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Technical Code for Designing of Remote Monitoring and Control Center about Unattended Substation

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Foreword

This code is prepared as required by the *Notice on Issuance of Development & Revision Plan of Electric Power Industry Standards in 2007* issued by the General Office of the National Development and Reform Commission (FGBGY [2007] 1415).

Appendix A to this code is a normative appendix.

This code is proposed by China Electricity Council.

This code is interpreted and managed by the Technical Committee on Electric Power Planning and Engineering of Standardization Administration of Power Industry.

This code is mainly drafted by Jiangsu Electric Power Design Institute.

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The opinions and suggestions proposed during the implementation of this code are to be referred to the Standardization Center of China Electricity Council at the following address: No. 1, Lane 2, Baiguang Road., Xuanwu District, Beijing, China. post code: 100761.

This code is translated by SUNTHER Translation & Solutions under the authority of China Electric Power Planning & Engineering Association.

1 Scope

This code specifies the principles and standards to be followed for the design of remote monitoring and control centers of unattended substations and applies to substations at 220kV and below.

2 Normative References

The following normative documents contain provisions which, through reference in this text, constitute the provisions of this code. For dated references, subsequent amendments (excluding the contents of errata) to, or revision of, any of these publications do not apply. However, parties to agreements based on this code are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For all the referenced codes with no dates indicated, their latest revisions are applicable for the standard.

GB/T 2887 *Specification for Electronic Computer Field*

GB/T 14429 *Telecontrol Equipment and Systems Part 1–3: General considerations-Glossary*

GB 50059 *Design Code for Substations (35kV–110kV)*

GB 50174 *Code for Design of Electronic Information System Room*

DL/T634.5101 *Telecontrol Equipment and Systems Part 5: Transmission Protocols Section 101: Companion Standard for Basic Telecontrol Tasks (IDT IEC 60870-5-101: 2002)*

DL/T 634.5104 *Telecontrol Equipment and Systems Part 5-104: Transmission Protocols-Network Access for IEC 60870-5-101 Using Standard Transport Profiles (IDT IEC60870-5-104:2002)*

DL/T 5002 *Specifications for the Design of Dispatch Automation in District Power Networks*

DL/T 5025 *Technical Code of Engineering Design for Digital Microwave Communication Project of Electric Power System*

DL/T 5149 *Technical Code for Designing Computerized
Monitoring and Control System of 220kV–500kV Substations*

DL/T 5218 *Technical Code for Designing 220kV–500kV
Substation*

3 Terms and Definitions

The following terms and definitions apply to this code.

3.0.1

Unattended substation

A substation without specially assigned operation and maintenance personnel. The operation monitoring and major control operations of such a substation are mainly performed by the remote monitoring and control center, and the equipment is patrolled and maintained on a regular basis.

3.0.2

Remote monitoring and control center

A site which remotely monitors and controls one or more monitoring points (unattended substations in this code) in a centralized manner.

4 General

4.0.1 Remote monitoring and control centers for unattended substations (hereinafter referred to as “remote monitoring and control center”) shall be constructed in accordance with the local power grid planning, the remote monitoring and control center planning, and the characteristics of local operation management, with the purpose of enhancing automation.

4.0.2 A remote monitoring and control center should remotely monitor and control all unattended substations at a voltage level of 220kV and below within its extent of jurisdiction.

4.0.3 The computer configuration of a remote monitoring and control center shall meet the functional and performance requirements of the whole system. The system capacity shall be compatible with the planned capacity of remote monitoring and control centers. Products of excellent performance in compliance with industrial standards shall be used.

4.0.4 In addition to this code, the design of remote monitoring and control centers shall further comply with related national and industrial standards in force.

5 Siting

5.0.1 The site of a remote monitoring and control center shall be selected based on the power grid planning and the distance between the center and the administered unattended substations. Relative geographic centers should be used for such purposes.

5.0.2 Remote monitoring and control centers should be located at district/county dispatching centers or inside substations within the district, or at a separately selected site.

5.0.3 The selection of the site of remote monitoring and control centers shall comply with related regulations in GB 50059, DL/T 5218 or DL/T 5025.

6 Computerized Monitoring and Control System of Remote Monitoring and Control Center

6.1 Construction Mode

The computer supervisory system of a remote monitoring and control center should be combined with the district/county dispatching automation system, or separately constructed.

6.2 Combined Construction

6.2.1 The data acquisition, supervision and control, and optimized control of voltage and reactive power of remote monitoring and control center are performed by the dispatching automation system in compliance with the requirements of DL/T 5002.

6.2.2 In the case that the ground wire has been connected or the grounding switch has been closed on the opposite side of the line, the district/county dispatching automation system shall prevent inadvertent closing of circuit breakers on the same side.

6.2.3 The remote monitoring and control center shall be provided with 2–3 workstations and necessary printing devices, and the workstations should be directly connected to the main network of the dispatching automation system.

6.3 Separate Construction

6.3.1 System Structure.

1 The computerized monitoring and control system of the remote monitoring and control center shall be established in a redundant, open, and distributed application environment, and its

software and hardware architecture shall meet the requirements on redundancy and modularity.

