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Planning guide for electrochemical energy storage station in power system

电力系统配置电化学储能电站规划导则

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Table of Contents

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1 Scope

This document specifies the system requirements analysis for electrochemical energy storage station in power system, as well as the configuration principles and methods of electrochemical energy storage station on the power supply side, grid side, and user side.

This document applies to the planning and configuration of the electrochemical energy storage station connected to power system at a voltage level of 10 (6) kV and above.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB 38755, Code on security and stability for power system

DL/T 2528, Basic terminology of electrical energy storage

3 Terms and definitions

For the purposes of this document, the terms and definitions given in DL/T 2528 and the following apply.

3.1

electrochemical energy storage station

Energy storage station whose energy storage uses electrochemical energy storage media, which mainly include: lithium-ion battery, lead-acid/lead-carbon battery, flow battery, sodium-ion battery, sodium-sulfur battery, fuel cell, etc. Electrochemical energy storage station is divided into three categories: power supply side, grid side, and user side according to its access point location.

3.2

peak shaving

regulation resources, and demand-side response capabilities, and be determined in combination with factors such as the construction conditions and construction period of the energy storage project.

4.5 When the planning and implementation of the electrochemical energy storage station differs significantly from expectations or there are major adjustments to the energy and power plan, planning assessment and rolling adjustments shall be conducted.

5 System requirements analysis

5.1 General requirements

5.1.1 The requirements analysis of electrochemical energy storage station in power system shall be determined based on the system's peak shaving, frequency regulation, black-start and other needs, and should be carried out in combination with the layering and zoning of the grid structure.

5.1.2 The calculation level year of requirements analysis shall be consistent with the planning level year, and divided into short-term, medium-term and long-term. Short-term requirements analysis shall list the analysis results year by year.

5.1.3 The requirements analysis for electrochemical energy storage station in power system shall be carried out based on the current status of the power system and the system power, electricity, and regulation balance results, and in combination with the planning level year power supply planning, grid planning, existing and planned new and retired flexible regulation resources, etc.

5.1.4 The requirements analysis for electrochemical energy storage station in power system shall meet the relevant requirements of GB 38755.

5.2 Basic data collection

5.2.1 The requirements analysis for electrochemical energy storage station in power system shall collect the current status and planning data of the area.

5.2.2 The current status data shall include data on power grid, power source, load, electrochemical energy storage station and other types of energy storage, and shall meet the following requirements:

a) Grid data includes grid structure, power flow distribution, as well as equipment parameters such as lines, transformers, and reactive power compensation devices;

b) Power supply data includes power supply type, power supply structure, installed capacity, layout, output characteristics, peak shaving and frequency regulation characteristics, black-start capability, power generation, annual utilization hours, maintenance and downtime, etc.;

c) Load data includes load type, maximum load, minimum load, load characteristics, power consumption, average annual growth rate, etc.;

d) Electrochemical energy storage station data includes energy storage battery type, rated charging power, rated discharging power, rated charging energy, rated discharging energy, regulation performance, grid connection point, technical and economic parameters, etc.;

e) Other types of energy storage data include technology type, installed capacity, regulation performance, grid connection point, technical and economic parameters, etc.

5.2.3 Planning data shall include load forecast data, power supply planning schemes, grid planning schemes, energy storage projects under construction and included in the plan, etc.

5.3 System peak-shaving energy storage requirements analysis

5.3.1 The system peak-shaving energy storage requirements shall be determined based on the analysis of the power, electricity and peak-shaving balance in each planning level year, and should be determined in the following way:

a) Calculate the system peak shaving requirements based on the output characteristics of power sources (including pumped storage power stations), the transmission curve of interconnected system tie lines and load characteristics, deduct the existing and planned new and retired system peak shaving capacity, and determine the power demand of the electrochemical energy storage station;

b) Calculate the system deficit and surplus balance electricity in typical modes for each level year on an annual, quarterly and monthly basis to determine the energy requirements of the electrochemical energy storage station.

5.3.2 The system peak-shaving energy storage requirements analysis shall be calculated using the production operation simulation method to determine the power and energy configuration scale of the electrochemical energy storage station.

5.3.3 The electrochemical energy storage station used for system peak shaving should combine the energy storage utilization rate and economic benefits, and make technical and economic comparisons with various types of flexibility regulation resources such as flexibility transformation of thermal power units and construction of pumped storage units in the planning area to determine the power and energy configuration scale.

5.4 System frequency regulation and energy storage requirements analysis

5.4.1 The system frequency regulation energy storage requirements shall be determined based on the frequency fluctuation analysis and should be determined in the following way:

b) For requirements that cannot be met through electrochemical energy storage operation optimization and time-sharing reuse, calculate separately in the configuration requirements analysis and reserve a certain margin.

