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GB/T 12326-2008

Replacing GB 12326-2000

Power quality - Voltage fluctuation and flicker

电能质量 电压波动和闪变

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Standardization Administration Committee.

Table of Contents

Foreword

This Standard replaces GB 12326-2000 *Power quality--Voltage fluctuation and flicker*.

Compared with GB 12326-2000, the main contents of this modification are as follows:

- adjusted the limits of flicker, used the long-term flicker value P_{lt} as the limit for flicker, a certain degree of relaxation than the original flicker limit. For flicker caused by a single fluctuating load, according to the actual situation, it was still divided into three levels, but there was a certain simplification, and put forward a clear management requirements for excessive user;

- adjusted the criterion of the voltage fluctuation limit. For voltage fluctuation of low voltage fluctuation frequency or regular periodic voltage fluctuation, the current limit was still used as the criterion; for irregular voltage fluctuations, it specified the maximum value of the voltage fluctuation as criterion and adjusted the previous limit. This enhanced the voltage fluctuation measurement and judged whether the operability was qualified;

- adjusted the flicker's measurement duration, value method. The flicker of the common connection point of the power system used one week (168 h) to measure. The flicker caused by a single fluctuating load used one day (24 h) to measure. They all took the maximum value as criterion for qualification;

- simplified flicker estimation method; deleted the sine wave which was not commonly used, triangular wave voltage fluctuation P_{st} = 1 curve analysis method, the simulation method which was difficult to implement and flicker time analysis in the previous standard;

- simplified flicker analysis examples and evaluation methods involved in Annex C of the previous standard; used a more concise way to list various arc furnace flicker evaluation coefficients;

- expanded the application scope of voltage fluctuations and flicker limits to extra high voltage (EHV) system, regardless of the flicker transmission of EHV to the next voltage level; unified the flicker transfer coefficient to 0.8, the recommended value;

- added statistical method of flicker passing rate, so as to facilitate the assessment of flicker conditions.

Power quality - Voltage fluctuation and flicker

1 Scope

This Standard specifies the limits and test, calculation and evaluation methods of voltage fluctuation and flicker.

This Standard is applicable to the rapid change of the voltage of the common connection point caused by the fluctuating load under the normal operation mode of the AC 50Hz power system and the occasion where people may obviously feel the light flicker.

2 Normative references

The following standards contain the provisions which, through reference in this Standard, constitute the provisions of this Standard. For dated references, subsequent amendments (excluding corrections) or revisions do not apply to this Standard. However, the parties who enter into agreement based on this Standard are encouraged to investigate whether the latest versions of these documents are applicable. For undated reference documents, the latest versions apply to this Standard.

GB/T 156-2007 *Standard voltage* (IEC 60038:2002, MOD)

GB 17625.2 *Electromagnetic compatibility (EMC) - Limits - Limitation of voltage changes, voltage fluctuations and flicker in* public low-voltage supply systems, for equipment with rated current ≤ 16 A (GB 17625.2-2007, IEC 61000-3-3:2005, IDT)

GB/Z 17625.3 *Electromagnetic compatibility--Limits--Limitation of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than 16A* (GB/Z 17625.3-2000, idt IEC 61000-3-5:1994)

IEC 61000-4-15:1996 *Electromagnetic compatibility (EMC) - Testing and measurement techniques - Flicker meter - Functional and design specifications*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

Each user, according to the ratio between its agreed capacity S_i ($S_i = P_i /\cos \varphi_i$) and the total capacity, shall determine the flicker limits of this user after considering the factors such as the effect of the last level on the next level flicker transfer (the transmission of next level to the last level is generally ignored). The flicker limits of single user can be calculated as follows:

First, calculate the total flicker limits G generated by all loads connected to PCC point:

$$G = \sqrt[3]{L_P^3 - T^3 L_H^3} \quad \cdots\cdots (2)$$

where,

L_P - Long term severity P_{lt} limit of PCC corresponding voltage level;

L_H - Long term severity P_{lt} limit of last voltage level;

T - The flicker transfer coefficient of the last voltage level to the next voltage level, 0.8 as recommended. The flicker transfer of EHV system to the next level voltage system shall not be considered. The flicker limits of each voltage levels are shown in Table 2.

The flicker limit of single user E_i is:

$$E_i = G \sqrt[3]{\frac{S_i}{S_t} \cdot \frac{1}{F}} \quad \cdots\cdots (3)$$

where,

F - Simultaneous coefficient of fluctuating load of which the typical value F = 0.2 ~ 0.3 (but it must meets $S_i/F \le S_t$); the determination method for PCC's total capacity S_{tHV} of HV system is shown in Annex B.

5.2.4 The third level regulation. For the single fluctuating load user which does not comply with the regulations of the second level, if it still exceeds its flicker limits after treatment, it shall relax the limit appropriately, based on PCC point actual flicker conditions and development forecast of grid. However, the flicker value of PCC point must comply with the provisions of 5.1.

6 Measurement and estimation of voltage fluctuation

The voltage fluctuation can be described by R.M.S. voltage shape U(t). The relative voltage change d and rate of occurrence of voltage changes r are indicators to measure the voltage fluctuation size and speed.

where,

ΔS_i - Three-phase load changes.

