

Uninterrupted Power Supply System Design of Data Center

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Abstract. The common architectures of UPS (Uninterrupted Power Supply) system in data center were expounded in detail. Take the case of UPS design on data center in grade A, the process for UPS system design was introduced and the recommended schemes were put forward. This paper has certain reference significance for similar design work.

1. Introductions

Data center is a building which can provides the running environment for electronic information equipment. The data center is divided into three levels as A, B, C according to the grades of reliability and availability from high to low in Data center design specification GB50174-2017 [1].

Data center in grade A should adopt double power supply and equipped with standby power. Data center in grade B should adopt double power supply. Data center in grade C can adopt single power supply. It's suitable for electronic information equipment to use UPS system [2]. This article will focus on expounding design procedures of UPS system architecture design in data center.

2. Architectures of UPS system

UPS system can divided into several architectures as follows according to the grades of reliability and availability.

2.1 Basic configuration

Basic configuration means that the system is equipped with only a set of UPS. This configuration has the advantages of simple structure, low cost, easy to maintain, but it also has the disadvantages of low availability, more single points of failure. The load will lose protection once the UPS break down.

2.2 Series connection redundancy

Two sets of UPS in series formed the primary and backup system. The output of backup UPS is connected to the static bypass input of primary UPS. Primary and backup UPS are completely independent of one another, and the system can use different manufacturers' product. Higher requirements are put forward about the reliability of the main static bypass and the disposal ability of mutation load.

2.3 Multiple redundancies

Two or more than two sets of UPS in parallel formed the parallel synchronous system, all the UPS must be manufactured by the same manufacturer and with the same technical requirements and capacity. All UPS work simultaneously and sharing the loads when compared with series connection redundancy.



2.4 Distributed redundancy

Double power conversion is the fundamental difference when compared with the several kinds of structures above. The inputs of the load which has double power supply are completely independent and sharing the loads. The input of the load which has single power supply can realize the switch between two power supplies by STS (static transfer switch). This architecture can realize the maintaining for the UPS module and the switch devices without maintenance bypass circuit and have strong fault tolerance performance. The architecture of distributed redundancy system is shown in Figure 1.

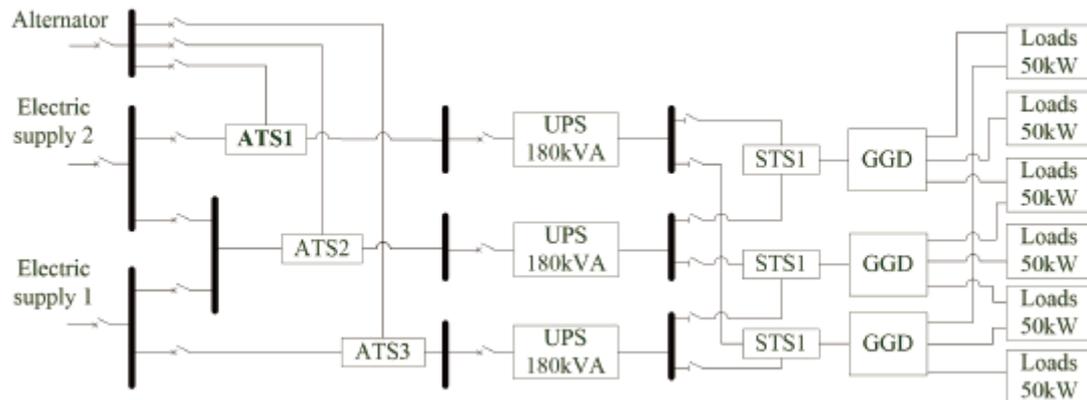


Figure 1. The Structure of Distributed Redundancy System

2.5 Dual redundancy system

Double busbar input is adopted as the input power supply of dual redundancy system. Two busbar of the system are connected by bus-couple switch which can realize the redundancy of mains input. Similarly, double bus-bar output is adopted as the output of dual redundancy system which can realize the input redundancy of loads. The input of the load which has single power supply can realize the switch between two power supplies by STS. This architecture has the highest fault tolerance performance among all architectures above. The structure of dual redundancy system is shown in Figure 2.

