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GB 50217 — 2007

Code for Design of Cables of Electric Engineering

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Announcement of Ministry of Construction of the People's Republic of China

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Announcement of
Issuing the National Standard of
Code for Design of Cables of Electric Engineering

The *Code for Design of Cables of Electric Engineering* has been approved as a national standard with a serial number of GB 50217—2007 and implemented on April 1，2008, where Article 5.1.9 and article 5.3.5 are compulsory provisions and must be enforced strictly. The original *Code for Design of Cables of Electric Engineering* GB 50217—1994 will be abolished from then.

This code will be published and distributed by China Planning Press as authorized the Research Institute of Standards and Norms, Ministry of Construction of the People's Republic of China.

Ministry of Construction of the People's Republic of China
October 23, 2007

Foreword

This code was revised from GB 50217—1994 *Code for Design of Cables of Electric Engineering*, by Southwest Electric Power Design Institute of China Power Engineering Consulting Group Corporation and the interests concerned in response to the *Notice on Printing and Distributing the Preparation and Revision Plan of National Standards for Engineering Construction from 2001 to 2002* (JB [2002] No. 85) issued by the Ministry of Construction.

The technical contents involved in this revision mainly include:

1. Supplementing the requirements on selection of the number of cores of MV and HV cable.

2. Supplementing the requirements on selection of cable insulation, while deleting the contents related to adhesive impregnated paper insulated cables.

3. Supplementing the requirements on selection of the permissible minimum cross-section of protective ground wire in case of a main core cross-section of $400\ mm^2 < S \leqslant 800\ mm^2$ and $S > 800\ mm^2$.

4. Supplementing the requirements on the cross-section and material of cables in cases where power supply circuit of large current loads consists of multiple parallel-connected cables.

5. Supplementing the general requirements on selection of cable terminals.

6. Supplementing the contents on directly cutting and insulating the metallic layer of cables.

7. Supplementing the requirements on grounding of the metallic layer of three-core cables of AC systems.

8. Supplementing the requirements on the permissible distance between cables and conduits in urban cable systems.

9. Supplementing the requirements on arranging maintenance access of overhead cable trays.

10. Supplementing the requirements on placement interval of safety holes along cable tunnels.

11. Supplementing Appendix B and Appendix F.

Articles in bold in this code are compulsory and must be observed strictly.

This code is administered and explained by the Ministry of Construction of the People's Republic of China in respect of compulsory articles. The daily management of it is the responsibility of the Standardization Center of China Electricity Council. And Southwest Electric Power Design Institute of China Power Engineering Consulting Group Corporation is responsible for the interpretation of the specific technical issues therein. During the implementation of the code, the interests concerned are expected to seriously summarize the experiences and collect the relevant information based on the project practices and at any time refer any comments and suggestions to Southwest Electric Power Design Institute of China Power Engineering Consulting Group Corporation at the address: No.18 Dongfeng Road, Chengdu City, Sichuan Province, Postcode: 610021, for reference in the future revision of the code.

This code is drafted by Southwest Electric Power Design Institute, China Power Engineering Consulting Group. The participants in the development of this regulation also include Northeast Electric Power Design Institute, and HILTI (China) Ltd.

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This code is translated by SUNTHER Consulting Co., Ltd. under the authority of China Electric Power Planning & Engineering Association.

Contents

1 General

1.0.1 This code is prepared for the purpose of designing cables that are to be safe, reliable, technically advanced, cost effective and easily operational and maintainable.

1.0.2 This code is applicable to the selection and laying design of power cables of 500 kV or below and control cables in newly built or expanded electric projects.

1.0.3 In addition to this code, the design of cables of electric engineering shall comply with relevant national standards in force as well.

2 Terms and Definitions

2.0.1 Fire Resistance

The ability of a specimen to resist burning in fire for a certain period of time under specified test conditions while maintaining its normal operation.

2.0.2 Fire Resistant Cable

Cables characterized by fire resistance.

2.0.3 Flame Retardancy

The characteristic of a test specimen that, after being burned under the specified test conditions and following the removal of the test fire source, the flame spread is confined within the specified scope and the resulting residual flame or residual matters can extinguish by itself within a limited period of time.

2.0.4 Flame Retardant Cable

Cable characterized by flame retardancy.

2.0.5 Dry-type Cross-linked

A cross-linking process whereby the amount of water used in the production of cross-linked polyethylene insulation is significantly reduced.

2.0.6 Water Tree

A brief term to describe the phenomenon of dendritic tiny cracks occurring in the insulation layer of XLPE cables during operation.

2.0.7 Metallic-plastic Composite Water Barrier

A water barrier consisting of a composite tape surrounding cables longitudinally, which is composed of a thin metallic layer (such as aluminum or lead foil) sandwiched in plastics layers.

2.0.8 Thermal Resistance

A physical quantity defined by the thermal ohm law for the one-dimensional heat dispersion process using the thermal network analytic method to calculate the current-carrying capacity of cables.

2.0.9 Auxiliary Ground Wire

Conductor laid in parallel with HV single-core cable line and grounded at both ends to establish a circuit for induced current.

2.0.10 Direct Burying

A cable laying method where cables are laid down on cushions at the bottom of the underground trenches and covered with a overburden layer, followed by placing protection slabs and then leveling the ground.

2.0.11 Channel

A covered trough structure without brackets intended to contain small quantity of cables.

