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Technical Rule of Communication Design for 220kV–500kV Substation

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Contents

Foreword

The standard is formulated according to the *Notice regarding Confirmation of the Project of Formulation and Revision of Electricity Industry Standards in 1997* (Zongkejiao [1998] No. 28) issued by the former Ministry of Electric Power.

The standard is the first issue. During the process of compiling, the drafting team has not only widely performed investigation and asked for advice and comments, but also developed in-depth studies on the principles and extent of compiling of the standard, so as to ensure that the standard conforms to relevant national regulations and reflects the current technical and economic level.

This standard mainly includes the contents of the Scope, General, Communication Facilities and Scope of Design, Communication Design of Substation, Article Explanations.

The standard was proposed by China Electricity Council.

Electric Power Industry Power Planning & Design Standardization Technical Committee is responsible for management and explanation of this standard.

The standard was prepared by Northeast Electric Power Design Institute.

The main drafters were He Bihui, Wang Yudong and Su Zhonghua.

1 Scope

1.0.1 This standard specifies the substation communication facilities and their design scope as well as the technical requirements for communication design in substations.

1.0.2 This standard is applicable to the communication design of newly-built 220 kV-500 kV substations. It can also be used as a reference standard for the communication design of 220 kV-500 kV substations subject to expansion or modification.

2 Normative References

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of DL/T 5225—2005. For dated references, subsequent amendments (excluding any corrigendum) to, or revision of, any of these publications do not apply. However, parties to agreements based on this part of DL/T 5225—2005 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

DL/T 5218 *Technical Code for Designing 220-500 kV Substations*

DL 5025 *Technical Specifications for Design of Micro-wave Communication Engineering in Electric Power System*

DL 548 *Code for Operation Management for Lightning Protection in Communication Station of Electric Power System*

DL/T 620 *Overvoltage Protection and Insulation Coordination for AC Electrical Installations*

DL/T 621 *Grounding for AC Electrical Installations*

DL/T 5157 *Design Technical Code of Dispatching Communication Exchange Network of Electric Power System*

DL/T 5189 *Technical Code for Designing Power Line Carrier Communication*

3 General

3.0.1 The communication design for substations must comply with the national fundamental construction policies and relevant technical and economic policies in electric power industry development and be technically advanced and economically viable so as to ensure safe, reliable, prompt and uninterrupted electric power communication.

3.0.2 During the process of communication design for substations, the approved products that conform to national standards shall be used. Equipment devoid of operating experiences shall not be employed in projects.

3.0.3 Communication design for substations shall be performed such that communication equipment is arranged reasonably and flexibly with moderate margins according to the capacity of the substation, the dispatching system, and its position in grid and communication network.

3.0.4 The following communication facilities may be installed for substations as applicable:

1 Communication for dispatching of electric power system.

2 Internal communication of substations.

3 Communication with relevant operation and maintenance management authorities.

4 Communication with Public Telephone Network.

4 Communication Facilities and Scope of Design

4.1 Communication for System Dispatching

4.1.1 There shall be at least two independent channels or two communication schemes between 220 kV-500 kV substations and the power grid dispatching center.

4.1.2 A system dispatching communication scheme shall be determined based on the approved system communication design in the feasibility study on power transmission and transformation projects.

4.1.3 The communication scheme for system dispatching may include fiber-optic cable communication, microwave communication, power line carrier communication, and satellite communication.

4.1.4 Communication circuits for power system dispatching shall accommodate the requirements of power dispatching, relay protection, security automation devices, data communication and dispatching automation.

4.1.5 220 kV-500 kV substations shall be usually equipped with digital dispatching program-controlled exchanges for communication networking for dispatching of power system. The technical specification thereof shall conform to DL/T 5157.

4.2 Internal Communication of Substation

4.2.1 The internal communication of substations refers to the administrative communication inside substations, which will involve the exchange equipment and cable routing for the communication

networks within substations.

4.3 Communication with Relevant Operation and Maintenance Management Authorities

4.3.1 Substations shall have communication channels provided for communication with relevant operation and maintenance management entities (like power supply companies or ultra-high-voltage power supply bureaus), which shall satisfy the needs for transmission operation and maintenance, production and administration, and dispatching automation.

4.3.2 Communication scheme may be selected to be wired or wireless communication depending upon the actual situations locally.

4.4 Communication with Public Telephone Network

4.4.1 Substations shall be provided with channels for communication with Public Telephone Network.

4.5 Scope of Design

4.5.1 For the communication schemes described in Article 4.1 to Article 4.4, only the power line carrier communication and the internal communication of substations are included in the scope of the communication design for substations. The communication schemes other than the above shall be designed in separate works.

4.5.2 The design interface between communication discipline and relay protection and dispatching automation shall lie in the input/output terminals of communication equipment (or terminals of wiring equipment).

