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To replace DL 5002 — 1991

Specifications for the Design of Dispatch Automation in District Power Networks

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Foreword

These specifications are revised in response to the *Notice on the Plan for Printing and Distributing Electric Power Industry Standard 2005* issued by the General Office of National Development and Reform Commission of the People's Republic of China (FGBGY [2005] 739). These specifications are intended to provide guidance for the design of dispatch automation in district power networks in China. Over the past decade, the DL 5002—1991 standard has played a major guide role in this regard. In principle, the provisions set forth herein on the design, function and performance indicators of dispatch automation design in district power networks apply to all district networks. Given the numerous district networks in China and their differentiated features, some functions and requirements specified herein are impractical or temporarily not required in some cases. Therefore, such functions and requirements can be used or not in project-specific designs.

Compared with DL 5002—1991, the major modifications made to these specifications are as follows, in addition to the supplements and adjustments to some of its original clauses:

—The applicable scope of the original specifications is expanded and some low indicators are modified.

—The application function at the master station is added, and telecontrol design and telecontrol equipment function at the plant/substation end are augmented.

Some relevant clauses in DL 5002—1991 are revised herein.

These specifications will supersede DL 5002 — 1991 upon

implementation.

These specifications are proposed by the China Electricity Council.

These specifications are solely managed by the Technical Committee on Electric Power Planning and Engineering of Standardization Administration of Power Industry.

These specifications are interpreted by the Northwest Electric Power Design Institute.

These specifications are drafted by the Northwest Electric Power Design Institute.

The leading authors of these specifications: Gao Xihong, Cui Ling, Xie Yuhe, and Liu Guohua.

These specifications are translated by SUNTHER Consulting Co., Ltd. under the authority of China Electric Power Planning & Engineering Association.

1 Scope

These specifications specify the principles that shall be followed in the design of dispatch automation system in district networks.

These specifications apply to the planning, design and feasibility study of dispatch automation system in district networks, district network dispatch automation engineering, and the design of small-sized hydropower stations, thermal power stations, and substations under the jurisdiction of district network centralized control station and district network dispatch center. These specifications can be used as a reference in the design of expanded/retrofitted generation and transformation projects in district networks.

2 Normative References

The following normative documents contain provisions which, through reference in this text, constitute provisions of these specifications. For dated references, subsequent amendments (excluding the contents of errata) to, or revisions of, any of these publications do not apply. However, parties to agreements based on these specifications 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.

GB/T 9813 *Generic Specification for Microcomputers*

GB/T 13729 *Remote Terminal Unit Equipment*

GB/T 18700.1 *Telecontrol Equipment and Systems—Part 6: Telecontrol Protocols Compatible with ISO Standards and ITU-T Recommendations—Section 503: TASE.2 Service and Protocol* (idt IEC 60870-6-503: 1997)

GB/T 18700.2 *Telecontrol Equipment and Systems—Part 6: Telecontrol Protocols Compatible with ISO Standards and ITU-T Recommendations—Section 802: Object Model* of *TASE.2* (idt IEC 60870-6-802: 1997)

GB/T 18700.3 *Telecontrol Equipment and Systems—Part 6-702: Telecontrol Protocols Compatible with ISO Standards and ITU-T Recommendations—Functional Profile for Providing the TASE.2 Application Service in End Systems* (idt IEC 60870-6-702: 1998)

GB/Z 18700.4 *Telecontrol Equipment and Systems—Part*

6-602: Telecontrol Protocols Compatible with ISO Standards and ITU-T Recommendation—TASE Transport Profiles (idt IEC 60870-6-602: 2001)

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

DL/T 630 *Technical Requirement for RTU with AC Electrical Quantities Input, Discrete Sampling*

DL/T 634.5101 *Telecontrol Equipment and Systems—Part 5-101: Transmission Protocols—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 IEC 60870-5-104: 2002, IDT)

DL/T 5003 *Specifications for the Design of Dispatch Automation in Electric Power Systems*

DL/T 5103 *Design Code for Unattended Substation of 35 kV–110 kV*

DL/T 5202 *Technical Code for Designing of Electric Energy Measuring System*

3 General

3.0.1 These specifications are developed to promote the modernization of dispatch management of district networks, reflect the operational requirements of power markets, unify technical standards for design, and implement related national policies.

