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

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**Specifications of solar energy resource assessment for solar
thermal electric plant**

光热电站太阳能资源评估规范

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1 Scope

This document specifies the content, the methods, the requirements and the verification methods for the assessment of solar energy resources for solar thermal electric plants.

This document applies to the solar energy resource assessment carried out for the planning, the design and the post-construction evaluation of solar thermal electric plants.

2 Normative references

The contents of the following documents constitute indispensable provisions of this document through normative reference in the text. For dated references, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies to this document.

GB/T 31155-2014 Classification of solar energy resource - Global radiation; GB/T 33677-2017 Classification of solar energy resource - Direct radiation; GB/T 33698-2017 Measurement of solar energy resource - Direct radiation; GB/T 34325-2017 Method for evaluating the accuracy of solar energy resource data; GB/T 37525-2019 Guidelines for the calculation of direct solar radiation; GB/T 37526-2019 Assessment method for solar energy resource; GB/T 40099-2021 Solar thermal electric plants - Method for generating the representative-year solar radiation data set; GB/T 42477-2023 Technical specification for meteorological observation at photovoltaic power stations and for the checking and correction of the data; QX/T 436-2018 Specifications for climatic feasibility demonstration -

Calculation of wind resistance parameters.

3 Terms and definitions

The following terms and definitions apply to this document.

Direct normal radiation: the direct radiation received on a plane perpendicular to the solar rays. [SOURCE: GB/T 31163-2014, 5.12]

Direct horizontal radiation: the direct radiation received on a horizontal plane. [SOURCE: GB/T 31163-2014, 5.13]

Global horizontal radiation: the sum of the direct radiation and the diffuse radiation received by a horizontal plane from the two pi solid angle (hemisphere) above it. [SOURCE: GB/T 31163-2014, 5.15]

Representative meteorological year, also termed typical meteorological year: the year that, under actual atmospheric conditions, represents the average state of the solar energy resource for a solar thermal power project.

Typical meteorological day, also termed representative day: under ideal atmospheric conditions, the day whose direct normal irradiation is closest to the average daily irradiation of the month in which it falls.

4 Content of the assessment

The solar energy resource assessment for a solar thermal electric plant shall cover the following three aspects.

Assessment of the solar energy resource on the horizontal plane: the calculation, analysis and evaluation of the solar radiation reaching the horizontal plane.

Assessment of the solar energy resource usable for solar thermal power generation: the calculation, analysis and evaluation of the direct normal radiation reaching the ground.

Analysis and assessment of high-impact meteorological factors: the quantitative or qualitative analysis and evaluation of the meteorological factors that have a large influence on the construction and operation of the solar thermal electric plant.

5 Requirements for the assessment of solar energy resources on the horizontal plane

Data requirements. In accordance with the requirements of Clause 5 of GB/T 37526-2019, monthly and annual data of global horizontal radiation and direct horizontal radiation covering the most recent 10 years or more, and representing the long-term variation of the horizontal-plane solar energy resource at the site of the solar thermal power project, shall

be collected and obtained.

Requirements on the content of the assessment. In accordance with the indices and thresholds of Clause 4 of GB/T 31155-2014, the horizontal-plane solar energy resource at the site of the project shall be graded, and the content shall cover the following three aspects: the grade of the annual irradiation of global horizontal radiation; the grade of the stability of global horizontal radiation; and the grade of the direct fraction.

6 Requirements for the assessment of direct normal radiation

Data requirements - radiation element. The radiation element for the solar energy resource assessment of a solar thermal electric plant is direct normal radiation.

Data requirements - time. The data shall include monthly and annual direct normal radiation data for the most recent 10 years or more at the site of the project, and hourly direct normal radiation data for the representative year. The project shall build a meteorological observing station in accordance with the requirements of GB/T 33698-2017 and obtain measured data covering more than one complete year.

Data calculation and processing - calculation of direct normal radiation. The monthly and annual data for more than 10 years shall be calculated by the method of Clause 5 of GB/T 37525-2019. The hourly direct normal irradiance data for the representative year shall be generated by the process and methods of Clause 5 of GB/T 40099-2021, and the monthly data for the representative year shall be derived from them by statistical aggregation.

