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The Design Rules of Telecommunication Lines against Danger and Interference Effects from Power Transmission Lines

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Contents

Foreword

These rules are revisions to DL/T 5033—1994 Design Rules of Telecommunication Lines against Danger Effects from Power Transmission Lines and DL/T 5063 — 1996 Design Rules of Telecommunication Lines against Interference Effects from Power transmission lines, in accordance with the requirements of the Notice on Issuance of Plan for supplementing Electric Power Industry Standard in 2003 issued by General Office of the National Development and Reform Commission (FGBGY [2003] 873).

As compared with DL 5033—1994 and DL/T 5063—1996, the following major revisions are made in these rules:

1 The applicable scope is extended;

2 The limits of danger effect on open telecommunication wires and cables are revised;

3 The limits of danger and interference effects on optical fiber telecommunication cables are supplemented;

4 The limits of danger effect on railway signal electrical lines are revised;

5 The content of protective measures is revised;

6 The original two design rules are merged into one.

These rules supersede DL 5033—1994 and DL/T 5063—1996 after it is implemented.

Appendices A, B, C and D to these rules are normative.

These rules are proposed by China Electricity Council.

These rules are solely managed and interpreted by the Technical Committee on Electric Power Planning and Engineering of

Standardization Administration of Power Industry.

Main drafting organization: Southwest Electric Power Design Institute.

The participants in the development of these rules also include China Power Engineering Consulting Group Corporation, East China Electric Power Design Institute, Northwest China Electric Power Design Institute, Central Southern China Electric Power Design Institute, Northeast China Electric Power Design Institute, North China Electric Power Design Institute, Shandong Electric Power Engineering Consulting Institute Corp., Ltd., Guangdong Electric Power Design and Research Institute, Henan Electric Power Survey and Design Institute, Jiangsu Electric Power Design Institute, and Liaoning Electric Power Design Institute.

The leading authors of these rules: Wei Dejun, Wang Yonggang, Wang Qiang, Tao Qin, Zhang Yongzhong, Wang Gang, Miao Guiliang, Han Yanming, Wu Xiquan, Wang Yi, Zhao Shixiong, Li Qisheng, Wang Zuomin, Xiong Wanzhou, Yu Wenzhi, Qiang Yuping, and Yu Hong.

The standard DL 5033—1994 superseded by these rules was issued on April 14, 1994.

The standard DL/T 5063—1996 superseded by this standard was issued on December 18, 1996.

These rules are translated by SUNTHER Translation & Solutions under the authority of China Electric Power Planning & Engineering Association.

1 Scope

These rules specify the limit of danger and interference effects on telecommunication lines arising from high voltage AC overhead power transmission lines (abbreviated as power transmission lines), give the calculation methods of such effects, and provide necessary parameters and protective measures.

These rules apply to the protection design of three-phase AC overhead power transmission lines with a rated voltage of 35 kV and above for telecommunication lines which comply with applicable standards.

2 Terms and Definitions

The following terms and definitions apply to these rules.

2.0.1

High trustworthy power transmission lines

Transmission line in system with directly grounded neutral point, featured by low failure rate and short duration of single-phase grounding short-circuit failure current (mostly shorter than 0.2s, never longer than 0.5s).

2.0.2

Neutral point not directly grounded system

A system in which the neutral point of transformer is not grounded or is grounded through an arc suppression coil or high impedance.

2.0.3

Neutral point directly grounded system

A system in which the neutral point of transformer is directly grounded or is grounded through low impedance.

2.0.4

Telecommunication lines

Communication lines, railway signal electrical line, cable television (signal, feed and subscriber) line, and remote controlling and signaling lines, in forms of overhead open wire, overhead or buried cable, and overhead or buried optical fiber cable.

2.0.5

Railway signal electrical lines

Cables and overhead open wires that transmit information for

railway signal system, such as relay semi-automatic or automatic obturate way circuit, remote controlling line, remote signaling line, and the track circuit within automatic obturates section.

2.0.6

Automatic obturate way circuit

Circuit used to determine the running directions of trains in cases where trains are running bidirectionally within automatic obturate section of the same railway.

2.0.7

Broadcasting user's lines

The matching transmission line between the output end of transformer and the corresponding input end of user's equipment used in the wired broadcasting power transmission system.

2.0.8

Voice-frequency transmission

Transmission of voice-frequency signals directly in metal conductors without analog modulation or digital coding.

2.0.9

Danger effects

Voltage and current induced in telecommunication lines by power transmission lines, excessive enough to endanger the safety of telecommunication operation and maintenance personnel, damage telecommunication lines or equipment, cause fire to buildings and structures, or cause inadvertent operation of railway signaling equipment bringing hazards to traffic safety.

