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REVIEW

Review on Electrical Installations and Light -ning Protection Measures for High-rise Building

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Abstract: Lightning protection technology is widely used in electrical construction industry by protecting the buildings and its internal electrical infrastructure. Further researches on lightning protection technology are crucial due to the complexity of high-rise building internal electrical design and existence of some problem in current lightning protection technology. Lightning protection system will be more mature along with the development of technology, contributing to better prevention, ensures the safety of people's lives and reduce the impact of economic loss caused by lightning. This article will focus on the analysis of electrical installations and lightning protection measures of high-rise building for future references.

Keywords: High-rise building, Electrical installations, Lightning protection

1. Design and Construction of High-rise Buildings Electrical Infrastructure

1.1Electrical load calculation

Electrical load is an estimation parameter for power system. The accuracy of calculation will influence the selection of reasonable devices, safeness and economical operations. Basically, high-rise building power load calculation is based on power load density and demands.

1.2 Power supply and voltage selection

Power supply and voltage selection is critical stage in high-rise building electrical design. In order to guarantee the quality and reliability of power supply, it should have at least two independent power sources in modern high-rise buildings. In reality, the actual amounts needed depends on the power load and regional power grids conditions. In principal, the operations require the supply of the power from the two independent power sources at the same time and acted as backup application for each other. In addition, relevant emergency facilities should also be

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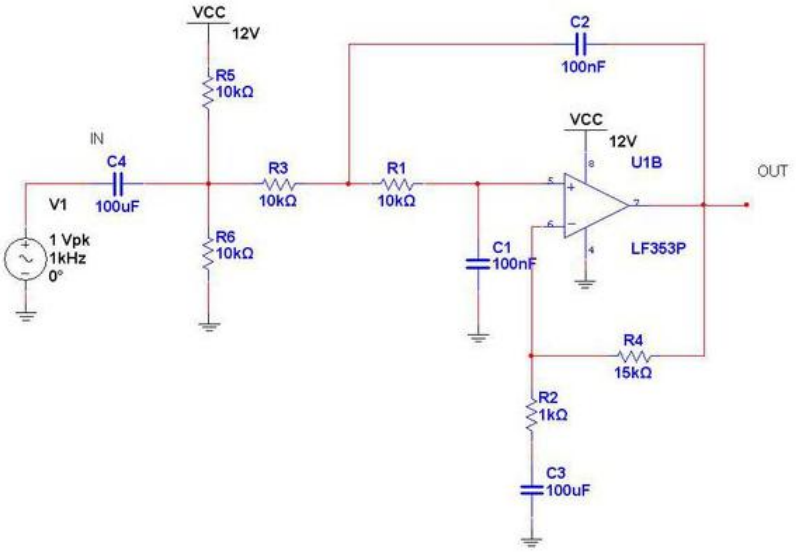

Figure 1 Schematic diagram for selection of power supply and voltage

installed, for instances, backup diesel generator sets which can automatically restore power within 18 seconds, in order to provide instant backup power supply for emergency lighting, elevators, computers and fire-fighting equipment in the critical moment while blackout. At the current stage, voltage supply of the domestic high-rise building under normal circumstances is 10kV. Figure 1 illustrated an example of power supply design.

1.3 Scientifically selection of wire and cable

Generally, high-rise buildings must be equipped with various cable systems; especially for fire alarm system which should be considered to select mineral-insulated cables to prevent damage to prevent fuse to blow or short out circuits that affect the operation of fire alarm system. In term of general lighting circuits and power facilities, low smoke zero halogen cable is the best selection to protect people and equipment from toxic and corrosive gasses emitted from sheath of cable or insulator when exposed to high sources of heat. Power consumptions for air-conditioning unit are relatively high; thereof architect can select intensive Busway for effective means of power distribution. To ensure the quality of Busway, it needs to be set to Ingress Protection 54 for installation in power distribution room and as Ingress Protection 65 for other areas.

1.4 Strengthen emergency lighting

The minimum level of illuminance for emergency lighting at evacuation staircases shall be 100% as usual; adapting energy-saving mode at normal condition and give illumination of sufficiently high level automatically during fire or malfunction. Refuge floors, power distribution room, generator room, switchboards room, light current room, smoking proof extractor fan room, fire service pump room, elevator control room, fire protection control room, fire extinguishing and fire alarm system, telephone and computer housing shall provide 100% illumination. Fire service and water pump room, main air-conditioner control room, refrigeration room and air-conditioner water pump room require minimum illuminance of 10%. Requirement for emergency illumination for public walkways and underground driveway are about 20%. High-rise building should equipped with emergency evacuation lighting system; basement, podium, hotels and apartments evacuation corridors, stairwells and exits with evacuation indicatory signs. Standby and evacuation lightings for evacuation indicatory signs and emergency lighting for other places powered by EPS which the batter capacity can last for duration of 90 minutes.