5 Design of Substation Communication

5.1 Power Line Carrier Communication

5.1.1 The arrangement of channel and frequency for power line carrier communication must comprehensively take into account all the requirements for transmitting telephone signals, telecontrol signals, high-frequency protection signals, and signal of security automation devices. In addition, the frequency allocated for existing channels and for newly-built channels shall be well planned to ensure the crosstalk among channels is acceptable and not exceeding the given value. When the crosstalk among channels can not meet the requirements, it shall be adjusted on the principle that the local part of the network conforms to the overall network and the low-voltage network conforms to the high-voltage network.

5.1.2 To save the spectrum resources of carrier wave, multifunctional multiplex equipment, i.e., telephone, relay protection and telecontrol multiplexer, shall be selected to be the power line carrier equipment whenever possible.

5.1.3 The 220 kV-500 kV power line carrier channels shall use phase to ground mode or phase to phase coupling mode as applicable.

5.1.4 The allowable SNR (Signal to Noise Ratio) value in power line carrier channels, the conditions for repeated use of the same frequency of the power line carrier channels in the same electric power system, and the recommended noise power levels for the 4 kHz bandwidth in transmission lines at different voltage levels shall all conform to the requirements specified in DL/T 5189.

5.2 Internal Communication of Substation

5.2.1 When necessary, an administrative exchange of 20-40 lines may be installed for purpose of communication inside the substation. If a program-controlled exchange for system dispatching has been installed in the substation, it can also be used as the administrative exchange for the substation.

5.2.2 Audio cables may be used for the communication during maintenance of outdoor switchgears in the substation.

5.2.3 The main distribution frame needs to be installed with security devices. The capacity thereof shall be configured to be 1.5 times of the total capacity of ports of equipment including exchanges, power line carrier equipment, fiber-optic cable equipment, microwave equipment and data network equipment.

5.2.4 The concealed wiring mode should be selected for installing communication cables inside the central control building, administration building, and other buildings.

5.2.5 The electrical cable structures shall be utilized for laying communication cables inside substations. In cases where the cable structures are unavailable, the communication cables shall be directly buried or buried with sleeves.

5.2.6 The selection of cables for communication inside substations:

1 In case of directly-buried laying, the steel tape armored cable is typically used.

2 In case of outdoor cable trench laying, the steel tape armored cable is typically used.

3 In case of indoor short-distance laying, the full-plastic shielded cable, instead of armored cable, should be selected.

5.3 Power Supply for Communication Equipment

5.3.1 The power supply for the communication equipment of substations shall be stable and reliable to ensure uninterrupted communication.

5.3.2 The AC power supply required for communication inside substations shall be a double-circuit AC power supply powered by different busbar sections of the auxiliary power.

5.3.3 A DC power supply system dedicated for communication shall be provided for 220 kV-500 kV substations. When both sets of relay protection equipped for a 500 kV power line use multiplex channels, the communication equipment should be respectively powered by two sets of independent DC power supply.

5.3.4 The DC power supply system dedicated for communication shall have a rated voltage of 48 V DC and supply the power in floating charge mode.

5.3.5 The capacity of the communication power supply shall be decided according to the total power consumption of communication equipment of a substation within the design life cycle. The battery groups installed in a manned substation shall be able to supply power independently for not less than three hours, while those in a non-manned substation shall be able to supply power for not less than 8-12 hours. There shall be one or two groups of batteries. In cases where two groups are equipped, the capacity of each group shall be 50% of the whole capacity.

5.3.6 The maximum pulse voltage drop of DC power supply shall not exceed 2 V-3 V.

5.3.7 The pulse voltage value of a DC power supply shall not exceed 2.0 mV (weighted).

5.4 Grounding

5.4.1 The design of over-voltage protection and grounding for communication inside substations shall conform to the requirements of DL/T 620, DL/T 621 and DL 548. The design shall also conform to DL 5025 in cases where microwave communication equipment is installed inside the substation.

5.4.2 The grounding design of substation communication equipment shall be performed based on the principle of common grounding. In other words, the operational grounding and protective grounding shall share the same set of grounding electrode (i.e., the main grounding grid of the substation).

5.4.3 Ring grounding busbar shall be provided in the individual communication equipment rooms, and shall be connected to the main grounding grid of the substation at two points nearby as a minimum (including two points). The ring grounding busbar shall generally use the copper bars with a cross section no less than 90 mm^2 or the galvanized flat steel bars with a cross section no less than 120 mm^2.

5.4.4 The AC power lines in the communication rooms shall have metal sheathings or shall be laid inside metal pipes.

5.4.5 The anode "+" of each DC power supply for communication equipment should be directly grounded at both the communication equipment side and the power supply equipment side, with stranded copper wires of a cross section determined based on the maximum fault current (generally in the range of 25-95 mm^2); the cathode "-" of DC power supply shall be installed with voltage-dependent resistors at both the communication equipment side and the power supply equipment side. DC feeder cable shall be provided with shields which shall be grounded at both ends.