirements and methods for the operation, maintenance, and handling of abnormalities and faults of VSC-HVDC substation equipment.

This Standard applies to VSC-HVDC substations with bipolar and symmetrical unipolar main circuit topologies. On-site operating procedures for substations can be formulated based on this Standard.

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 30553-2014, High-voltage direct current power transmission using voltage sourced converters

DL/T 572, Power transformer operation specification

DL/T 664, Application rules of infrared diagnosis for live electrical equipment

DL/T 724, Specification of operation and maintenance of battery DC power supply equipment for electric power system

DL/T 969-2005, Guideline of substation Operation

DL/T 1193-2012, Terminology for Flexible Power Transmission

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 30553-2014, DL/T 1193-2012 as well as the followings apply.

3.1

interconnection mode of operation

An operation mode of which the AC side of the VSC-HVDC substation is connected to the active AC power grid, while the DC side is connected to other substations.

3.2

island mode of operation

An operation mode of which the AC side of the VSC-HVDC substation is connected to an isolated load or an isolated power plant, while the DC side is connected to other substations.

3.3 STATCOM mode of operation

An operation mode of which the AC side of the VSC-HVDC substation is connected to the AC power grid, while the DC side is electrically disconnected from other substations.

3.4 symmetrical monopolar mode of operation

An operation mode of which the DC circuit potential of the substation is clamped by AC side neutral point equipment or other equipment; the DC voltage output on the two terminals is symmetrical for a single VSC converter. See Annex A.

3.5 asymmetrical monopolar mode of operation

An operation mode of which the DC voltage output from the two terminals is asymmetrical for a single VSC converter, typically with one terminal grounded. See Annex A.

3.6 bipolar mode of operation

An operation mode of which two or more VSC asymmetric unipolar circuits form a bipolar DC circuit. See Annex A.

4.1 Operating mode

Based on the connection method between the substation and the AC/DC system, the operating modes are classified as follows.

- a) interconnection mode of operation;
- b) DC island mode of operation;
- c) Static synchronous compensator (STATCOM) operating mode.

According to the DC side wiring configuration of the substation, the operating modes include.

- a) symmetrical monopolar mode of operation;
- b) asymmetrical monopolar mode of operation;
- c) earth return line mode of operation;
- d) metal loop mode of operation.

4.2.1 Maintenance state

The maintenance state of DC systems includes the following types.

- a) Transformer maintenance. the transformer is under maintenance, the relevant grounding switch is closed (or the grounding wire is connected), and safety measures are in place.
- b) Maintenance of converter valves, etc.. the starting resistor, grounding equipment, and converter valves are under maintenance; the metal return line changeover switch and disconnecter, the earth return line changeover switch and disconnecter, the DC pole (busbar) disconnecter, the neutral line circuit breaker and disconnecter are in the open state; the relevant grounding switch is in the closed state (or the grounding wire is connected), and safety measures are in place.
- c) DC line maintenance. the DC pole (busbar) disconnecter is in the open state, the pole line side grounding switch is in the closed state (or the grounding wire is connected), and safety measures are in place.
- d) Grounding electrode line and grounding electrode maintenance. the circuit breaker and disconnecting switch of the grounding electrode line are in the open state, the grounding knife switch of the grounding electrode line is in the closed state (or the grounding wire is connected), and safety measures are in place.

4.2.2 Cold standby state

The cold standby state of a DC system includes the following types.

- a) Converter cold standby. the AC incoming disconnect switch of the converter is in the open state; the metallic return disconnect switch, the earth return disconnect switch, the DC pole (busbar) disconnect switch, and the neutral circuit breaker are in the open state; the relevant grounding switch is in the open state; and the safety measures are removed.

b) DC line cold standby. the isolating switches of the DC poles (busbars) of the two substations are in the open state, the grounding switch on the pole line side is in the open state, and the safety measures are removed.

4.2.3 Polar isolation state

The DC field equipment is isolated from the DC line (including the grounding electrode line). The DC electrode (busbar) disconnecting switch, neutral line circuit breaker, metallic return line disconnecting switch, and earth return line disconnecting switch are in the open state.

4.2.4 Polar connection state

The DC pole (busbar) disconnecter, neutral line circuit breaker, metallic return disconnecter, and earth return disconnecter are in the closed state.

4.2.5 Earth return line connection state

DC equipment is connected using the earth return line method.

4.2.6 Metal return line connection state

DC equipment is connected using the metal return line method.

4.2.7 Converter valve charging state

The converter valve is in a locked state, charging from either the DC or AC side.

4.2.8 Converter valve operating state

The converter valve is unlocked and put into operation.

5.1.1.1 Personnel requirements

Operators must undergo job training and pass an examination before being allowed to work. They shall be familiar with the performance of primary equipment, secondary equipment, DC equipment, station power systems, auxiliary equipment, anti-mis- operation interlocking devices, fire protection equipment, and other equipment in the

VSC-HVDC substation (see Annex B for main equipment parameters), as well as the related lines and systems. They shall be proficient in using the system diagrams for primary, secondary, and auxiliary systems (see Annex C). They shall understand the jurisdiction of dispatching at all levels, dispatching terminology, and dispatching instructions.