3.0.2 Dispatch automation system in district networks is now a main technical means for generation and dispatch of electricity. A district network dispatch automation system consists of dispatch automation system master station, power plant and substation telecontrol system (plant/substation end). As the basis for design of master station and plant/substation end, these specifications may also be referenced in addition to other applicable for the design of district network centralized control stations and other parts.

3.0.3 The district network dispatch automation design shall be based on the planning and design of district network (primary) system that has been reviewed. The system dispatch management structure and division of dispatch management responsibilities shall be defined prior to initiating the design.

3.0.4 As a principle, the design level year of district network dispatch automation should be the same as the level year of the district network (primary) system.

3.0.5 The planning and design of district network dispatch automation system may be used as the basis for feasibility study of district network dispatch automation engineering, design of dispatch automation, and preliminary design of dispatch automation in power generation and transformation.

3.0.6 The design of district network dispatch automation shall be adaptable to the hierarchical management structure of power system dispatch, and controlled in hierarchies. The information shall be directly monitored, collected, and transmitted.

3.0.7 In designing district network dispatch automation, an analysis of power system features, operational needs and communication conditions is required to propose the functional requirements, technical indicators, telecontrol information contents, information transmission schemes, requirements for functions and configurations of interface computers, as well as configurations of telecontrol systems.

3.0.8 The design of master station shall be based on reviewed planning, design and feasibility study of district network dispatch automation system to determine the types and specifications of equipment, prepare preliminary design and construction drawings, and coordinate with design liaison, acceptance, and other engineering services.

3.0.9 The design of plant/substation end shall be based on reviewed planning and design of district network dispatch automation system to verify dispatching relationships, contents of information to be collected by telecontrol, determine specifications and types of equipment, and information transmission channels, and prepare ordering drawings, schematic wiring diagrams, and installation wiring diagrams.

3.0.10 District network dispatch automation systems shall suit domestic situation to meet grid operational requirements.

3.0.11 In addition to the provisions herein, the dispatch automation design of electric power system shall comply with the current national and industrial codes and regulations.

4 Master Station

4.1 Overall System Structure

4.1.1 The master station of the dispatch automation system shall employ a redundant, open and distributed application environment. The entire hardware and software architecture shall meet the requirements in respect of redundancy and modularization.

4.1.2 Commercially available and stable latest versions of software such as operating systems and databases are recommended for dispatch automation systems. The system applications shall be in modular design and meet applicable national and international standards. Standard software programming interfaces shall be used to enhance software and hardware independence.

4.2 General Functions

4.2.1 Based on its assigned dispatch responsibilities, a district network dispatch automation system shall achieve the following general functions:

1 Computer communication.
2 Supervisory control and data acquisition (SCADA).
3 Network topology.
4 State estimation.
5 Load forecast.
6 Dispatcher power flow.
7 Voltage reactive power optimization control.

4.2.2 A district network dispatch automation system should be

based on its assigned dispatch responsibilities and actual needs to fulfill the following functions:

1 Short-circuit current calculation.
2 Calculation of arc suppression coil compensation degree.
3 Static security analysis.
4 Static equivalent in external networks.
5 Calculation of network loss.
6 Dispatcher training simulator (DTS).

4.2.3 The district network dispatch automation functions can be implemented in stages. Basic functions closely related to operational safety and economic effects shall be deployed first. The functions for which infrastructures are not available can be postponed or implemented in stages.

4.2.4 District network dispatch centers shall, based on their various application levels, consummate the remote control and regulation functions and progressively achieve the network analysis and DTS functions.

4.2.5 For data collection over network and connection to other computer systems, sufficient consideration shall be given to network security and necessary protective measures shall be provided.

4.2.6 A central control station may collect and supervise data of power plants and substations under its jurisdiction and provide basic preventions against unintended operations, as well as gather and send information to district network dispatch centers.

4.3 Technical Requirements

4.3.1 A special telecontrol channel shall be provided for communication between telecontrol systems of the master station and the plant/substation end. The telecontrol protocols shall comply with DL/T 634.5101,

DL/T 634.5104 and other applicable standards. Only one telecontrol protocol released as national standard should be applied within the scope of a district network dispatch center. If other telecontrol protocols are present within this scope, they may be converted or addressed by other means.

