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To Replace SDGJ 84 — 1988

Design Regulations of Content and Profundity for Hydro and Fossil Fuel Power Plant Connecting to the System

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Contents

Foreword

This standard is a revision to SDGJ 84—1988 *Design Regulations of Content and Profundity for Hydro and Fossil Fuel Power Plant Connecting to the System* in accordance with the *Notice regarding Printing and Distributing 2008 Industry Standard Planning issued by the General Office of the National Development and Reform Commission* (FGBGY [2008] 1242).

Since the issuance and implementation of SDGJ 84—1988 *Design Regulations of Content and Profundity for Hydro and Fossil Fuel Power Plant Connecting to the System* in 1989, it has been playing an active guiding role in the early design of connection of hydro and fossil fuel power plants to power systems. With technical progress in the electric power system, increasing expansion of grid scale, further extension of nationwide networking, and the ongoing deepening of reform on power industry commercialization system, some articles of the original regulations need to be revised or enriched due to their failure to meet the design requirements. This standard is revised for better planning and design of electric power system.

Revisions and changes are made as compared with the last edition in the following major aspects:

—Add the requirement that the connection scheme shall meet DL 755 *Guide on Security and Stability for Power System*;

—Add the content of subject study;

—Delete the content of investment estimate;

—Add the content of connection design (secondary system), etc.

This standard will supersede SDGJ 84—1988 upon

implementation.

This standard is proposed by China Electricity Council.

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

This standard is drafted by Northeast Electric Power Design Institute and East China Electric Power Design Institute of China Power Engineering Consulting Group.

The leading author of this standard: Primary system: Guo Jia, Li Zhiguo, Wu Jingkun, Fu Guang, and Tan Yongcai.

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Opinions and suggestions proposed during the implementation of this standard are to be referred to the Standardization Center of China Electricity Council (No.1, Lane 2, Baiguang Road, Xuanwu District, Beijing, 100761).

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

1 Scope

This standard specifies the requirements for design content and profundity for connection of primary and secondary systems in large hydro and fossil fuel power plants to power systems.

This standard is applicable to the design of connection of large hydro and fossil fuel power plants to 220 kV and above voltage levels.

This standard may be as a reference for connection of small and medium hydro and fossil fuel power plants to other voltage levels and their content can be deleted as appropriate.

2 Normative References

The following normative documents contain provisions which, through reference in this text, constitute provisions of this standard.

For dated references, subsequent amendments to, or revision (excluding the contents of errata) of any of these publications do not apply. However, parties to agreements based on this rule 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 documents referred to applies.

DL 755 *Guide on Security and Stability for Power System*

SD 325 *Guideline of Power System Voltage and Reactive Power Technology*

3 General Provisions

3.0.1 The design of connection of large hydro and fossil fuel power plants to power systems shall be generally conducted concurrently with feasibility study, or according to the schedule of the entrusted task if necessary.

3.0.2 The design of connection to power system shall be guided by power industry planning, power network planning and design, transmission planning of power source base, and approved power system design, in accordance with applicable national policies and design rules and regulations.

3.0.3 For large hydro and fossil fuel power plants which transport power across regions or provinces, cascade hydro power stations in river basin, new fossil fuel power plants with a planned capacity above 2400 MW or close to concentration of fossil fuel power sources, their specific connection schemes shall be determined based on the completed and reviewed transmission system planning.

3.0.4 The design of primary system for connection of large hydro and fossil fuel power plants to power system is intended to further the study of the relationship between power plant and power system, demonstrate transmission direction, outgoing line voltage level, number of outgoing line circuits, and propose system requirements for main electrical connection and parameters of related electrical equipments, thereby meeting the requirements of feasibility study and preliminary design of the plant for primary system and providing basis for feasibility study of transmission engineering of the plant. The design of secondary system connection shall be conducted after review

of the primary system connection design by related departments and according to the approved primary design scheme, proposing connection schemes for system relay protection, safety and stability control, dispatch automation, energy metering, power plant bidding system, dispatch data network access and security protection, and system communication. Where necessary, the connection design scheme of internal DMIS and integrated data network shall be completed as well.

3.0.5 The connection scheme of large hydro and fossil fuel power plants shall be selected from multiple alternative schemes through technical and economic demonstration considering both long-term and short-term future scenarios. The recommended scheme shall be justified by advanced technology, economic effectiveness, stability and safety, clear connection, strong adaptability to short-term and long-term scenarios, and flexible operation. Sensitivity analysis shall be conducted for uncertainties and variables in the power system.

3.0.6 The connection design shall meet the requirements for optimal allocation of energy and resources and market-oriented operation of the power sector to the maximum extent possible.

4 Connection Design (Primary System)

4.1 Design Basis and Principles

4.1.1 State the basis for design tasks.

4.1.2 State the content of design as well as the opinions and special requirements of the entrusting party for the major principles of design.

4.1.3 State the comments on preliminary feasibility study and transmission system planning design of the power plant.

4.1.4 State the generation capacity, schedule, and determine the design level year of the power plant.

4.1.5 State the issues of principle regarding connection design of power plant, such as power industry planning, power network planning and design, power system planning and feasibility study of major power engineering projects.