2 The applications used in the computerized monitoring and control system of the remote monitoring and control center shall be in modular design and should comply with related international and national standards. Standard application programming interfaces shall be used to improve the independence of software and hardware.

3 Double Ethernet and hot standby shall be used to ensure fast and reliable transmission of data.

6.3.2 System Functions. The computerized monitoring and control system of the remote monitoring and control center shall provide the following functions:

- 1 Computer communication.
- 2 Data acquisition and supervisory control.
- 3 Optimized control of voltage and reactive power.
- 4 Preventing inadvertent closing of circuit breakers at the same side in the case that the ground wire has been connected or the grounding switch has been closed on the opposite side of the line.

6.3.3 Technical Requirements.

1 Special telecontrol channels shall be provided for the communication between remote monitoring and control centers and telecontrol systems of unattended substations, and the telecontrol protocols shall comply with DL/T 634.5101 and DL/T 634.5104. Data communication with the dispatching center should also be possible. National regulations on safety protection of electric secondary systems shall be observed.

2 The data acquisition, processing and control type shall comply with related provisions of DL/T 5002.

3 The remote monitoring and control center shall be equipped

with clocks which are accurate to milliseconds and can receive synchronization commands from standard clocks.

4 Technical Indicators.

- 1) Remote metering quantity:
 - the combined error of remote metering shall not be greater than $\pm 1.0\%$ (ratings).
 - the minimum setting for transmission across dead band shall be no less than 0.25% (ratings).
- 2) Remote signaling quantity:
 - the accuracy shall not be less than 99.9% .
 - the resolution of sequence of event between substations shall not be greater than 10ms.
- 3) The remote controlling accuracy shall be 100% .
- 4) The remote regulation accuracy shall not be less than 99.9% .

5 Real-time Indicators:

- 1) For remote metering, the transmission time from across dead band to the main station, or the refresh time of important remote metering quantities in the cyclic transmission mode shall be 4s.
- 2) The time for remote signaling displacement transmission to the main station shall not be greater than 3s.
- 3) The transmission time of remote controlling and remote regulation commands shall not be greater than 4s.
- 4) The response time to workstation screen when invoked:
 - 85% of the screens $< 2s$.
 - The remaining screens $< 3s$.
- 5) The refresh cycle of real-time data of workstation screens shall be 5s–10s (adjustable).

- 6) The output cycle of printing reports can be set as required.

6 Reliability Indicators.

The annual system availability shall not be less than 99.9%.

6.3.4 Types of Hardware and Configuration Principles.

1 The hardware used in the computerized monitoring and control system of a remote monitoring and control center consists of the following:

- 1) The computer system including servers, workstations, and front end processors;
- 2) Local area network switches, external memory, and network security equipment;
- 3) I/O equipment;
- 4) Standard clocks;
- 5) Man-machine interface equipment including consoles and displays;
- 6) Channel interfaces;
- 7) Special uninterruptible power supplies (UPS).

2 The configuration principles for the hardware used in the computer supervisor control system of a remote monitoring and control center are as follows:

- 1) The hardware shall be capable of achieving the functions described in 6.3.2 and meet the technical requirements of the system;
- 2) New computer systems shall be highly expandable, maintainable, compatible, reliable, and cost-effective.

3 The scale of the computer system shall be determined according to the expected performance of the target year and the future needs in the 8–10 years to come based on the following factors:

- 1) The capacity of the data acquisition and monitoring and control object;
 - 2) The type and quantity of the telecontrol system;
 - 3) The type and quantity of peripheral equipment;
 - 4) The quantity of channels and transmission rate;
 - 5) The CPU load rate and estimation conditions.
- 4 The main system equipment shall be in redundant configuration to ensure a safe and reliable operation of the system.
- 1) The monitoring workstations shall be visualized, convenient, safe and reliable for operators to operate them, and the failure of one workstation shall not affect the monitoring and control of substations;
 - 2) The system server shall be in duplicate configuration. When one server fails, the other one shall take over automatically to prevent loss of any SCADA data;
 - 3) The front end communication equipment shall be in duplicate configuration to ensure the reliable communication of the monitoring and control system with external systems.
- 5 The average CPU load rate of the master server and the master workstation should be below 20% within any given 30 minutes under normal grid operation conditions, and below 50% within 10 seconds after a grid fault occurs.
- 6 The load rate of the local area network should be below 10% under normal conditions.
- 7 Necessary channel interfaces shall be provided according to the technical requirements of the telecontrol system and information transmission mode on channels, and the requirements on the quantity and quality of channels shall also be proposed.

8 Security and confidentiality measures shall be available for monitoring workstations with a security class not below class 3.

6.3.5 Software Requirements.

1 The software used in the computerized monitoring and control system of a remote monitoring and control center shall comprise system software, support software, and necessary application software.

2 The operating system shall be stable, safe, and reliable. There shall be a maintainable and expandable real-time database and historical database which suit the grid features. There shall be also easy-to-use and practical image and report software.

3 The application software shall be used on a supporting platform which conforms to national standards.

4 The system software and support software shall be duly protected.

5 The application software shall be technologically mature in modular structure. They may be configured according to needs of the local grid and the requirements as specified in 6.3.2.

6 The system shall be easy for online commissioning and maintenance.