Research on the Construction of Green and Low-Carbon Water Conservancy Data Center

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Abstract: In order to create a green and efficient data center and promote the technical level of green and low-carbon construction of data centers. This paper clarifies the necessity of building a green and low-carbon data center, and proposes construction methods suitable for data centers, which is in terms of architecture, electricity, power supply and distribution, air conditioning, and equipment configuration and layout.

Keywords: Data Center; Green; Low Carbon

1. Introduction

With the rapid development of a new generation of information technology, the data center is an important support for computing power, and the construction boom is booming. The total annual development of my country's data center industry has grown by about 30%, and it is expected to maintain rapid growth during the "14th Five-Year Plan" period[1]. As the data center is a high-energy-consuming industry, its green, low-carbon, energy-saving, and high-quality development will be the key development direction of future data centers, as well as the direction of industry development and national policies. According to my country's "dual carbon" goal, we strive to achieve carbon peaks by 2030, carbon neutrality by 2060, and dual control of energy efficiency. The development of the industry must conform to the historical trend, establish an effective low-carbon data center development path, and help the country achieve the "dual carbon" goal.

2. The Necessity of Construction

The amount of data storage is on the rise in geometric orders of magnitude, and the requirements for data storage services are becoming more and more urgent. The existing decentralized information islands alone cannot meet the needs of industry development. Intensive construction of data centers, large-scale operation, and industrialized management mode are the only way to realize the sharing of advantageous resources and solve the problems of repeated investment, resource waste and energy loss from the source. Therefore, it is necessary to plan and build a centralized data center[2].

3. Problems of Traditional Computer Room

In order to promote the energy conservation and emission reduction of data centers, the Ministry of industry and information technology proposed in the 12th Five Year Plan for industrial energy conservation that the pue value of data centers should be reduced by 8% by 2015. The "cloud computing demonstration project" organized by the national development and Reform Commission also requires that the pue of the data center constructed by the demonstration project should be less than 1.5.

In the construction of traditional computer room, problems such as energy consumption, refrigeration and air flow management are not fully considered. Many data centers have high pue and adopt high reliability environmental power supply equipment in the traditional sense, but the efficiency of these equipment is low. The pue of the data center is more than 2.0 or even higher, which means that about half of the energy used in the data center is consumed in the it load, and the other half is used for the key physical infrastructure of the network, including power supply equipment, cooling equipment and lighting facilities.

4. Green and Low-Carbon Construction Approach

4.1 Building Insulation

The data center is mainly to add wall panels on the basis of the wall, and add rock wool and other thermal insulation materials between them. At the same time, it further improves the

performance of anti-static, sound insulation, heat preservation and dust prevention of the data center, and further optimizes and improves the overall internal environment of the computer room.

4.2 Electrical Energy Saving

(1) The lighting source adopts LED lamp, and the luminous efficiency is 50% higher than that of conventional metal halide lamp.

(2) Electrical devices and equipment: for example, the power transformer adopts high-efficiency and low loss products, which reduces the power consumption; The high-voltage circuit breaker is used for low-power equipment. On the basis of improving the natural power factor, the device automatically compensates the electrostatic capacitor screen for reactive power compensation, so that the power factor can reach more than 0.91. On the basis of detection, effective harmonic control measures are taken to reduce the loss caused by harmonic current.

(3) The single-phase electrical equipment are evenly connected to the three-phase network to reduce the imbalance of three-phase load current and make it reach the current imbalance degree of power supply network less than 20%.

(4) High frequency switching rectifier is selected for the rectifier equipment required for DC communication power supply to improve efficiency.

4.3 Energy Saving of Air Conditioning System

The energy consumption of air conditioning system mainly includes fans and air conditioning terminal units. Variable frequency air conditioning is adopted. According to the change of air conditioning load, 10% - 100% stepless regulation can be realized to save the operation cost of air conditioning. At the same time, it has the following characteristics: power saving, voltage stabilizing function, reducing the impact on the power system and reducing noise. The arrangement of inter train air conditioning is adopted, and the cold channel is set to reduce the loss of cooling capacity. The return air temperature can reach 30 ℃ - 32 ℃.

4.4 Energy Saving of Transformation and Distribution System

Data centers make full use of the advantages of water conservancy hubs and are deployed near hydropower stations to maximize the use of clean energy from the power supply side, give priority to local consumption of new energy, promote the use of clean energy in data centers, and continuously optimize the energy structure. The transformation and distribution system actively applies new technologies to improve the safety and reliability of the power supply system, and at the same time considers energy-saving measures in all aspects of the transformation and distribution system[3].

4.4.1 Optimizing System Structure and Energy Saving

According to the load capacity, power supply distance and distribution, characteristics of electrical equipment and other factors, the centralized power supply or decentralized power supply mode is reasonably selected, the consumption of conductors is reduced, the conductor cross-section and line laying scheme are reasonably selected, and the loss of distribution lines is reduced. According to the overall layout and planning of the equipment room, the power equipment room should be arranged reasonably, so that the power supply is as close to the load center as possible, so as to reduce the loss caused by the long power transmission distance, which is conducive to energy saving.

In terms of power distribution system structure and UPS system structure, it is also possible to appropriately adopt a new organizational structure according to the requirements of safety level positioning and energy saving and emission reduction targets, so as to obtain appropriate safety level and energy saving effect at appropriate cost.

4.4.2 Selection of New Products and Energy-Saving Equipment

The use of new products and energy-saving equipment can reduce the energy consumption of the equipment itself and improve the overall energy-saving effect of the system. The selection of power transformation and distribution equipment should choose energy-saving equipment determined by the national certification agency, as well as power distribution equipment that meets the national energy-saving standards[4].

For example, when the traditional UPS equipment is working normally, the efficiency has not been high due to the relatively low load rate of the equipment. Some new UPS products that have appeared in recent years, such as

modular UPS equipment and high-frequency UPS equipment, have obvious advantages in efficiency compared to traditional 6-pulse and 12-pulse rectifier UPS. This project selects these equipment appropriately according to the requirements of safety level positioning and energy saving and emission reduction targets.

4.4.3 Reasonable Equipment Configuration and Layout

Reasonably calculate and select the capacity and configuration quantity of the UPS; the capacity and quantity of the UPS configured in the project are based on the short-term and long-term load conditions of the newly built communication room; the efficiency of the UPS uninterruptible power supply should meet the requirements of relevant national and industry standards[5].

4.4.4 Reasonable Selection and Layout of Wires

(1) When laying out the wires in the design, optimize the wire routing and minimize the wire length.

(2) In the case of long power supply lines, under the premise of meeting the requirements of laying conditions, current carrying capacity, thermal stability, protection coordination and voltage drop, appropriately increase the cross-section of the conductors to reduce line losses.

5. Conclusion

This paper studies the realization path of green and low-carbon construction of data center computer room infrastructure, and puts forward the construction methods suitable for data center in terms of architecture, electrical, power supply and distribution, air conditioning, etc. it has significant advantages in energy saving and layout, which is conducive to the green and safe operation of data center and promote the improvement of the technical level of green and low-carbon construction of data center.

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