4.1.6 State other major principles to be followed during design.

4.1.7 State the major information and data source of design basis.

4.2 Status of Power System and Overview of Power Plant

4.2.1 The status of power system related to the power plant, including:

1 Situation of power networks at and above 220 kV.

2 Load level and characteristics.

3 Power source capacity and mix.

4 Power sending/receiving to/from adjacent power networks.

5 Major operation indicators of power network.

4.2.2 Overview of the power plant, including site conditions,

planned capacity, construction capacity for current phase. For hydro power plants, the guaranteed output, annual generation, as well as average monthly output in different representative level years, expected output, forced output and regulation performance of reservoir shall also be stated. For expanded power plants, the overview of old plant and expansion conditions shall also be stated.

4.3 Power Demand Forecast

4.3.1 The load forecasts made in power market analysis and forecast reports and power system planning and design reports recently reviewed by planning authorities or load levels recognized by the national, provincial or local network are usually used.

4.3.2 Provide the year-on-year increase of installed capacity and energy demand and distribution of load, and brief the reasons for load increase. Load increase in areas near the power plant shall be specially described.

4.3.3 For the purpose of researching the requirements of system operation scenarios and peak regulation for the power plant, the load characteristics and development trend shall be analyzed.

4.4 Power Source Planning

4.4.1 List the power source projects put into operation, as well as their installed capacity and schedule during the planning period.

4.4.2 List the decommissioning plan of generator sets during the planning period.

4.5 Balance of Electric Power and Energy as well as the Status and Role of Power Plant in Power System

4.5.1 Give the electric power exchange between the system

concerned and other systems in the design level year and prospect year.

4.5.2 In case that the connection design requires studies on operation mode of hydro and fossil fuel power plants, a list should be made to indicate the output indicators of such power plants within the national, provincial or local network. These indicators include: Guaranteed output, monthly average output in different level years, expected output and forced output of hydro power plants; allowable minimum output of fossil fuel power plants.

4.5.3 The following shall be determined through analysis of balance of electric power and energy:

1 Analyze the balance of electric power and energy in the national, provincial or local network as required. According to the annual electric power balance for the year before the first generator set is put into operation until the design level year and prospect year, make a power balance sheet to determine the total operating capacity and relevant reserve capacity of hydro and fossil fuel power plants; for fossil fuel power plants, the average annul operating hours of generator sets in design level year shall be determined, and recommendations shall be made on the design annul operating hour of the power plant concerned.

2 Analyze the peak regulation of the power system and requirements for the power plant.

3 Check the appropriate installed capacity and schedule of the designed power plant, and further demonstrate the region of power supply, necessity of building the plant and its role in the power system.

4 If necessary, analyze the electric power balance in different hydrological years on a monthly or ten-day basis.

5 For pumped storage power plants, the requirements of system for peak regulation shall be studied and peak-valley difference shall be

analyzed and demonstrated.

4.6 Connection Scheme

4.6.1 Describe the network construction of power systems related to the designed power plant before its operation.

4.6.2 Analyze the typical operation modes on representative days of different seasons (only the maximum output season for fossil fuel power plants; wet seasons and dry seasons for hydro power plants) to determine power exchange between the designed power plant and power receiving areas.

4.6.3 Propose voltage level and alternative schemes for connection of the power plant according to the analysis results of operation mode, system voltage series, and characteristics of existing network, load distribution and short circuit level.

4.6.4 The connection scheme shall meet the requirements for safety and stability in DL 755.

4.6.5 As regards comparing different alternative schemes, the following electrical calculation and analysis shall be conducted:

1 Power flow calculation and analysis, to determine whether a scheme can meet the need for power supply in normal and failure conditions and compare the active power loss of different schemes.

2 Stability calculation for specific objects under study, to check the stability level. If the calculation results show instability, analysis and studies shall be done to propose measures for enhancing the stability level. Calculate the stability limit of critical circuits as required to compare the difference of stability margin between various alternative schemes.

3 Calculate the reactive power configured and short-circuit current if they impose huge impact on comparing the alternative

schemes.

4.6.6 Conduct comprehensive technical and economic comparison and analysis on alternative connection schemes to propose a recommended scheme.

4.6.7 If necessary, the following electrical calculations shall be conducted with respect to the recommended connection scheme:

1 In case that the power plants are connected to system through a long EHV line (especially through compact lines), the self-excitation of generators shall be checked through calculation. A solution shall be proposed accordingly if there are conditions for self-excitation to occur.

2 Calculate power frequency overvoltage and secondary arc current to propose preliminary configuration opinions on high-voltage reactors and small neutral reactors for high-voltage reactors.

3 Calculate reactive balance at node to propose reactive power configuration of system at high voltage and low voltage.

4 Calculate phase and voltage regulation to determine voltage regulation mode and transformer tap, to put forward requirements for power factors of generators and to determine whether leading phase operation is needed. The calculation of reactive power compensation and phase and voltage regulation shall meet the requirements in SD 325.

5 Calculate short-circuit current of related systems after the power plant is put into operation, and propose the short-circuit current level of related systems for 10 years and more after the power plant is put into operation.

4.6.8 After the connection scheme is reviewed, if necessary, special studies shall be made to calculate electromagnetic transient and electromagnetic induction to decide whether the breaker requires closing resistor, and check the configuration of high-voltage shunt