2.0.10

Interference effects

Voltage and current electrically and magnetically induced in telecommunication lines by power transmission lines, high enough to

affect the normal operation of telecommunication circuits.

2.0.11

Adjacency

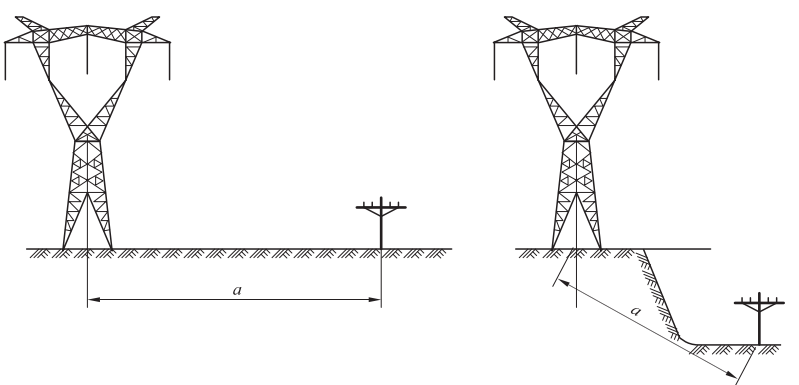
The relative positions between telecommunication lines and transmission lines when the electromagnetic effects of the power line may cause dangers or interferences to the telecommunication line.

Parallel adjacency describes a situation in which the variation of distance between two adjacent lines does not exceed 5% of the arithmetic mean of the distance. With the variation exceeding 5% and the distance between the two lines increasing or decreasing linearly (both lines having no turning points), the relative position of the two lines is called oblique adjacency.

2.0.12

Adjacent distance

The distance obtained by perpendicularly drawing a line from any point on the centerline of the telecommunication line to that of the power transmission line, represented by "a", as shown in Figure 2.0.12.



a) Even ground b) Uneven ground

Figure 2.0.12 Adjacency schematic diagram of power transmission lines and telecommunication lines

2.0.13

Equivalent distance

If the ratio of the adjacent distances at both ends of an oblique adjacent section, a_A/a_B, falls in $1/3 \leqslant (a_A/a_B) \leqslant 3$, the adjacent distance of this oblique adjacent section can be calculated as equivalent distance "a", as shown in Figure 2.0.13.

$$a = \sqrt{a_A / a_B}$$

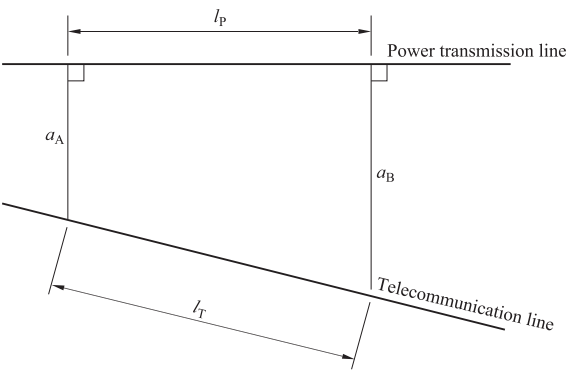


Figure 2.0.13 Schematic diagram of adjacent distance and adjacent length

a_A and a_B —the adjacent distances at both ends of an oblique adjacent section;

l_T —length of the telecommunication line for the adjacent section;

l_P—length of the power transmission line for the adjacent section.

2.0.14

Length of adjacent section

The projected length of the adjacent section of telecommunication line on the power transmission line, represented by l_P, as shown in Figure 2.0.13.

2.0.15

Cross-over

The situation in which a power transmission line strides over a

telecommunication line.

2.0.16

Inductive coupling effect

Effects caused by the current in the power transmission line and that through inductive coupling in the ground on the telecommunication line.

2.0.17

Resistive coupling effect

Effects on the grounding systems, burial cables and burial optical fiber cables in telecommunication offices (stations) caused by ground resistive coupling when the short-circuit current flowing through the grounding system of power transmission line towers results in a potential difference between the direct grounding area and the remote ground area which raises the ground potential.

2.0.18

Capacitive coupling effect

Effects of voltage on power transmission lines on telecommunication lines through capacitive coupling.

2.0.19

Magnetic induction endlong electromotance

Potential difference between any two points on a telecommunication line, established by the current in the power transmission line and the ground through inductive coupling.

2.0.20

Magnetic induction ground voltage

The relative-to-ground potential of any one point on a telecommunication line, induced by the current in the power transmission line and the ground through capacitive coupling.

