

The Research of Operation Adjusting for the District Cooling System

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Abstract: District cooling system has its superiority in energy saving, environment protection and operation, but the theory of system operation and regulating is not mature now. This essay analysed the project example of district cooling system current and using the mature theoretic of central heating for reference, and discussed the way of operation adjust for the district cooling system. It should equip the computer management system and surveillance system. The parameter of the cooling intermedium of the system should be adjusted according to the scientific data. The system should be managed by quantifying. All these will serve evidence and direction for the district cooling system in our country.

Keywords: district cooling system, operation adjusting

1. INTRODUCTION

District cooling system is a method that supplies the chilled water to the units that need chilled in some range by a big centralized refrigerator. A independent district cooling system includes 5 basic parts: 1) The plant that supply the chilled water 2) cool storage equipment 3) the system of chilled water transportation 4) the connection of trunk net and the user 5) the software used in the system.

For its superiority in energy saving and environment protecting and operation, the district cooling system has been studied and used widely. It can improve the efficiency of operation; make the building handsome and the system credibly.

District cooling offers both economical and environmental advantages. The method cuts electrical loads and operating costs when a building no longer runs its own chillers. "It eliminates the equipment, labor, materials, and operating hassles of on-site chillers, cooling towers, and associated equipment," said Mark Spurr, a district-cooling consultant with Resource Efficiency Inc. in St. Paul, Minn. "The building owner can operate with a smaller maintenance workforce." District cooling also gives building operators an alternative to replacing or modifying their chlorofluorocarbon-based chillers as that technology is being phased out.

The environmental benefits of district cooling are also significant. The average fossil-fuel or nuclear power plant operates at 30-percent efficiency, according to Thomas R. Casten, president and chief executive officer of Trigen Energy Corp. in White Plains, N.Y., which owns and operates 12 city district-energy systems and supplies district cooling in many of them. By applying cogeneration with district heating and cooling, Casten said, Trigen facilities can convert between 55 and 90 percent of their fuel to electricity, steam, hot water, and chilled water. At the same time, he added, Trigen facilities produce less than half the

pollutants of conventional generation. Besides, the district also has the social benefits.

2. THE NECESSARY OF COOLING SYSTEM'S OPERATION ADJUSTMENT

The cost of the pump's operation is considerable in the HVAC project. It can reach 30% of the general cost in some HVAC system. So, the measures adopted to reduce the cost of the pump's operation will be great significant.

The investigation of Pudong airdrome in Shanghai indicates that the flux and the head of delivery were on the big side. So they had to turn down the valve to increase the resistance to reduce the redundant flux and the head of delivery. There are two main reasons as following:

(1) The scale of operation was smaller than the designed. The flux of passenger designed of the airdrome was 2000 person-time per year, cool load designed was 82.8 MW, and velocity of flow designed was 4.0m/s. However the actual maximal flux was 6,890,000 person-time per year, the actual maximal cool load was 35.96MW; the actual maximal velocity of flow was 1.12m/s. All of them was smaller than the designed, which made part of the head of delivery of pump become margin.

(2) The influence of the HVAC load. The weather condition changed seasonally. This character makes the load of air-conditioning become asymmetric. The air-conditioning system ran in the part of load most of the time. In this condition, air-conditioning system controlled the number of the refrigerating machine and the pump, the head of delivery need to reduce in the further. Now the valve should be turned down to cancel out the redundant pressure to reach the system's demand.

For the two reasons above, we can only change the resistively curve to adjust the system. However this

way is at the cost of consumption of the pump's operation.

In the consumption of energy of the heating supply, the heat load of the building accounts for 90% of the general cost, the cost of the transmission and distribution net accounts for 10%. In the centralize heating supply system, the difference between the temperature of the water supply and the backwater is 25°C, but the difference between the temperature of the water supply and the backwater is 5—10°C. The flux in the district cooling system will be 4 times that in the centralize heating supply system. Similarly, the power will be $4^3=64$ times that in the centralize heating supply system. Hence considering the initial cost and the management of the operation, the cost of the transmission and distribution net will exceed 10%, it will also be great significant.

3. ADJUSTMENT OF COOL QUANTITY

3.1 Initial adjustment

The aim of the initial adjustment is to make the flux of the user in the system assigned reasonably according to the cool load. It can erase the hydraulic disorder, which created in the design, constriction and the management. It can erase the asymmetry of the temperature. It also is the basic of the operation adjustment.

3.2 Operation adjustment

The conventional way of adjustment includes temperature adjustment, flux adjustment and change the flux according to the time. They change the cool by adjusting the temperature of the water supply and the backwater, flux, operation time to adapt to the change of the cool load of the users. The adjustment above was just a theoretic method; the condition is that the system must run steadily and continuously, the actual load and circle flux must accord with the designed. However this is hard to reach. So we should adopt the way of Adjustment of cool quantity.

Adjustment of cool quantity is a way that the cool supplied will be controlled directly according to the user's load. The circle flux of the system is fixed by the level of the hydraulic disorder, it often bigger than the designed. The temperature of chillers water is formed by the balance of the heat of the system, not by the managers.

The temperature will reach the number designed if the system run in the defined temporal hour according to the defined cool data and reach the accumulating total cool. The key is make the system run optimally and it is unimportant that the state of the system is unstably.

