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**Design guidelines for distributed energy system of
combined cooling, heating and power**

分布式冷热电能源系统设计导则

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Table of Contents

Foreword.....	3
1 Scope.....	4
2 Normative references.....	4
3 Terms and definitions	6
4 General rules	8
5 Planning and decision-making	10
6 Engineering design	12
7 Operation management	17
Appendix A (Informative) Configuration of the distributed energy system of combined cooling, heating and power.....	20
Appendix B (Informative) Scope of evaluation content of the distributed energy system of combined cooling, heating and power	22
Appendix C (Informative) General process of distributed energy project approval and engineering construction	24
Appendix D (Informative) Energy-converted standard coal reference coefficients	25
Appendix E (Informative) Various energy-converted equivalent electric coefficient.....	27
Appendix F (Informative) Energy quality coefficient of common cold and heat quantity	28
Appendix G (Informative) Energy equivalent value of energy-consumed medium	29
References	30

Design guidelines for distributed energy system of combined cooling, heating and power

1 Scope

This Standard specifies the general rules, planning and decision-making, engineering design, and operation management which are involved in the design of the distributed energy system of combined cooling, heating and power.

This Standard applies to the distributed energy system of combined cooling, heating and power, which is based on gas fuels; it also applies to the design of distributed energy project or distributed energy station of combined cooling, heating and power, which is based on gas fuels. It can be used as reference for the distributed energy system of combined cooling, heating and power, which is based on liquid fuels, under the same technical conditions.

This Standard does not apply to the distributed energy system of combined cooling, heating and power, which is driven by solid fuels, including renewable energy, and other non-fossil energy sources.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only the dated version applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB/T 2589-2020, General rules for calculation of the comprehensive energy consumption

GB 3096, Environmental quality standard for noise

GB 8978, Integrated Wastewater Discharge Standard

GB 10070, Standard of environmental vibration in urban area

GB 12348, Emission standard for industrial enterprises noise at boundary

GB 13271, Emission standard of air pollutants for boiler

GB/T 15316, General principles for monitoring and testing of energy conservation

GB 50019, Design code for heating ventilation and air conditioning of industrial buildings

GB 50028, Code for design of city gas engineering

GB 50040, Standard for design of dynamic machine foundation

GB/T 50087, Code for design of noise control of industrial enterprises

GB 50118, Code for design of sound insulation of civil buildings

GB 50365, Standard for operation and management of central air conditioning system

GB 50736, Design code for heating ventilation and air conditioning of civil buildings

GB/T 50852, Classification standard of building engineering consultation

GB 51131, Technical code for gas-fired combined cooling, heating and power engineering

GB/T 51285, Standard for the energy-efficient effect evaluation of building energy performance contracting

DL/T 5508-2015, Code for design of gas-fired distributed energy station

JG/T 299, Technical specifications of thermal storage equipment for cooling and heating

NB/T 32015, Technical rule for distributed resources connected to distribution network

NB/T 42029.5, Code for design of reciprocating internal combustion gas engine power station - Part 5: Cooling system

3 Terms and definitions

Terms and definitions determined by GB/T 33757.1, GB/T 36160.1-2018, GB/T 36160.2-2018, GB 50365, GB/T 50852, GB/T 34913-2017, GB/T 2589-2020, GB 51131, and the following ones are applicable to this document.

3.1

Distributed energy system of combined cooling, heating and power

Energy quality utilization ratio

The percentage OF the sum of the output equivalent electric quantity and cooling (heating) quantity of the distributed energy system of combined cooling, heating and power AND the sum of the input equivalent gas or liquid fuel heat quantity and other energies.

Note 1: This term takes into account the difference in energy grade and quality, which is different from 3.4 energy utilization ratio.

Note 2: Refer to the "second boundary" in Figure A.1 for the calculation boundary.

3.6

Commissioning

The working procedures and methods that perform a whole-process management through testing adjusting and balancing, performance verification, acceptance and seasonal working condition verification of the distributed energy system of combined cooling, heating and power, so as to ensure the realization of the design intent and the satisfaction of the actual use requirements of users.

4 General rules

4.1 The design of distributed energy system of combined cooling, heating and power shall mainly consider:

- a) Guaranteed supply of energy (gas);
- b) Reasonable site selection and establishment;
- c) Efficient and energy-saving system;
- d) Economic operation;
- e) Environmental protection.