2. High-rise Building Lightning Protection Measures

2.1 Lightning rod

Air termination system is required to be set at the top of buildings which vulnerable to lightning strike. Typically, top floor of high-rise buildings will be equipped with air termination system at the center location integrated with lightning tapes at the surroundings. It also needs to set with connecting compensation devices between expansion joints. The design of lightning network shall follow the lightning protection level of the buildings in designing the grid sizes. Built in of the system requires experience to determine the burial depth of lightning accessories between insulation and waterproof layer. The depth of burial will influence the air termination effect. For high-rise building with slanting roof, the lightning accessories cannot be built in at eave and corners of buildings. In the aspect of lightning rod, the layout should follow relevant design specifications. Usually, the lightning rods for high-rise building are made up of steel or galvanized round steel materials. The end of lightning rod composed of hemispherical and the radius is decided by actual situation and specifications. Lightning rods vulnerable to the effects of air, snow, lightning, etc. which require sophisticated materials with strong physical strength, corrosive resistance and oxidation resistance. It is essential to guarantee that erection joints of accessories are firm in order to minimize deterioration rate of equipment as well as to carry out periodic inspection on lightning rods to ensure functionality. While lightning rod subjected to lightning strike, it will increase the probability of lightning strike and have impacts on the internal aspects of buildings such as electrical equipment and people. Thus, some of the high-rise building rarely used lightning rods, but select lightning tapes or network as air termination equipment. Lightning rod will be selected unless there are some issues related on irregular shapes or difficulties on lightning tapes installation.

2.2 Down-conductor system

In order to maximize the drainage effect, the design of down-conductor must be denser with great quantities to reduce the distances between down conductors. The layout must be uniform and symmetrical to reduce voltage and avoid lightning-counter attack. Too long of down conductors will greatly reduce the effectiveness of lightning induction. Install equalizing rings at certain intervals of heights can reduce the impact of voltage differences between down-conductors of similar heights. The welding issues o down-conductors should not be overlooked as minor error will eliminate the function of down-conductors. In the same column of down conductor, there must be at least two reinforcements with radius greater than 5 mm, the length of splice must be six times greater than the diameter, with double-sided and exothermic welding between down conductor system and air termination system.

2.3 Grounding electrode system

The best selection is natural grounding electrode with ring electrode sited around the periphery, standard moisture content not less than 4 percent and without coating at the outer surface. Generally, artificial earth electrode consisted of a welded of pile and grade beam foundation as an enclosed earth system. Electrical equipment shall be connected with grounding electrode as a system subjected to minimum electrical resistance value.

2.4 Reasonable shield

(1)To improve lightning-counter attack and to ensure electromagnetic pulse and electrical lines against lightning impact. (2) The magnitude of electromagnetic field generally weakest at electrical main line, thereof down conductor system columns should avoid from that area. (3) To improve shielding effect, steel conduits and wiring ducts must connect with equipotential bonding and grounding-bus of each floor. (4) To avoid lightning invasion to low voltage system by

protecting electrical equipment, power distribution equipment and power line, placing lines from switchboards into steel tube outside switchboard. The other side of lines not connected to switchboard must connect with electrical protective cover and simultaneously link to the lightning protection equipment on the roof. Electric jumper lead must be set up associated with installation of over-voltage protection in the case of steel tube fractures.

2.5 Electrical protection

For the power system control of high-rise buildings' facilities such as elevators and computers, it should establish equipotential bonding in the electrical system control center to improve electrical equipment safety. It makes an electrical connection between the grounding electrodes with protective earth in distribution board; maximize the reduction degree of interference.

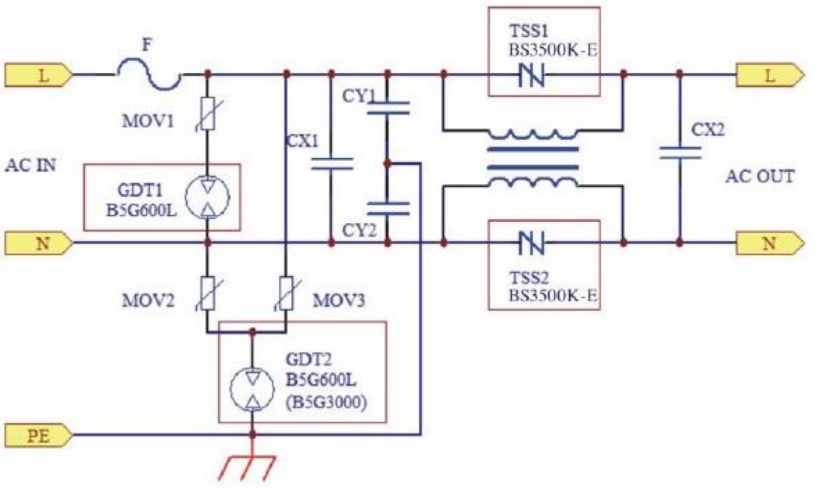

Figure 2 The main electrical protection measures

In summary, China's construction industry is thriving along with the economic growth and development of construction technology. City modernization contributed to the development of high-rise buildings and intelligent buildings. These buildings equipped with an intricate web of power lines, plus complete electrical facilities to supply power to the whole building. Nevertheless, high-rise buildings vulnerable to lightning strikes results in causalities and economic losses. Thus, we must pay special attention to the lightning protection issues of electrical construction projects. It requires further research for future works.

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