4. NUMERALIZED MANAGEMENT

4.1 Job of numeral zed management

(1) The main job of management in district cooling system monitor and measure temperature, flow, cool quantity and energy consumption by monitor or computer control system according to outdoor atmosphere and relevant cooling load of consumers, and control the instantaneous cool quantity (cooling

load) and each day's cool quantity in order to guarantee the indoor temperature.

(2) Make sure of the full operation of equipment of cool-supply system, including maintenance and repair of equipment, finding problems and solve them.

(3) Try best to reduce the ineffective loss of energy, increase the efficiency of cool-supply and save energy.

(4) According to the data of practical operation, we should analysis the cool-supply quality and efficiency of cool-supply system, count the practical energy consumption (electricity consumption and water consumption), calculate practical cool-supply index, do some economical analysis and beneficial check, and do some operation and management planning in order to get ready for the next heating season.

4.2 Energy-saving technical method of quantity management of cool-supply system

In order to guarantee the quality of cool-supply during the time of operation, increase the utilization ratio and make power equipment work with high efficiency under the condition of full load and make the net system operate in the situation of good hydraulic work condition, we should do some theoretic calculation and establish energy-saving method and measure according to the condition of cool-supply system.

Energy-saving technical method of cool-supply system is established according to the current condition of system and cursory calculation of cool load, calculation of energy consumption, circular water quantity, current equipment and specific requirements of consumers. Whether the energy-saving method is true or not put influence on the effect of quantity management, economical benefit and social benefit. So, we should establish specific energy-saving method and measure after theoretic calculation and technical and economical analysis and feasibility analysis. According to energy-saving method, cool-supply system will has cool-supply adjustment during the time of operation and supply cool according to practical requirement in order to realize quantity management.

Advanced technology needs scientific management, the energy-saving technology of supplying cool according to requirement stimulate the improvement of management of cool-supply, while scientific management guarantees the practice of such technology. At the same time of emphasizing the scientific management cool-supply system, we should take some measures according to practical needs and improve all rules and adjustments, operate and management regularly; and train and improve employees in order to make them operate the system efficiently and be familiar with property of net consumers and the specification of equipment and master the skill of operation, adjustment, maintenance and repair of equipment.

Applying quantification managing, there must be a set of intact technical data, include the craft design drawing of the cool source, refrigeration main frame and auxiliary equipment drawing and instruction book, outdoor network and every user's systematic design drawing, the cool -supply system quantification managing and the cooling index, operation parameter

table, and operation record etc.

Make the rules of management of operation, define the duty, authority and task of the personnel, set up post duty for operation and the maintain personnel. There must be special personnel to be in charge to implement quantification managing. All these are important conditions of quantification managing of district cooling.

4.3 Condition of implying quantification managing in district cooling system

In order to guarantee the cool -supply system can run safely and reliably during cooling season, all preparation must do well before putting into operation. For instance: the training of the full-time staff of quantification managing, appearance test, pressure test, washing, measuring instrument installation and debugging, water filling, starting, etc.

4.4 outdoor pipe network balance of cooling system

In cooling system, it is usually excepted the flow in outdoor pipe network system can be assigned rationally between every user according to the designing requirement, and assigned rationally between every cooling equipment inside user system. Generally speaking, how carefully hydraulic balance is done while hydraulic calculating, flow and room temperature of some users' still be large or small after putting into operation, namely so-called heating disorder phenomenon.

Above-mentioned problems must be settled by system pre-adjusting, called network hydraulic balance. But there are no flow meter in users' intake in most cooling systems. In this case, how to carry on system pre-adjusting and make every user's flow assign rationally, becomes an extremely difficult problem. We can invest a large number of financial resources, material resources to (such as install automatic regulating valve, computer controlling and regulating device in every users' intake, etc.) solve this problem, but it is difficult to realize in a large scale. Its difficulty is obviously greater to solve heating disorder problem for the indoor user's system, especially residential building, in addition the factor of people, here we adopt "iso-temperature drop" adjustment law.

"iso-temperature drop" adjustment law, carry on hydraulic balance according to the principle of equivalent temperature drop to make flow reach the value we needed without regard to pipe disspelling, under the condition of equal design load of every user. "iso-temperature drop" adjustment law can make flow in networking assigned rationally among every user, solving the hydraulic balance problem. But hydraulic disorder problem still exist during every lift line in user air conditioner water system and between every fan coil. Only the cooling quality could be guaranteed after the whole system balance adjustment was done well. User system also must be balanced to make all users' room temperature reach the requirement.

It is a careful and complicated work to do heating balance adjustment of the cool -supply system, needing carry on repeatedly and spend much time, so we should organize professional to complete this work. The heating balance of cool-supply system and rational assignment of flow is the primary condition of implementing quantification managing, guaranteeing cooling quality. Certainly, under the conditional situation, to adopt the automatic control to adjust, the result is better.

5. CONCLUSION

Allocate the computer management system and perfect systematic operation, install the cooling computer monitoring system, regulate parameter based on scientific data, use cool quantity regulate method to carry on quantification managing, to make every effort to realize energy-saving.

System adjustment experience needs to be accumulated, because the district cooling development in our country started relatively late. I consult the maturity theory from central heating and put forward some views about district cooling, and hope for help to the development of district cooling of our country.

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