5.6.2 The layout location of the electrochemical energy storage station shall be based on the scenario requirements it meets, combined with power supply, grid planning and layout, future load growth and distribution, regional power supply reliability characteristics, comprehensive benefits and other factors, adopting the principle of nearby deployment, focusing on the selection of key grid nodes or nearby nodes such as tight load power supply, new power source collection, large-capacity DC feed-in, insufficient voltage support capacity, etc., and analyzing the impact of energy storage charging and discharging power on the power quality, voltage regulation, main transformer and line load of the surrounding grid. See Appendix A for the application scenarios and comprehensive benefits of electrochemical energy storage stations.

6 Electrochemical energy storage station on the power supply side

6.1 Configuration principles

The planning scheme for configuring electrochemical energy storage stations on the power supply side shall be coordinated with the power supply development plan. According to the power supply construction sequence, spatial layout and grid access conditions, determine the planning scale, construction sequence and spatial layout of the electrochemical energy storage station in combination with the needs of multiple scenarios. The power supply side energy storage participating in the power market shall meet the requirements of accepting grid dispatching.

6.2 Electrochemical energy storage stations equipped in wind farms and photovoltaic power stations

6.2.1 The planning scheme for configuring electrochemical energy storage stations for wind farms and photovoltaic power stations should be determined based on the utilization capacity of energy storage in multiple application scenarios and the comprehensive economic benefits.

6.2.2 The rated power and rated energy of electrochemical energy storage stations configured in wind farms and photovoltaic power stations shall be determined in the following manner based on the analysis of wind power and photovoltaic output characteristics, combined with application scenarios such as tracking planned output curves, improving transmission capacity, assisting frequency regulation, and providing grid peak shaving capabilities:

a) For the scenario of tracking the planned output curve, it should be determined according to the requirements for the power generation plan deviation assessment limit;

b) For the scenarios of improving transmission capacity, it should be determined based on the power size and duration of the maximum output of wind farms and photovoltaic power stations exceeding the transmission capacity of the line, as well as the need to reduce the peak-to-valley difference in station output;

c) For the scenarios of assisting frequency regulation, it should be determined based on the requirements of the grid dispatching operation for the primary frequency regulation limit, regulation rate and dynamic performance of wind farms and photovoltaic power stations;

d) For the scenarios of providing grid peak shaving capabilities, it should be determined based on the grid dispatching and operation requirements for the station peak shaving regulation capacity.

6.2.3 Wind farms and photovoltaic power stations in the same region are connected to the power grid using a multi-station aggregation method. The planning scheme of the electrochemical energy storage station should be determined in combination with the comprehensive output characteristics of the aggregation station.

6.2.4 Wind farms and photovoltaic power stations in different regions shall be coordinated with electrochemical energy storage stations. The planning scheme of the electrochemical energy storage station shall be determined in combination with the comprehensive output characteristics after the output of each station is superimposed.

6.2.5 The construction sequence of electrochemical energy storage stations configured for wind farms and photovoltaic power stations shall be determined in combination with the batch construction of wind farms and photovoltaic power stations, as well as the transmission capacity of the transmission lines of the stations and their collection stations.

6.3 Electrochemical energy storage station configured with conventional power supply

6.3.1 The planning scheme for electrochemical energy storage station configured with conventional power sources shall be determined through technical and economic analysis, taking into account the energy storage construction cost and recovery model, and the overall economic efficiency of conventional power sources and energy storage.

6.3.2 When the peak-shaving capacity of conventional power sources is required to be increased, the rated power and rated energy of the electrochemical energy storage station can be determined from the perspective of meeting the minimum technical output of the power source and the power source regulation speed, based on the peak-

planning and construction schedule, to meet the power system's annual planning and configuration requirements for the electrochemical energy storage station.

8 Electrochemical energy storage station on the user side

8.1 The planning of user-side electrochemical energy storage stations should be combined with the electricity price mechanism and energy storage operation model, and the scale of the electrochemical energy storage power station shall be determined based on the current data and actual needs of user-side energy storage, as well as factors such as the policy environment, user willingness, and industrial supporting facilities.

8.2 The rated power and rated energy of the electrochemical energy storage station configured on the user side shall be determined based on the utilization capacity of the energy storage in multiple application scenarios and the comprehensive economic benefits, combined with the grid access conditions, and after technical and economic comparison.

8.3 The electrochemical energy storage station configured on the user side shall be determined based on the analysis of the user load characteristics in the planned horizontal year, combined with application scenarios such as time-of-use electricity price benefits, demand charge reduction, emergency power supply guarantee, power quality improvement, and participation in demand response, and the rated power and rated energy shall be determined in the following way:

a) For time-of-use electricity price profit scenarios, it should be determined based on factors such as user electricity consumption characteristics, household distributed power generation characteristics, power transformation (distribution) facility capacity, and electricity price information;

b) For demand-based electricity fee reduction scenarios, it should be determined based on the capacity of the user's power transformation (distribution) facilities and peak load power in the planned level year;

c) For emergency power supply scenarios, it should be determined based on the reliability requirements of power supply to important loads, the power grid transfer capacity and the existing emergency power supply conditions;

d) For power quality improvement scenarios, it should be determined based on the power quality management needs of the user's grid connection point and internal power supply system;

e) For demand response scenarios, it can be determined in combination with the response compensation mechanism.

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