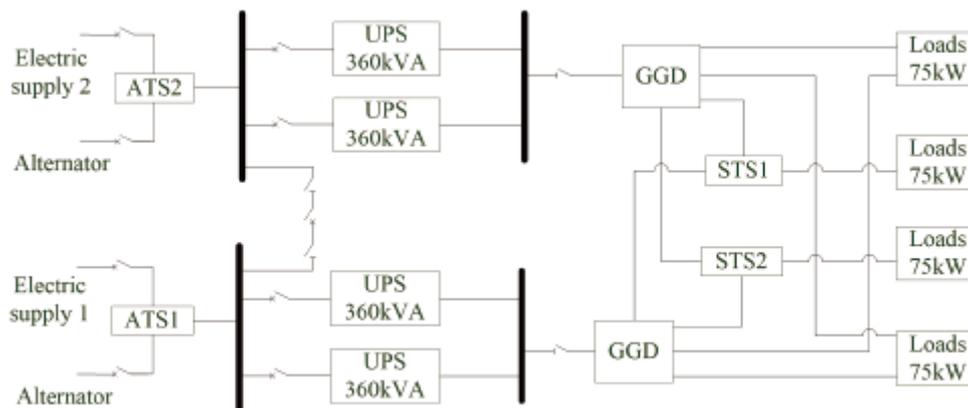


Figure 2. The Structure of Distributed Redundancy System

3. Design of UPS system

3.1 Choose the architecture of UPS system

The architecture of UPS system should be chosen according to the load rank, expected investment, requirement of reliability or maintainability and so on. Architecture with high reliability and fault

tolerance performance should be chosen for high degree data center, and architecture with high reliability which is inexpensive should adopted for the users lack of investment and risk tolerance. For example, basic configuration is more suitable for minitype communication base station and small businesses, series connection redundancy is more suitable for small and medium-size enterprises or communication stations, multiple redundancy is more suitable for large and medium-size enterprises or communication stations which has data center, distributed redundancy and dual redundancy system is more suitable for large enterprises or communication center.

3.2 Confirm the capacity and quantity of UPS

The capacity and quantity of UPS should be determined according to the system architecture and calculated load of electronic information equipment. The basic capacity of UPS should not less than 1.2 times of electronic information equipment calculated load (P_{js}) which is calculated by formula (1).

$$P_{js} = K_d P_e \quad (1)$$

In general, the capacity of UPS is signified by apparent power (S_{js}) which is calculated by formula (2) [3].

$$S_{js} = \frac{P_{js}}{\cos \varphi} \quad (2)$$

3.3 Illustration

Taking the UPS system design on data center in grade A as an example, the total rated power (P_e) of electronic information equipment is 300kW, the loads with single power supply and loads with double power supply occupying half of the total rated power for each, both of the rated power factor ($\cos\varphi$) of UPS and demand coefficient (K_d) are equal to 0.8, the mains input can meet the requirements of data center in grade A.

It is clear that the distributed redundancy and dual redundancy system should be adopted for data center in grade A according to the previous analysis, and both of the schemes are expounded respectively as follow.

3.3.1 Distributed redundancy. The calculated load of electronic information equipment is 240Kw which is calculated by formula (1), the basic capacity of UPS should not less than 360kVA which is calculated by formula (2). It can be seen that distributed redundant system consists of 3 sets of UPS according to Figure.1. In consideration of the large capacity of UPS, it's more suitable to choose modular UPS for improving the reliability and availability of system, every modular UPS consists of 9 modules, capacity of each module is 20kVA, the full capacity of each modular UPS is 200kVA.

3.3.2 Dual redundancy system. It can be seen that dual redundancy system consists of 4 sets of UPS according to Figure. 2. Modular UPS is adopted for improving the reliability and availability of system as also, every modular UPS consists of 9 modules, capacity of each module is 40kVA, the full capacity of each modular UPS is 400kVA.

Obviously, the total UPS capacity, module number and the cost of distributed redundancy system is less than dual redundancy system. The structure of distributed redundancy system is more complicated than dual redundancy system which brings about difficulties for maintenance work. In general, distributed redundancy system is more suitable for this sample duo to the low cost of system.

4. Conclusions

Uninterrupted power supply system design of data center should comprehensively consider the system availability, reliability, construction cost and characteristics of electric equipment and so on, and make reasonable selection of system architecture with a special focus on actual demand.

5. References

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