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PEOPLE'S REPUBLIC OF CHINA**

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**Technical guide of HVDC earth electrode system
(English Translation)**

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1 Scope

This Standard specifies the terminology terms and definitions of HVDC earth electrode system, and proposes technical conditions, test items and methods, and general technical principles of operation and maintenance.

This Standard applies to the earth electrode system at both ends of the monopolar and bipolar HVDC transmission system; it does not apply to the converter grounding grid.

2 Normative references

The following documents are indispensable for the application of this document.

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

GB/T 17949.1, Guide for measuring earth resistivity, ground impedance and earth surface potentials of a ground system - Part 1. Normal measurements

GB/T 13498, Terminology for high-voltage direct current (HVDC) transmission

DL/T 5224, Technical Rule for the Design of HVDC Earth Return Operation

System

DL/T 475, Guide for measurement of grounding connection parameters

3 Terms and definitions

Except for the terms which are specified in this Chapter, the rest shall be in compliance with the relevant provisions of national and industry standards.

3.1

HVDC earth electrode system

The general term for a group of devices that are specially designed and constructed to operate with earth or sea water as a current loop during normal operation or failure, in the high-voltage direct current transmission system. It is mainly composed of an electrode line, an earth electrode feeder line and an earth electrode.

When the earth electrode is in operation, if a person stands on the ground near the earth electrode and touches an earth conductor that is connected from a remote place, or if a person stands on the distant ground and touches an earth conductor that is drawn from a place near the electrode site grounding, the touch potential it bears is the transfer potential. The maximum value of the transfer potential is the earthing electrode potential rise.

4.1 General technical guidelines

4.1.1

The design of the DC earth electrode shall consider the three working conditions of rated current under monopolar mode, maximum overload current and maximum transient overcurrents.

4.1.2

The design life of the DC earth electrode shall generally be no less than 30 years under the specified operation mode.

4.1.3

The DC earth electrode is generally composed of 2 or more separated components.

4.1.4

In order to prevent the earth current of the HVDC earth electrode system from corroding and interfering with the converter station, the straight-line distance between the earth electrode and the converter station in the HVDC transmission system should not be less than 10 km; it shall be ensured that the grounding grid of the converter station is completely separated from the earth electrode.

4.1.5

The DC earth electrode generally has ring, star, linear, ray, grid shapes, which should be confirmed according to the conditions of the electrode site topography, geology, hydrology, traffic conditions, from the two aspects of convenient construction and reasonable technology and economy.

4.1.6

The buried depth of the DC earth electrode shall be determined, according to the requirements for step potential in this Standard, by comprehensive techno-economic comparison in combination with the soil climate characteristics of the electrode site, the engineering excavation and the external force factors; it is generally not less than 1.5 m.

4.1.7

The earth electrode design shall consider the changes of the groundwater level; water injection devices shall be installed when necessary.

4.2 Electrode site selection

4.2.1

The DC earth electrode site should generally be far away from densely populated cities and towns, and areas with more public facilities underground.

4.2.2

Geological and hydrological surveys must be carried out within 20 km of the pre-selected electrode site. The content of the survey at least includes.

- a) Geological structure and thickness of each layer. The depth from the ground to the bedrock, the thickness of the bedrock.
- b) Seawater erosion conditions, detailed geological map of pre-selected electrode sites with contours (land electrodes) or isobaths (ocean electrodes).
- c) Surveys shall be conducted when the survey data is incomplete.

4.2.3

Before designing the DC earth electrode, it is necessary to evaluate the influence of the earth electrode on the surrounding environment. Therefore, it is necessary to investigate the existing and planned transmission lines and important facilities around the electrode site. For the assessment of environmental impact, refer to the relevant standards and regulations for preventing corrosion of metal structures.

4.2.4

The selection of the DC earth electrode site shall consider the impact on the surrounding environment. In principle, there should be no underground metal pipelines, railways or effective grounding transmission and transformation facilities within 10 km of the pre-selected electrode site.

4.2.5

The electrode site selection of the DC earth electrode should be determined by the technical and economic comparison of no less than 3 different schemes.

4.3.1 Groundwater level

The groundwater level of the electrode site can be obtained through hydrogeological maps or on-site detection.

4.3.2 Earth resistivity

4.3.2.1

The earth resistivity of the electrode site is generally measured by injecting current on the spot.

4.3.2.2

The earth injection current that is used to measure the earth resistivity on site shall be a direct current.

4.3.2.3

The test method can be any traditional earth resistivity test method, such as Wenner quadrupole method, Schlumberger-Palmer method, or the unequal-distance quadrupole method (see Appendix A).

5.1 General principles

5.1.1

The purpose of testing the HVDC earth electrode system is.

- a) The various parameters of the earth electrode shall meet the design standards.
- b) Whether the step potential, touch potential and transfer potential, which are caused by the HVDC earth electrode system under the maximum operating voltage, meet the requirements of the guidelines.
- c) Understand the interference and influence of the HVDC earth electrode system on the public utility system (such as water supply, electricity, gas, fishery administration) in the surrounding area; measure, if necessary, so as to check whether it meets the design requirements.

5.1.2

The earth electrode shall complete the acceptance test before system debugging.

5.1.3

The time sequence of the test items specified in this Standard can be carried out at the same time or in crossover if there is no special description.