2.0.12 Manhole

A covered pit-type cable structure that can be accessible for installation of accessories such as cable joints or for pulling cables.

2.0.13 Cable Buildings

Structures including cable troughs, channels, ducts, tunnels, mezzanines, shafts and manholes exclusively intended for laying cables or installing accessories.

2.0.14 Slip Fixing

A fixing method that allows cables to experience axial angle change or slight transverse displacement at the attachment point attributable to thermal expansion and contraction of cables.

2.0.15 Rigid Fixing

A clamping fixing method by which cables will not displace as a result of thermal expansion and contraction.

2.0.16 Snaking of Cable

A cable laying method by which cables are rendered to be in the form of a snake, which contributes to decreased axial cable thermal stress and increased free expansion and contraction consistent with the requirements of quantitative parameters.

3 Selection of Cable Type and Cross-section

3.1 Material of Cable Conductor

3.1.1 The control cable shall use copper as the conductor material.

3.1.2 In the following occasions, copper-core power cables shall be applied:

1 The circuits of generator exciters, major power supplies and mobile electrical devices which need to have highly reliable connections.

2 A severe working environment where intense vibration, explosion danger, or corrosion to aluminum exists.

3 Fire resistant cables.

4 Power cables close to the high-temperature equipment.

5 When used in public facilities requiring high security; and

6 When more power cables are needed due to considerable working current.

3.1.3 The cable conductor can be of either copper or aluminum except where the relevant products use only copper conductor or where only copper conductor is allowed to be used according to Articles 3.1.1 and 3.1.2.

3.2 Number of Power Cable Cores

3.2.1 Where the neutral of power source of 1 kV or below is solidly grounded, the number of cable cores for the three-phase circuit shall be determined in accordance with the following requirements:

1 Where the protective wire is grounded by connecting with the exposed conductive parts of energized equipment, the following

requirements shall be met:

1) If the protective wire and the neutral line share the same conductor, four-core cables shall be used.

2) If the protective wire is independent of the neutral line, five-core cables should be used; however, four-core cables together with an additional protective conductor may be used provided that the requirements of Article 5.1.16 of this code are met.

2 Where the earth of exposed conductive parts of energized equipment is independent of that of the power supply system, four-core cables shall be used.

3.2.2 Where the neutral of power supplies of 1 kV or below is solidly grounded, the number of cable cores for single-phase circuits shall be selected in accordance with the following requirements:

1 Where the protective wire is grounded by connecting with the exposed conductive parts of energized equipment, the following requirements shall be met:

1) If the protective wire and the neutral line share the same conductor, two-core cables shall be used.

2) If the protective wire is independent of the neutral line, three-core cables should be used; however, two-core cables together with an additional protective conductor may be used provided that the requirements of Article 5.1.16 of this code are met.

2 Where the earth of exposed conductive parts of energized equipment is independent of that of the power supply system, two-core cables shall be used.

3.2.3 The number of cable cores for 3 kV-35 kV three-phase power supply circuits shall be selected according to the following requirements:

1 For circuits with a large working current or cables laid underwater, three single-core cables may be used for each circuit.

2 In other cases, three-core cables of ordinary belted type shall be used, or alternatively, three single-core cables in stranded configuration may be used.

3.2.4 For 110 kV three-phase power supply circuits, three single-core cables may be used for each circuit, except for cables laid underwater in lakes or seas and with small cable cross sections, in which case three single-core cables may be used.

For three-phase power supply circuits of 110 kV or above, three single-core cables shall be used for each circuit.

3.2.5 For HV AC single-phase power supply circuits such as that for electric railways, two-core cables or two single-core cables shall be used for each circuit.

3.2.6 The number of cable cores for DC power supply circuits shall be selected according to the following requirements:

1 For LV DC power supply circuits, two-core cables should be used, and single-core cables may be used as an alternative.

2 For HV DC transmission systems, single-core should be used, and coaxial two-core cables may be used when laid underwater in lakes and seas.

3.3 Cable Insulation Level

3.3.1 The rated phase-to-phase voltage of power cable conductor in an AC system shall not be lower than the working line voltage of the circuit in which it is used.

3.3.2 The selection of the rated voltage between the power cable's core and the insulation shielding or the metal sheath in an AC system shall comply with the following requirements:

1 In systems where neutral-point is grounded solidly or through low resistance, at least 100% of the working phase voltage of the circuit shall be used if the fault is cleared within one minute.

2 The power supply systems other than that described in Item 1 should not use the voltage less than 133% of the circuit's working phase voltage; 173% of the circuit's working phase voltage should be used when a single-phase-to-ground fault may last for more than 8 hours or high security is required in the generator circuit.

3.3.3 The withstand voltage level of cables in AC systems shall meet the requirements on insulation coordination of the system.

3.3.4 The insulation level of DC transmission cables shall be able to withstand voltage tests by application of impulse voltage superimposed on DC voltage with reversal of direction with polarity, and the XLPE cables shall be able to suppress space charge accumulation and to avoid local high field strength suitable for the operation of DC electric field.

3.3.5 The rated voltage of control cables shall be selected to be not lower than the working voltage of the circuit and meet the following requirements:

1 The rated voltage of control cables (pilot cables) laid in parallel with HV cables shall meet the requirements for this arrangement.

2 The rated voltage of control cables for HV distribution devices of 220 kV or above shall be 450/750 V.

3 In other cases, the rated voltage of control cables should be 450/750 V and may be lower if the external electrical interference is less.