4.3.2 Network communication should be used for communication between dispatch automation systems of different dispatch centers and between dispatch automation system and other computer application systems within the same dispatch center. The communication protocols shall comply with provisions specified in GB/T 18700.1, GB/T 18700.2, GB/T 18700.3, and GB/T 18700.4.

4.3.3 For network communication, safety and isolation measures shall be taken according to national regulations on security protection for secondary power systems.

4.3.4 Data Collection, Processing, and Control Type.

1 Remote metering quantity: analog quantity, pulse quantity, digital quantity.

2 Remote signaling quantity: status signal.

3 Remote controlling command: digital quantity, pulse quantity.

4 Remote regulation command: analog quantity, pulse quantity, and digital quantity.

5 Clock synchronization signal.

6 Calculation quantity.

7 Statistics quantity.

8 Manual input quantity.

4.3.5 The master station shall be equipped with an internal calendar clock with a millisecond resolution and able to receive synchronization commands from GPS standard clock.

4.3.6 The error between the dispatch automation system time and

standard time shall not be more than 1 ms.

4.3.7 Technical Indicators.

1 Remote metering quantity:

(1) The comprehensive error of remote metering shall not be more than ±1.0% (ratings).

(2) The minimum setting for transmission across dead band shall not be less than 0.25% (ratings).

2 Remote signaling quantity:

(1) The accuracy shall not be less than 99.9%.

(2) The resolution of sequence of event between substations shall not be more than 10 ms.

3 The remote controlling accuracy shall be 100%.

4 The remote regulation accuracy shall not be less than 99.9%.

4.3.8 Real-time Indicators:

1 For remote metering, the transmission time from across dead band to the controlling 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 controlling station shall be no greater than 3s.

3 The transmission time of remote controlling and remote regulation commands shall not be more than 4s.

4 The response time of workstation screen when invoked:

(1) 85% of the screens ≤ 2s.

(2) The remaining screens ≤ 3s.

5 The refresh cycle of real-time data of workstation screens shall be 5–10s (adjustable).

6 The invoking and response time of real-time data screens on mimic panel (electronic):

(1) 85% of the screens ≤ 5s.

(2) The remaining screens ≤ 10s.

7 The output cycle of printing reports can be set as required.

8 The time from automatic switching between active and standby machines to restoration of basic monitoring functions shall not be more than 30 s.

9 The data refresh cycle of mimic panel shall be 6—12s.

10 The single calculation time of network topology shall be ≤ 10s.

11 The single calculation time of state estimation shall be ≤ 15s.

12 The optimization calculation time for reactive power shall be ≤ 10s.

13 The power flow calculation error of the dispatcher shall be ≤ 1.5%.

14 The single power flow calculation time of dispatcher shall be ≤ 5s.

Note: the above items 10–14 are the indicators where the calculated network scale has no more than 500 computation nodes.

4.3.9 Reliability Indicators:

1 The annual availability of a stand-alone system shall not be less than 96%.

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

4.4 Principles for Selection and Configuration of Hardware

4.4.1 The dispatch automation system in a district network shall include the following hardware:

1 Computer system, including server, workstation, and pre-processing equipment.

2 LAN switch, external storage, and network security devices.

3 Input/output device.

4 Standard clock equipment.

5 Dispatching equipment, including electromechanical or electronic mimic panel, dispatching console, and monitor.

6 Channel interface.

7 Dedicated UPS.

4.4.2 Principles for configuration of dispatch automation hardware in district networks.

1 The hardware shall fulfill the dispatch automation functions and meet the technical requirements of the system.

2 The new computer system shall have high scalability, maintainability, compatibility, reliability, and cost efficiency.

4.4.3 The scale of computer system shall be determined based on the dispatch automation functions for the design level year and the needs for 10 years development, with a consideration of the following conditions.

1 Capacity of data collection and monitored objects.

2 Type and quantity of telecontrol systems.

3 Type and quantity of data exchange with higher-level and neighboring district network dispatch automation systems.

4 Type and quantity of external equipment.

5 Quantity of channels and transfer rate.

6 Load rate and estimation condition of CPU.

4.4.4 The average load rate of the main server and workstation CPU should be less than 20% in any arbitrary 30 minutes under normal network operation and less than 50% in any arbitrary 10 seconds under faulted network operation.

4.4.5 The LAN load rate should be less than 10% under normal conditions.

4.4.6 Data communication equipment shall be provided for computers