

Substation is an important part of the electric power system, which is related to the safety of electric power and the development of society. Currently, the daily operation and maintenance of substations is mainly through regular inspection and maintenance by inspectors to determine whether there are defects and hidden dangers in the equipment. Since substation is a high-risk scene, the safety and security of personnel is extremely important.



Application of High-Precision Positioning Terminal in Safety Protection of Substation Personnel

Project Background

Due to the inadequate technical protection and lack of scientific and efficient control means in the traditional operation of substations, it is easy to cause lagging safety warning for operators, and managers are unable to monitor the operation process, track playback and real-time command and dispatch in real time, which in turn causes casualties and property losses to a certain extent. Entrusted by the client, Hi-Target provided personnel safety protection upgrades for a substation of State Grid to precisely guarantee the safety of operators.

Pain Point Analysis

The project faces three major pain points: First, the complex operating environment of the substation and the serious impact of electromagnetic interference, resulting in inaccurate positioning equipment. Second, the project needs to overcome the integration of indoor and outdoor positioning problems. Traditional positioning methods are relatively single, and indoor and outdoor positioning cannot be achieved on the same device. Third, the project requires high accuracy of positioning equipment, and requires real-time warning alarms for intrusion of operators in the area.

Implementation Program

For the requirements of this project, Hi-Target provides base station and UWB base station construction, high-precision map acquisition and other infrastructure services. Through the use of a number of centimeter-level high-precision positioning terminals, such as the self-developed high-precision smart helmet Qbox S30, Hi-Target high-precision cell phone Qmini A10 (UWB) and UWB work card, which are

connected to the power grid high-precision location service system, a complete set of substation operation safety protection system is formed to ensure the safety of power operation by means of technical defense.

In the program, Hi-Target high-precision smart helmet Qbox S30 and high-precision cell phone Qmini A10 (UWB) have strong anti-electromagnetic interference capability because they contain miniaturized omnidirectional spiral antenna and UWB positioning antenna, which can guarantee the accuracy of data transmission and accuracy of positioning equipment. Meanwhile, Hi-Target high-precision terminal products are multi-shaped, compact and wearable, with centimeter-level positioning, communication and shooting functions, which can realize integrated indoor and outdoor positioning of substation personnel on the same device and provide real-time warning.



Workflow

I. Base station and UWB base station construction

According to the site conditions and operational needs, the project carries out the construction of base stations, UWB base stations and other infrastructure.

1. Base station construction

Site selection and survey

Before the field survey, the operators first send the proposed site situation questionnaire to the customer for determining the land or roof use and power supply, communication, water supply, station site security protection and other infrastructure support conditions, develops the survey work plan, prepares the instruments and equipment and information; second erect the geodesic choke antenna on the selected address for which the height of the antenna erection should be consistent with the height of the proposed observation pier. And then collect and download observation data and convert the data into standard files, use data quality analysis software to process and analyze the observation data. The availability rate of the observation data should not be lower than 95%, the average multi-path impact on MP1 should be less than 0.5m, and the MP2 and MP3 should be less than 0.65m, the test results should be filled in the "station site field test results table".



Site selection and site survey FIG2

Observation pier construction

In order to build the observation pier faster and better, before the concrete pouring, the pre-customized and processed marble slabs are vertically fixed around the bottom of the pier body, and the stainless steel drum should be the center, and the four marble slabs on the side are vertically fixed. The joints between them are bonded with glue, and the periphery is bound and fixed with thin iron wire. After the concrete poured on the observation pier has set, the column of the observation pier should be finished, including cleaning the outer packing tape of the stainless steel drum, removing the cement stains on the column, and ensuring that the stainless steel drum of the column is bright and free of stains. At the same time, PVC threading pipes are laid between the bottom of the observation pier and the observation room to avoid the exposure of antenna cables and ensure the appearance, integration and standardization of the outdoor observation pier.

Data center equipment installation and high-precision solution software deployment

Installation and commissioning include data center network layout, server and network equipment installation, and high-precision calculation software deployment. After the network is connected, the observation data of the receiver is transmitted to the server through the network channel, and the differential service can be broadcast after the calculation software is configured.

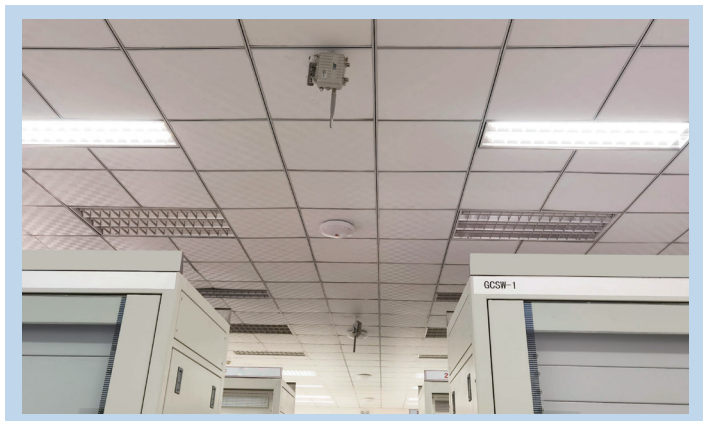
Accuracy verification

Select three known points in the coverage area of the base station. After the high-precision positioning terminal is connected to the base station to achieve a fixed solution, it is placed on the known point and collected 20 times smoothly. The obtained coordinates are compared with the coordinates of the known points. The error is within 2 cm, the accuracy of the base station meets the requirements.