4.2 The design activities of the distributed energy system of combined cooling, heating and power should include planning and decision-making, engineering design and operation management; the design content generally includes feasibility study, engineering design, and project evaluation and assessment. For preparation of each stage, see GB/T 50852, or refer to the contents of the municipal public engineering design documentation depth regulations and the constructional engineering design documentation depth regulations, but not limited to the feasibility study of the project.

establishment and engineering construction of the distributed energy project can be found in Appendix C.

5.2 The earlier stage of a distributed energy project is the planning and decision-making stage; a feasibility study of the project shall be compiled according to the requirements of 4.2 according to the complexity of the project.

5.3 For the feasibility study of the project, refer to Appendix B for the assessment of the earlier decision-making stage, which includes:

- a) This stage is a qualitative assessment, which shall perform analysis of the technology and energy efficiency of the distributed energy system of combined cooling, heating and power;
- b) The assessment is based on the matching of project supply and demand, energy saving rate, energy utilization ratio, environmental and social impact, and supplemented by economic indicators;
- c) The assessment shall meet the content requirements of 4.6 and be calculated in accordance with GB/T 33757.1 and GB/T 36160.1-2018;
- d) The assessment should refer to the "first boundary" in Figure A.1 to make a preliminary estimate of the types and quantities of energy supply and demand.

5.4 The distributed energy station of combined cooling, heating and power (hereinafter referred to as "distributed energy station") shall be set up close to users; the site planning and building requirements shall comply with the relevant regulations of GB 50016 and DL/T 5508-2015.

5.5 The distributed energy system of combined cooling, heating and power shall be designed in accordance with the requirements of the preliminary environmental impact assessment; the environmental protection planning and design of the distributed energy project shall meet but not limited to the following requirements:

- a) The exhaust gas emission and chimney setting shall meet the requirements of GB 13271;
- b) The noise value of the distributed energy station shall meet the requirements of GB 3096, GB 12348, and GB 22337;
- c) The environmental vibration of the distributed energy station shall meet the requirements of GB 10070;
- d) The discharged water quality shall meet the requirements of GB 8978 and GB/T 31962.

6.2.1 The cooling, heating, and power design loads of the distributed energy system of combined cooling, heating and power shall be implemented as follows:

- a) The design load shall include the design day calculation load and the hourly load throughout the year; the cooling and heating loads include building load and technical load;
- b) The design load of each stage of the project: estimation shall be adopted in the earlier-stage planning stage; calculation shall be adopted in the mid-term design stage; actual measurement shall be adopted in the later-stage operation stage;
- c) For the design load, give priority to adopt or refer to the measured data; then, obtain it by calculation. For the calculation of the cooling and heating load, see GB 50736;
- d) For the design load analysis of the distributed energy system of combined cooling, heating and power, see DL/T 5508-2015.

6.2.2 The design and configuration options of the distributed energy system of combined cooling, heating and power are as follows:

- a) For the power subsystem, see Appendix A, Appendix B, and Appendix C in GB/T 36160.2-2018;
- b) For the refrigeration and heating subsystem, see Appendix B and Appendix C in GB/T 36160.1-2018;
- c) Refer to Figure A.2. for the cold storage and heat storage system.

6.2.3 For the distributed energy system of combined cooling, heating and power, determine the form and capacity of the cold storage and heat storage system according to the capacity of the power generation system, user load characteristics, local peak and valley electricity price policies, and economical efficiency of investment and operation.

6.2.4 In order to maximize the use of exhaust heat, efficient use of energy, and convenient management, the design shall provide the annual operation strategy and operation mode of the distributed energy system of combined cooling, heating and power, as well as guiding the operation and commissioning of the project in the later period.

6.2.5 For the preliminary design and construction drawing design, refer to Appendix B for the design of the distributed energy system of combined cooling, heating and power, to perform the following analysis and evaluation:

6.4.1 The power generation system of the distributed energy system of combined cooling, heating and power is composed of gas turbine or internal combustion engine, steam turbine, exhaust-heat recovery boiler, generator and auxiliary equipment. For specific parameter requirements and forms, see GB/T 36160.2-2018.

6.4.2 The choice of the form and capacity of the prime mover shall take into account factors such as project characteristics, load characteristics, noise, nitrogen oxide emission concentration, and economic efficiency.

6.4.3 The power generation system design shall comply with the relevant regulations of GB/T 36160.2-2018, GB 51131 and DL/T 5508-2015.

