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Limits and monitoring methods of total electric field of DC transmission project

直流输电工程合成电场限值及其监测方法

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1 Scope of application

This Standard specifies the limits and monitoring methods of total electric field of DC transmission project.

This Standard is applicable to the monitoring, evaluation and management of total electric field of DC transmission project.

2 Normative references

The content of this Standard refers to the provisions in the following documents. For undated reference documents, the effective edition is applicable to this Standard.

HJ 24 Technical guidelines for environmental impact assessment of electric power transmission and distribution project

3 Terms and definitions

The following terms and definitions apply to this Standard.

3.1 DC transmission project

The project which transfers direct current from a power supply location to a power demand location. DC transmission project includes DC transmission lines, converter stations and grounding electrode systems.

3.2 Total electric field

The combined electric field OF the electric field generated by the charge on the DC charged conductor AND the electric field generated by the space charge caused by the conductor corona. The physical quantity, which measures the intensity of the total electric field, is the electric field intensity. Its unit is volts per meter (V/m); kilovolts per meter (kV/m) is commonly used in engineering.

3.3 Percentile level of total electric field (E_n)

SORT the continuous measurement data (equal time interval sampling values) of the total electric field at the monitoring point according to the absolute value

from small to large. The n% data is called the percentile level of total electric field, E_n. Its meaning is that, the absolute value of n% of the measured data during the measurement period is less than or equal to E_n. For example, E_{95} and E_{80} respectively indicate that, the absolute value of the measured data within 95% and 80% of the measurement period is less than or equal to E_{95} and E_{80}.

4 Limits

In order to control the public exposure caused by total electric field, the limit of total electric field intensity E_{95} in the environment is 25kV/m; the limit of E_{80} is 15kV/m.

For places such as farmland, garden plots, pastures, livestock and poultry breeding grounds, breeding water surfaces, and roads under the DC overhead transmission line, the limit of the total electric field intensity E_{95} is 30kV/m. Warning and protection signs shall also be given.

5 Monitoring technical requirements

5.1 Monitoring instrument

The monitoring instrument of the total electric field shall be able to measure the size and polarity of the total electric field at the same time; and, have the function of automatic continuous measurement and recording.

The field mill is generally used to monitor the total electric field. The field mill shall use a square metal plate with an area of 1 m×1 m and good conductivity as the ground reference plane. It must be grounded reliably.

The field mill shall be within the validity period of calibration. See Appendix A for its calibration method.

5.2 Environmental conditions

The monitoring of the total electric field shall be carried out under the weather with wind speed (2m above the ground) less than 2m/s, no rain, no fog, and no snow.

5.3 Monitoring method and frequency

The monitoring point shall be selected at a place where the terrain is flat and there is no obstruction. The field mill shall be placed directly on the ground. The distance between the upper surface and the ground shall be less than 200mm. PLACE a square metal plate with an area of 1 m×1 m and good conductivity on

the wall of the converter station; is arranged in a direction perpendicular to the wall. The distance between two adjacent monitoring points may be 5m. Generally, monitor to a distance of 50m from the wall.

5.4.3 Building

When monitoring outside the building, the total electric field monitoring point shall be arranged on the side of the building close to the DC transmission project; and not less than 1m away from the building.

When monitoring on the balcony of the building or the platform used for living, working or studying, the points shall be arranged in an area not less than 1m away from walls or other fixed objects (such as guardrails). However, the points should not be arranged in a location, which needs to be reached with the help of tools (such as ladders) or by special methods (such as climbing).

5.5 Data recording and processing

5.5.1 Data recording

During monitoring, it shall record meteorological conditions such as wind speed, wind direction, temperature, relative humidity, air pressure, and weather conditions during the monitoring period. In addition to recording the monitoring data of each monitoring point, it shall record the specific location of the monitoring point and the start and end time of each monitoring.

When monitoring DC overhead transmission lines, it shall also record the line parameters of the pole wire at the monitoring point or monitoring path, such as wire height, distance between poles, wire type, operating voltage, operating current, tower number, line direction, number of circuits on the same pole and line arrangement. When monitoring the converter station, it shall also record the operation mode of the converter station, converter valve power, DC voltage, etc.

For each monitoring point, it shall monitor for at least 30min; sample at equal intervals during the monitoring period; record at least 100 data.

5.5.2 Data processing

In the continuous monitoring of the total electric field, the monitoring data is highly dispersed. The cumulative probability method shall be used for data processing.

6 Quality assurance

The monitoring organization shall have the capabilities and conditions suitable

Appendix A

(Normative)

Calibration method of field mill

A.1 Overview

Since the DC total electric field cannot be coupled with the plates like the AC electric field, the monitoring of the DC total electric field requires a special sensor; to make the electric flux received on the sensing element periodically change; and the corresponding induced charge also changes periodically. By using the current formed by the periodically changing induced charge, the corresponding field intensity can be measured. The electric field tester must not only be able to accurately monitor the DC total electric field, but also be able to introduce excess adsorbed ions into the ground without affecting the reading. At present, the sensor of the commonly-used monitoring instrument is the field mill sensor.

The total electric field of the bipolar DC transmission line not only changes in size, but also changes in its polarity due to the existence and drift of space ions. Therefore, the monitoring instrument can not only measure the size of the total electric field, but also determine the polarity of the total electric field.

A.2 Working principle of field mill sensor

The structure of the field mill sensor is shown in Figure A.1. The probe is composed of two coaxially-installed circular sectors. The upper sector is driven by a motor to rotate with the shaft. The lower sector is fixed.

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