Data calculation and processing - checking and correction of direct normal radiation. On the basis of direct normal radiation data measured on site over more than one complete year, the hourly direct normal irradiance data of the representative year calculated under 6.2.1.2 shall be corrected by the following steps. Checking and infilling: the direct normal radiation measured on site is checked by the method of Annex A of GB/T 37526-2019, and missing and unreasonable data are infilled by the method of 6.2 of GB/T 42477-2023, so as to obtain a continuous and complete data set with an effective completeness of 100 per cent. Calculation of concurrent data: using the results of 6.2.1.1, monthly direct normal radiation data concurrent with the on-site measurements are obtained. Checking: the concurrent calculated data are checked against the measured monthly direct normal radiation data and the characteristics of the error are analysed. Correction of the representative year: the on-site measurements and the concurrent calculated results are correlated to obtain a regression equation; using that equation, the monthly direct normal radiation data of the representative year calculated under 6.2.1.2 are corrected, and the corrected annual total direct normal radiation of the representative year is then calculated.

Data analysis - interannual variation. The annual direct normal radiation data for more than 10 years calculated under 6.2.1.1 shall be used to analyse the interannual variation of direct normal radiation.

Data analysis - annual variation. The monthly direct normal radiation data of the representative year calculated under 6.2.1.2 shall be used to analyse the annual course of direct normal radiation, so as to describe how the solar energy resource of the project varies over the twelve months of the year. On the basis of the direct normal radiation measured on site over more than one complete year, the annual course of the annual direct normal radiation and the annual course of the daily maximum irradiance shall also be analysed.

Data analysis - diurnal variation. On the basis of the direct normal radiation measured on site over more than one complete year, the diurnal variation of direct normal radiation on the typical day of each month of the measured year and under different weather conditions (clear, cloudy, haze, dust, overcast, rain and so on) shall be analysed, so as to describe how far and in what way the irradiance follows the weather. The typical day of each month is selected in accordance with Annex A.

Data analysis - distribution of irradiance. On the basis of the hourly direct normal irradiance data of the representative year calculated under 6.2.1.2, the distribution of direct normal irradiance shall be analysed, and the share of direct normal radiation energy falling in each irradiance interval, by month and for the whole year, shall be given in intervals of 100 W per square metre.

Grading. On the basis of the corrected monthly direct normal radiation data of the representative year from 6.2.2, the direct normal radiation at the site of the project shall be graded in accordance with the indices and thresholds of Clause 4 of GB/T 33677-2017, as shown in Table 1 and Table 2, covering the grade of the annual direct normal irradiation and the grade of the stability of direct normal radiation.

Table 1 grades the annual direct normal irradiation, denoted HDN and taken as a multi-year mean, normally over 30 years, into four resource zones. The first-class resource zone, symbol A, has an annual direct normal irradiation of 1700 kilowatt-hours per square metre or more, equivalent to 6120 megajoules per square metre or more. The second-class zone, symbol B, runs from 1400 up to but not including 1700 kilowatt-hours per square metre, equivalent to 5040 up to 6120 megajoules per square metre. The third-class zone, symbol C, runs from 1000 up to but not including 1400 kilowatt-hours per square metre, equivalent to 3600 up to 5040 megajoules per square metre. The fourth-class zone, symbol D, is below 1000 kilowatt-hours per square metre, equivalent to below 3600 megajoules per square metre.

Table 2 grades the stability of direct normal radiation, denoted Rwd. The note to the table explains that Rwd is obtained by first calculating the multi-year mean, normally over 30 years, of the mean daily direct normal irradiation for each month, and then taking the ratio of the smallest of those values to the largest. Radiation is graded very stable, symbol A, at an Rwd of 0.7 or more; stable, symbol B, from 0.5 up to but not including 0.7; moderate, symbol C, from 0.3 up to but not including 0.5; and less stable, symbol D, below 0.3.