6.5 Refrigeration and heating system

6.5.1 The refrigeration and heating system of the distributed energy system of combined cooling, heating and power is composed of electric refrigeration and heating system, exhaust-heat refrigeration and heating system, exhaust-heat recovery boiler and auxiliary equipment. For specific parameter requirements and forms, see GB/T 36160.1-2018.

6.5.2 The exhaust-heat utilization system shall follow the design principles of temperature matching and gradient utilization; the selection of the refrigeration and heating system shall comprehensively consider factors such as project characteristics, load characteristics, energy quality coefficient of the output medium, and economic efficiency.

6.5.3 The application equipment of the refrigeration and heating system shall be determined according to the prime mover's exhaust heat parameters. The exhaust heat shall be used when the exhaust gas temperature is ≥ 120 °C and the cooling water temperature is ≥ 75 °C. The energy efficiency of the selected refrigeration and heating equipment shall meet the requirements of GB 19577 and GB 29540.

6.5.4 The prime mover and the refrigeration and heating equipment shall adopt a one-to-one configuration; for micro gas turbines and internal combustion engine generator sets with a small unit capacity, a many-to-one form can be used, and the same model of modular combination should be used for the generator sets.

6.5.5 The design of the refrigeration and heating system shall still comply with the relevant regulations of GB/T 36160.1-2018, GB 50019 and GB 50736.

6.6 Monitoring and control system

7 Operation management

7.1 General provisions

7.1.1 The distributed energy system of combined cooling, heating and power shall strengthen operation management and standardize project evaluation to achieve efficient operation of the system.

7.1.2 The operation management strategy, control and use methods, operation instructions, and settings of different working conditions of the distributed energy system of combined cooling, heating and power shall be used as technical data management, which should be entrusted to professional institutions to study and formulate.

7.1.3 The distributed energy project shall undergo special system adjustment, which includes six stages, namely project establishment, data collection, inspection and testing, analysis and diagnosis, rectification implementation, and effect verification.

7.1.4 The distributed energy system of combined cooling, heating and power shall develop comprehensive, safe and reliable emergency management measures for accidents. For key parts which are of high temperature, high pressure, inflammable and explosive, and prone to emergencies, risk analysis and safety evaluation shall be carried out in advance, and emergency plans and long-term preventive emergency measures shall be formulated.

7.1.5 The operation and management of the distributed energy system of combined cooling, heating and power shall comply with relevant regulations in GB 50365, GB/T 51131, GB/T 17981-2007, GB/T 36160.1-2018, GB/T 36160.2-2018, and GB/T 33757.1.

7.2 Operation evaluation

7.2.1 After the distributed energy system of combined cooling, heating and power has been in stable operation for at least one year (including at least a complete refrigeration season and a complete heating season), refer to Figure 1 and Appendix B for the following measurements, verifications, and evaluations:

- a) For the evaluation results of 6.2.5 in the design stage, perform evaluation and review in the operation stage, to verify whether the performance meets the indicator requirements of 4.6;
- b) According to the annual cooling, heating, power supply and power consumption and fuel consumption of the distributed energy system of

the exhaust-heat utilization ratio is lower than 75% for a long time, the operation mode shall be optimized and adjusted.

7.3.3 The fuel supply and power generation system shall be inspected, maintained and tested regularly to ensure normal and effective operation.

7.4 Personnel and management

7.4.1 The operation of the distributed energy system of combined cooling, heating and power shall have professional operation and management personnel; the personnel shall be complete; the technical level shall be reasonable; they shall have relevant professional knowledge such as safety, health, and energy saving.

7.4.2 Operation management personnel shall undergo professional training and shall be employed after passing the assessment; the employing department shall establish and improve the personnel training and assessment system, and shall keep relevant files.

7.4.3 The operation management department shall establish the energy management system of the enterprise according to GB/T 23331; formulate the energy management system according to GB/T 15587; formulate and improve the target parameters suitable for the distributed energy system of combined cooling, heating and power according to GB/T 36713.

7.4.4 Public institutions shall establish an energy management system and energy management evaluation indicators for the distributed energy system of combined cooling, heating and power in accordance with GB/T 32019 and GB/T 30260.

7.4.5 For the distributed energy system of combined cooling, heating and power that is under the energy conservation monitoring, relevant measures for energy conservation monitoring shall be formulated in accordance with GB/T 15316.

7.4.6 The distributed energy system of combined cooling, heating and power should be managed through building information models, smart equipment emergency management models, asset management databases, and equipment maintenance and repair databases.

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