For phase single-phase load:

$$d \approx \frac{\sqrt{3}\Delta S_i}{S_{sc}} \times 100\% \qquad \text{(8)}$$

where,

ΔS_i - Phase single-phase load.

NOTE In absence of short-circuit capacity of normal smaller way, the system short-circuit capacity designed to take can be calculated by the maximum short circuit capacity of the system during production multiplied by 0.7, the coefficient.

7 Flicker measurement and calculation

Flicker is the cumulative effect of voltage fluctuations over a period of time. It reflects the light perception caused by the instability of the illumination. It is mainly measured by short term severity P_{st} and long term severity P_{lt}. The calculation method of short term severity P_{st} is shown in Annex A. The long term severity P_{lt} is obtained by the calculation of short term severity P_{st} contained in the measurement period:

$$P_{lt} = \sqrt[3]{\frac{1}{12}\sum_{j=1}^{12}(P_{stj})^3} \qquad \text{(9)}$$

where,

P_{stj} - The short term severity of No. j within 2 h.

The flickers caused by various types of voltage fluctuations can be directly measured by flicker meter which complies with IEC 61000-4-15:1996. This is the baseline method for determining the flicker value. For three-phase equiprobable fluctuating load, it can select any phase to measure.

When the load is a periodic, interval and rectangular wave (or step wave), the flicker can be estimated by its relative voltage change d and rate of occurrence of voltage changes r. When the relative voltage change d and the rate of occurrence of voltage changes r are known, it can use Figure 1 (or Table 4). Use P_{st} = 1 curve, check out the relative voltage change d_{Lim} when P_{st} = 1 that corresponds to r and calculate its short term severity:

m - The value depends on the nature of the primary flicker source and the overlapping possibilities of its operating conditions;

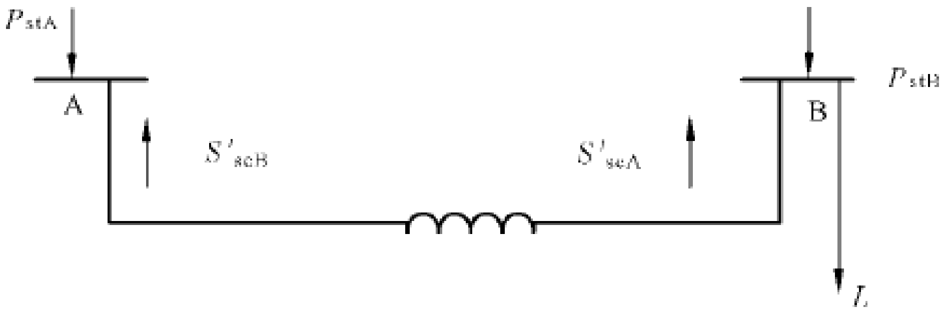
m=1 - Used for a situation in which fluctuating load causes relative voltage change and a high overlap ratio;

m=2 - Used for a situation in which random fluctuating load causes relative voltage change simultaneously (for example, electric arc furnace of overlapped melting period);

m=3 - Used for a situation in which fluctuating load rarely causes relative voltage change simultaneously (commonly used);

m=4 - Only used for synthesis of relative voltage change caused by electric arc furnace of which the melting period is not overlapped.

8.2 The transfer of flicker on different bus bars in power system is shown as Figure 2. It can be calculated by the following simplified formula:



L - Fluctuating load.

Figure 2 Flicker transfer calculation

$$P_{stA} = T_{BA} \cdot P_{stB} \qquad (12)$$

where,

$T_{BA} = \dfrac{S'_{scA}}{S_{scA} - S'_{scB}}$ is the transfer coefficient of B's short term severity transferring to A;

P_{stA} is the short term severity caused at A when B's short term severity transfers to Al

P_{stB} is the short term severity at B;

Annex C

(Informative)

Estimation method for flicker of electric arc

When electric arc furnace is in operation, especially during the melting period, the random and significant fluctuations in the reactive power shall cause serious voltage fluctuations and flicker of power supply bus. When electric arc furnace is in melting period, the contact between electrode and furnace charge (or molten steel after melting) can have two extreme states: open-circuit and short-circuit. When these two states are successively present, its maximum reactive power variation ΔQ_{max} shall equal to short-circuit capacity S_d.

The maximum relative voltage change, d_{max}, caused at PCC of electric arc furnace can be obtained by formula (6) through its maximum reactive power variation ΔQ_{max}. In addition to d_{max}, the main factor, the flicker size caused at PCC of electric arc furnace is also related to electric arc furnace's type, furnace parameters, short net, smelting process, the status of charge. Through the empirical formula, by the help of electric arc furnace's type and its d_{max}, it shall roughly estimate its flicker value. The empirical formula is as follows:

$$P_{lt} = K_{lt} \cdot d_{max} \qquad \text{(C.1)}$$

where,

K_{lt} - usually take 0.48 for AC electric arc furnace;

K_t - usually take 0.30 for DC electric arc furnace;

K_1 - usually take 0.20 for refining electric arc furnace.

CONSTEEL electric arc furnace usually takes 0.25 for K_{lt}.

------ The End ------