Enhancing site power safety and reliability

New challenges

Mobile data service expansion in the 3G era requires new network deployment techniques, which pose new challenges to the power system. In the 2G era, indoor sites were favored; in the 3G era, with the application of distributed base stations, outdoor sites have become the norm. Ambient temperatures are often above or below those for indoor sites (22 to 25°C), so site power must be more temperature resistant, dustproof, and lightning-proof.

Mobile data service is the current battlefield for operators. To maintain its market lead, China Mobile is constantly expanding its 3G network coverage, with an emphasis on indoor and WLAN hotspots. For indoor coverage scenarios, radio access equipment can only be installed in corridors or on walls, which makes power supply more difficult to acquire and maintain reliably.

Cooling modernization

In October 2008, China Mobile announced its target to reduce energy usage per unit of telecommunications traffic by 20 percent from 2008 levels by the year 2012. This would translate into a savings of 11.8 billion kilowatt hours of electricity. According to China Mobile statistics, temperature control accounts for 45 percent of a site’s total power consumption. To curtail this waste, China Mobile has initiated a modernization scheme for its site cooling as a key part of its endeavor to save energy and reduce carbon emissions.

Under the scheme, 400,000 base stations will be reconfigured to employ measures such as direct ventilation, intelligent ventilation and temperature lifting. This will result in a higher ambient temperature around the power supply, so it will need to be more heat-resistant.

Power equipment: The foundation

To adapt to the aforementioned challenges, China Mobile is building a safe and reliable power system which has the following features at the equipment level.

Improved temperature adaptability

The industry is moving towards higher ambient site temperatures. In medium and high-temperature areas, the power equipment can reach 50°C after long operation; thus the power system must work normally at 55°C without reduced power output. In frigid areas, the power supply should work reliably when the ambient temperature is -20°C.

A power system’s temperature adaptability depends on component quality, board thermal design, cabinet thermal design and
cabinet heat insulation. Reliable operation in high temperatures is component-dependent, while the board and cabinet thermal designs are vital for improving heat dissipation efficiency and reducing the working environment temperature.

Superior cabinet heat insulation ensures that the ambient temperature is affected as little as possible by outside temperature fluctuations. In frigid areas, heating film can be employed to ensure normal running of the power system.

Superior cabinet temperature control

In outdoor site scenarios, the power system is not strictly a power supply, as the power cabinet integrates primary power and site monitoring equipment as well as batteries. Therefore, the cabinet must have superior temperature control capability.

An outdoor power cabinet can use temperature control techniques such as heat exchange, direct ventilation, thermal electronic control, and intelligent thermal exchange to ensure normal operation. The cabinet should also have temperature partition capability to adjust the battery cabinet temperature to about 25°C, which will help prolong battery life.

Comprehensive lightning protection

Comprehensive lightning protection must follow the principle of "comprehensive governance, all-around prevention." Multiple-layer protection should strictly control electric shock, safely ground the lightning current, improve the low-resistance grounding system, and remove the ground loop. Lightning protection measures such as current surge protection and signal & data line protection must also be taken.

For comprehensive lightning prevention and protection, the power system should be equipped with class-C and class-D lightning protection for the AC circuitry, and class-D protection for the rectification circuit unit. Direct current lightning protection with co-modules (15kA) and differential modules (10kA) is also required. Lightning protection must also cover the signal board to prevent lightning strike due to board extension. Lastly, lightning protection on the solar junction box and solar controller should not be neglected.

Battery quality and charge/discharge management

The battery is the last resort for a station’s power. In recent years, sloppiness on the part of battery suppliers has led to numerous cases of battery leak and bulge. Battery leak causes acid corrosion of cell connectors, which may lead to shorting. China Mobile once had a fire caused by a battery leak in an equipment room. Leaks and bulges also reduce battery capacity sharply, sometimes even rendering them useless.

Management of charge and discharge also impact battery reliability and service life. Digital monitoring enables more intelligent charge and discharge management, while more refined temperature compensation can adjust the temperature to a desirable level; both measures boost battery service life.

Management: An indispensable element

Superior equipment is not sufficient to guarantee safe and reliable power. Safety management also merits attention and commitment. China Mobile’s base station power systems are generally reliable, but safety risks remain. In 2009, a provincial branch thoroughly examined its power systems in all central exchange buildings; roughly 90 safety flaws were found. The China State Council and the Ministry of Industry and Information Technology have issued several edicts requiring carriers to pay special attention to power system safety.

Engineering guideline enforcement

In China Mobile’s experience, many site power accidents can be avoided during the engineering phase. For example, the grounding system is the key component that receives lightning current. If the welding process and erosion proofing are substandard, a huge risk is incurred. During battery installation, if cell connector screws are fastened poorly, resistance stemming from contact with the terminal post is increased, which prolongs battery discharge time, potentially to the level that the extra heat generated may cause fire.

To ensure engineering quality, China Mobile has formulated and enforced several guidelines covering all aspects of project engineering, including technical specification, contracting, engineering implementation monitoring, and engineering quality control. In addition, China Mobile requires that power systems and networking be planned, constructed, and put into operation simultaneously. China Mobile has also been careful to select qualified contracting firms, whose workers must be certified before commencing work.

Strengthening routine maintenance

Routine maintenance should discover flaws before accidents occur. Under the guiding principle of “proactive maintenance and prevention,” China Mobile has made significant progress in this regard.

It has intensified education and strictly enforced regulations that require every worker to complete safety certification training before carrying out a job. In addition, China Mobile also includes safety checking during its routine operation; violations are stopped or rectified in a timely manner.

During the past few years, China Mobile has run several large-scale projects involving evaluation and enhancement of power system safety; a plethora of hidden dangers have been exposed and reckoned with.

The stable performance of base stations is a prerequisite for superior service quality and user experience. Both attention and resources must be dedicated if power system safety and reliability are to be guaranteed. □

Editor: Xu Ping x.ping@huawei.com