Deployment mode of District centralized cooling system in City

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Abstract— Nowadays, district central cooling system is used widely to provide cooling for a city or a large area. The existence of a large amount of vanadium brings unexpected problems to the prevention of high temperature. This paper discusses the main features of District centralized cooling system, introduces the characteristics and construction of the multi-energy system including district centralized cooling system. The corresponding planning and deployment methods are described. Design and deployment of system are introduced. From the energy system of Guangzhou university town and Qian Hai Area of Shen Zhen, the composition of energy system of district and its application in different area are studied.

1. INTRODUCTION
With development of social and economic, various type of advanced cooling system appeared constantly. Global climate change is a major challenge facing all mankind. With its advantages such as energy-saving, district central cooling system is used widely to provide cooling for a city or a large area. All air handling equipment is centralized in the air conditioning room, which is composed of chiller, heat pump, cold and hot water circulation system, cooling water circulation system, and terminal air treatment equipment, such as air handling unit, fan coil unit, etc.[1][4][8]

In this paper, deployment mode of district cooling system is introduced. An optimization algorithm method for district cooling system is described, including the area, the hierarchical planning method of building energy consumption, the design method of centralized air conditioning system in the building. Due to the cost factor, although it has the effect of energy saving, the application of central refrigeration is conditional. It is very important to analyze the load and optimize the design of refrigeration system. The optimized method can improve energy efficiency and economic performance.

Central cooling system (air condition) is also an important part and form of integrated energy system. The deployment and configuration of centralized cooling is also the key research in the planning, operation and management of the whole integrated energy system.
This paper illustrates construction and main methods of district cooling system in city area. District centralized cooling system configuration and application in Guangzhou university town and Qian Hai area of Shen Zhen are described in this document.

2. DISTRICT CENTRALIZED COOLING SYSTEM

District central air conditioning system is also known as central air conditioning. All air handling equipment in a building or even area is concentrated in the air conditioning room. It is composed of water chiller, heat pump, cold and hot water circulation system, cooling water circulation system (air-cooled chiller does not need this system), and terminal air treatment equipment, such as air handling unit, coil unit, etc.

With the improvement of central air conditioning system design and manufacturing level, higher requirements are put forward for the research and design scheme and the role of central cooling system in the integrated energy system[5].

Construction of centralized cooling system is shown as follows:

Fig 1 Structure of typical centralized cooling system.

In view of the safety of cooling and the improvement of energy utilization efficiency, the primary driving energy of the main unit in the regional cooling system is mainly come from electric power. Some of unit is driven by heat source (steam or hot water)[6][7].

In the district cooling system, the optimal allocation of the design capacity between different kinds of driven power is achieved as a very important task.

3. DEPLOYMENT MODE OF ENERGY SYSTEM INCLUDING COOLING SYSTEM

Regional cooling technology is to meet the air-conditioning cold energy demand of many buildings in a specific area. The chilled water is prepared by special refrigeration station and supplied by regional pipe network. It is one of the infrastructure of modern city.

In the central air conditioning project, the chiller station is the core part, which consumes a lot of energy and is the equipment with the largest energy consumption in the chiller station, and its energy consumption generally exceeds 60% of total energy consumption of the total.

By selecting large-scale high-efficiency equipment and adopting advanced energy-saving control technology, the disadvantages of low efficiency and uneven quality caused by using small and medium-sized air-conditioning equipment in different buildings are overcome.

Different chiller configuration schemes will affect the operation scheme of refrigerator system, and then affect the annual energy consumption of cold source, water pump and cooling tower.

From the air conditioning planning and design, first of all, Area where the building is located, the environment, and the use of the building will be achieved and mastered to determine the precise interior design parameters. Various parameters of the building and the humidity and heat load is calculated, to analyze the air conditioning system mode from the economic and technical aspects. Then, air supply state and air supply volume is determined[8].
The next step, solar energy utilization, wind power utilization and other renewable energy schemes have been studied. Through reasonable architectural design scheme, the natural cooling function of the building is strengthened. Application of various energy saving measures to effectively reduce air conditioning energy consumption. A variety of green energy to achieve accurate matching[9].

Finally, the automatic control system analyzes the whole system by detecting the parameters of cold station equipment, pipe network and power system at the same time. The most efficient operation scheme is implemented[10].

The sequence is shown in the figure 2 as follows:

- **Step 1**
  - Building analysis
  - Load forecasting

- **Step 2**
  - Resource analysis
  - System Config.
  - Load forecasting
  - Optimization

- **Step 3**
  - Control & monitor
  - Platform construction

![Fig 2 sequence of deployment for multi-energy system including cooling system](image)

The air conditioning system is also equipped with a new automatic control system, which can automatically monitor, display and adjust some key parameters of the air conditioning system, and timely alarm when the parameters exceed the limit or the equipment is abnormal.

The regional energy management platform is composed of air conditioning control device, user monitoring device and billing measurement device. The platform needs to integrate artificial intelligence, edge computing, cloud platform, Internet of things and other latest technologies.

Due to the using of large-scale and efficient air-conditioning equipment, advanced energy-saving control and regulation technology are adopted to achieve the purpose of high-efficiency energy consumption at same time.

4. CASE STUDY

4.1. Cooling system of QianHai area

Qianhai, located on the west side of Shekou Peninsula in Shenzhen, covers an area of 14.92 square kilometers, with a construction scale of 26 million-30 million square meters.
Based on the characteristics of high construction density in Qianhai, Qianhai has planned to build a regional centralized cooling system. Qianhai cooperation zone will build 10 cold stations and 90 km municipal cooling pipe network with a total cooling capacity of 400000 tons. The cooling service covers three areas of Guiwan, Qianwan and Mawan, with a total cooling building area of 19 million square meters. It is the largest regional centralized cooling system in the world under planning.

Advanced control platform is used for control. Intelligent, self-learning and other new technologies have been applied to achieve accurate matching between production and demand.

According to the calculation, the construction of regional central cooling system is the best choice for Qianhai new center air conditioning solution. Compared with conventional central air conditioning, the energy saving rate of regional cooling can reach about 12%, and 130 million kwh of electricity can be saved every year, which is equivalent to reducing the use of 16000 tons of standard coal and reducing about 130000 tons of carbon dioxide emissions.

4.2. Cooling system of Guangzhou university Town
Guangzhou University city is located in Panyu district of Guangzhou, with a total planning area of about 43 square kilometers and a planned total population of about 350,000 and an existing population of 200,000.

Guangzhou University City has been carrying out comprehensive energy, new energy utilization of beneficial exploration. The air conditioning load of Guangzhou University City is located in 10 universities and the north and south commercial center, with a cooling installed capacity of 520 MW, which has a clear and stable cooling load and high cold demand density. In addition, Guangdong is located in the tropical area, which has the conditions for regional cooling system deployment. On the net, in addition to the distribution network construction, also formed a relatively complete cold network in the region. There are 3 refrigeration stations (4 were originally located).

The district of cooling system structure of the pilot park of university is shown as below:
After the project is deployed, the whole cooling system will work under the control of a general control center, including distributed energy station, cooling station, renewable energy power generation, various multi-energy application users, etc. The application of the platform in the typical area of demonstration project can effectively reduce the energy supply cost.

5. CONCLUSION

Nowadays district centralized cooling is an important means to improve the quality of life and reduce energy consumption and emissions. In this paper, the characteristics of district cooling system are introduced and analyzed[12]. The corresponding planning and deployment methods are described. Typical central refrigeration project configuration is also studied and analyzed. It can provide a useful reference for the promotion of the follow-up technology.[13]

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