2.UWB base station construction

The main construction contents of UWB base station construction include base station erection, switch cabinet fixing, threading pipe fixing, communication cable laying, power line laying, internal wiring, equipment commissioning, etc.

During the project construction and commissioning process, we arrange technical engineers with certified engineer qualification to conduct on-site commissioning. The commissioning includes system operation condition analysis, system performance adjustment, implementation of system performance adjustment with the consent of the customer, system backup and system testing, and finally the system is delivered to the customer for use.



UWB base station installation FIG3

II. High-precision map acquisition (substation data acquisition)

By using RTK and 3D laser scanning equipment, accurate vector data can be collected. The substation data collection includes data of various types of energized equipment such as transformers, capacitors, grounding cutters, etc., as well as data of roads, houses, grass, open space, fences and other land types within the substation area.

After the substation data collection is completed, draw equipment, roads and other layers through Arcgis. According to the on-site conditions, the operators input the attributes of each area, and finally draw a thematic map.



Substation data acquisition FIG4

Result

By using a variety of Hi-Target high-precision positioning terminals, the functions realized are as follows:
Personnel location positioning: By using the Hi-Target high-precision smart helmet Qbox S30, high-precision cell phone Qmini A10 (UWB), and UWB work card, managers can view the location and action trajectory of operating personnel in real time, obtain personnel information, and conduct visual command and dispatch.

Power equipment inspection: By using the high-precision cell phone Qmini A10 (UWB), it can correlate work plans, make equipment protection records, and conduct standardized inspections based on lines - inspection points - equipment. It supports standard options, text entry, photo upload, field recording and other recording methods, supports data security and storage, seamlessly integrates with the back-end processing system, exports inspection data, and realizes Informa ionization of power equipment inspection.

Operation safety warning: By using high-precision intelligent safety helmet Qbox S30 and UWB work card, personnel indoor and outdoor centimeter-level positioning can be realized. At the same time, delineate two and three dimensional electronic fences, in and out of the fence alarm, the backstage command center and high-precision safety helmet Qbox S30 can realize two-way sound and light alarm, intelligent alarm (off hat, fall, ascent, silence, SOS alarm, etc.), to achieve all-round, all-weather remote intelligent monitoring.

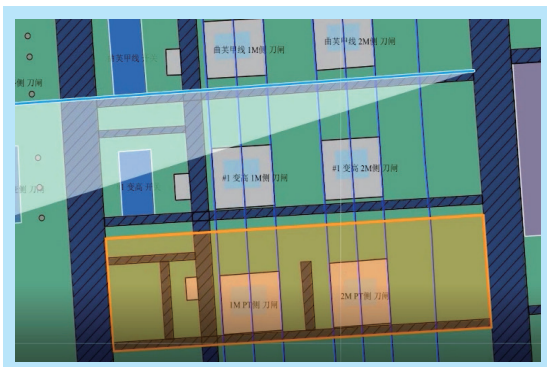
Remote command assistance: By using high-precision intelligent safety helmet Qbox S30, audio and video calls (video intercom between backstage command center and safety helmet, visualization of on-site operation) and voice intercom (single call intercom or group call intercom between backstage monitoring center and high-precision intelligent safety helmet) can be realized without distance limitation of coverage. In case of emergency, operators can request support and take emergency measures remotely at the first time. And the camera on the Qbox S30 can collect the operation situation in real time and send back pictures and videos, so the manager can understand the work situation of the operators and regulate the work process in real time through remote monitoring.



View history track FIG5



Power Equipment Inspection FIG6



Delineation of the electronic fence FIG7



Remote command assistance FIG8

Project Summary

By using a variety of Hi-Target high-precision smart helmets Qbox S30, high-precision cell phone Qmini A10 (UWB), UWB work cards and other high-precision positioning terminals in substations, it can realize accurate map display, centimeter-level positioning of personnel and safety protection, visualization and standardization of operations and real-time safety warning, guarantee the safety of power grid operations by means of technology and defense, and significantly improve operational efficiency.



More information at <https://en.hi-target.com.cn/become-our-partner/>

About Hi-Target

Established in 1999, Hi-Target is the first professional high-precision surveying and mapping instrument brand to be successfully listed in China.

Hi-Target provides a wide range of surveying equipment including GNSS receivers, CORS stations, Total Stations, 3D Laser Scanners, GIS Data Collectors, UAV/UAS, and Hydrographic products to offer complete commercial solutions for various industries.

As the leading brand in the geospatial industry, Hi-Target invests heavily in research and development, on top of collaborating with more than 100 universities globally to bring the latest positioning technology and innovation for product development.

For over 20 years, Hi-Target has approximately 2,500+ employees worldwide, with an established network of 20+ subsidiaries, 28 branches and more than 200 partners in 100+ countries / regions to service and support our customers.

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