2.0.21

Electro-induction body current

Current produced in the human body by capacitive coupling when a person touches a telecommunication line which is located in the HV electric field of a power transmission line.

2.0.22

Weight

The result of attenuating or increasing different frequency components in relation to one reference frequency so that the measurements are consistent with subjective assessments.

2.0.23

Weighted net

Net used to weigh various frequency audio effects.

2.0.24

Noise-meter

A metering instrument consisting of a weighted net and a voltage meter.

2.0.25

Noise-meter voltage

The voltage measured on the 600 Ω pure resistor using a noise meter when a pure resistor (having a characteristic impedance equal to the circuit to which it is connected) is connected to the remote end of the voice-frequency phone circuit and a 600 Ω pure resistor is connected to the near end (if the circuit characteristic impedance is not 600 Ω, use an impedance transformer to adjust the impedance).

2.0.26

Noise-meter electromotance

The sum of absolute values of noise meter voltages measured at both ends of the voice-frequency phone circuit.

2.0.27

Equivalent interference current

The 800 Hz current which flows in the power transmission line and causes in the adjacent phone circuit a noise meter electromotance equal to the noise meter electromotance caused by the harmonic currents at various orders that actually exist in the line.

2.0.28

Equivalent interference voltage

The 800 Hz voltage which is applied to the power transmission line and causes in the adjacent phone circuit a noise meter electromotance equal to the noise meter electromotance caused by the harmonic voltages at various orders that actually exist in the line.

2.0.29

Sensitivity coefficient

Used to represent the sensitivity of telecommunication lines against the interference. The magnetic sensitivity coefficient objectively is reflected by the impendence balance between two conductors of a telecommunication line. The electric sensitivity coefficient is reflected by the admittance balance between two conductors of a telecommunication line.

As the two values are approximate within the voice-frequency range, they are collectively called sensitivity coefficient.

2.0.30

Screen factor

The ratio of the voltages or currents respectively with or without a shield induced by a power transmission line in a telecommunication line.

2.0.31

Electrical short line

If a telecommunication line is shorter than 10% of the signal

wavelength, this line can be considered as the “electrical short line”.

2.0.32

Attenuation factor of transmission effect

The factor that represents the attenuation characteristics of transmission effect of noise meter voltage as the calculation distance accumulates.

2.0.33

Ring effect

Magnetically and electrically induced interference effects due to the geometric asymmetry between conductors a and b of the telecommunication line and conductors phase A, phase B and phase C of the power transmission line.

2.0.34

Unbalance effect

Magnetically and electrically induced interference effects due to unbalanced admittance and impedance in the two conductors of a telecommunication line.

3 Faults of Power Transmission Line and Operating Conditions of Telecommunication Line Circuits

3.0.1 The fault conditions of a transmission line that may endanger the adjacent telecommunication lines shall include:

1 One phase of transmission lines of a symmetrical three-phase system with directly grounded neutral point is short-circuited to the ground.

2 Two phases of transmission lines of a symmetrical three-phase system with the neutral point not directly grounded are simultaneously short-circuited to the ground at different locations.

3 One phase of transmission lines of a symmetrical three-phase system with the neutral point not directly grounded is short-circuited to the ground.

3.0.2 When calculating the danger effect caused by power transmission lines on adjacent telecommunication lines, the following different operating modes of telecommunication lines should be selected depending upon the operating conditions of the telecommunication lines.

1 The telecommunication lines have one end grounded through low impedance and the other end grounded through high impedance (open circuiting).

2 The telecommunication lines have both ends grounded through low impedance.

3 The telecommunication lines have both ends grounded through high impedance (open circuiting).

4 Limit Values of Danger and Interference Effect

4.1 Limits of Danger Effect

4.1.1 In neutral point not directly grounded systems, when phase-to-earth short-circuit faults occur to one phase of the transmission lines and a human touches the adjacent telecommunication line conductors, the current flowing through the human body as a result of capacitive coupling shall not be larger than 15 mA.

4.1.2 Under fault conditions of power transmission lines, the magnetic induction voltage (including magnetic induction endlong electromotance and magnetic induction ground voltage) generated on adjacent open telecommunication lines shall meet the following stipulations.

1 For the limit values of fundamental voltage, see Table 4.1.2-1.

Table 4.1.2–1 Limit values of fundamental voltage

Power Transmission Line	Voltage limit (V)
High trustworthy power transmission line	650
Other power transmission lines	430

2 For the limit value of human safety voltage as a function of the fault duration of power transmission lines, see Table 4.1.2-2.