

GIS spatial analysis based solutions for the electricity industry

Key words:GIS; Electricity; GNSS;Substation;Power line;

SUMMARY : The electricity industry, as the country's infrastructure, is the most important safeguard for a country. Intelligent electricity system management has always been a very important requirement to ensure his stable operation.

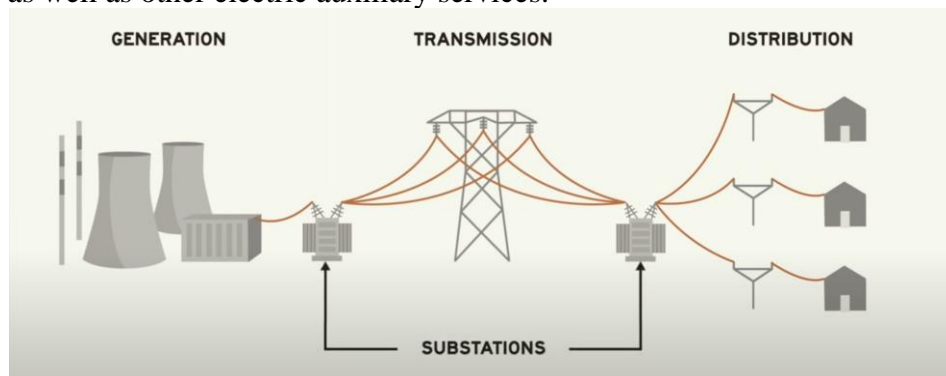
This article introduces a solution for the electricity industry that combines GNSS, GIS, monitoring and other technologies for power station management, line inspection, electricity equipment monitoring, etc. Normally involves multi-sensor fusion technology, LIDAR, UAV, GIS data collection, indoor and outdoor positioning and other cutting-edge technologies.

With our solutions, we can significantly reduce the labour costs of daily management in the electricity industry, while giving staff an easy and quick overview of the overall status of the power system through an online platform. When faults or problems occur in power systems and facilities, they can be detected and alerted at the earliest opportunity.

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1. INTRODUCTION

The electricity industry system is a system for the production and consumption of electric energy consisting of generation, transmission, distribution, sale and use of electricity, of which the electric power industry covers four items: generation, transmission, distribution and supply. The electric power industry is a basic industry that converts various types of primary energy into electricity through corresponding power generation equipment, and then transmits the electricity from power plants to end users through transmission and distribution networks, providing end users with electricity of different voltage levels and different reliability standards as well as other electric auxiliary services.



A Components of an electrical system

This system mainly introduces some application scenarios of GIS solutions in the power industry, including personnel management of substations, data collection and management of substations, daily inspection of power equipment, monitoring of power infrastructure, etc.

In the daily management of electricity power stations, mainly based on GNSS and UWB technologies, integrating geographic information, cloud computing, big data and other technologies, the CORS base station, UWB indoor positioning base station, high-precision indoor and outdoor integration terminal and safety control platform can grasp the precise location of substation personnel in real time, real-time early warning and alarm for leaving the work area and entering the danger zone by mistake, reducing the problems of irregular operation of operators and inaccurate grasp of safety distance.

In the data collection and management of electricity power stations, on the traditional program, the data collection mode is use pen and paper record coordinates, paper-based ledger, difficult to manage and not uniform. And also, internal and external data collection and processing software function is not perfect, and lack of update maintenance, work efficiency is not high. And on the modern GIS program, based on GNSS technology, integration of geographic information, cloud computing, big data and other technologies, through the data acquisition software to achieve convenient collection of power grid data, automatic connection, automatic upload, a key to complete the internal data processing, so that the power grid data collection

more accurate and efficient.

In the daily inspection of power equipment and the monitoring of power infrastructure, power inspection is the detection of overhead transmission and substation line channels and their ancillary facilities. From the inspection mode divided into overall inspection and infrastructure inspection, the overall inspection is concerned with the topological relationship between the power line and the surrounding environment, danger point detection, tree growth analysis, power line measurement, tower deformation monitoring, etc. The infrastructure inspection is mainly concerned with the detailed structure, such as the breakage detection of lead wires, insulators, other accessories, and the inspection of substations.

2. PERSONNEL MANAGEMENT OF SUBSTATIONS

The substation operation environment is special and complex, and when the actual engineering vehicle carries out the operation, there is a high-voltage charged area around it because the power cannot be completely turned off. And because of the dense electric power facilities, the engineering vehicle is not flexible enough, and its actual operation near the charged area requires strict control of the safety distance. At present, the main means of safety control is to rely on engineering operators and site safety guards to make judgments based on visual inspection, there are limitations of sight distance and human limitations, it is difficult to control accurately, resulting in the risk of touching power equipment leading to personnel safety hazards and damage to power equipment. Therefore, it is necessary to build a set of operation safety management protection system to realize the safety of electric equipment in the construction operation area and reliable safety protection for site personnel.



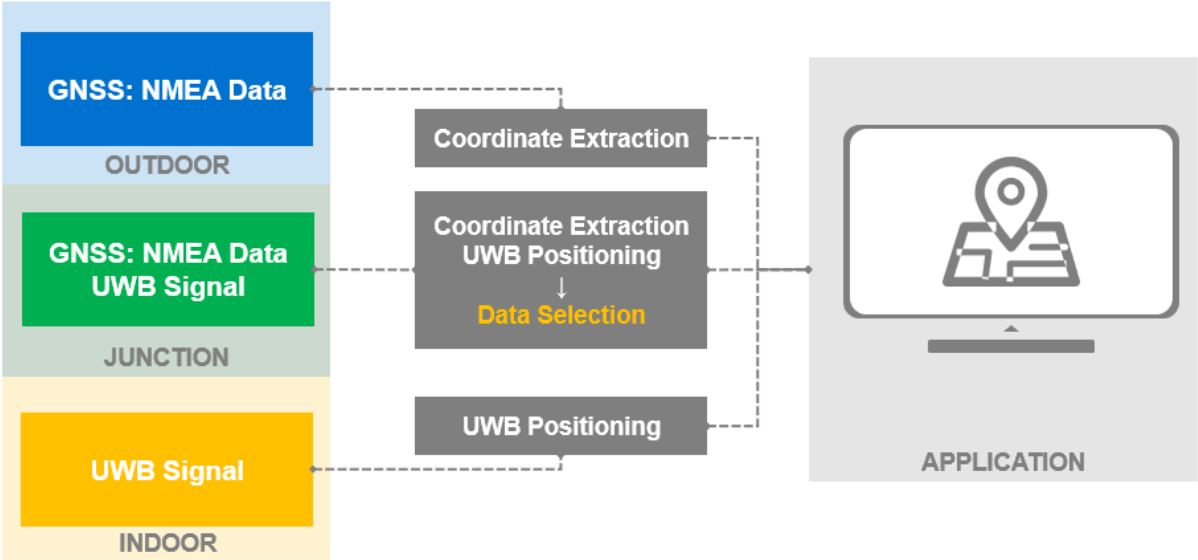
Substation Inspection Management System

Develop a reliable operation safety protection system, including positioning acquisition and terminal with safety protection software, of which consists of a GNSS high-precision positioning terminal, a GNSS high-precision positioning tablet PC, and a GNSS high-

precision smart helmet; the safety protection software includes a desktop operation safety protection platform and a mobile operation safety protection APP. It is possible to achieve.

- 1、 Precise real-time position monitoring of operation personnel, site management personnel and operation equipment positions
- 2、 Accurate 3D location map of the site power facilities and equipment area
- 3、 The command center can observe the site panoramic operation situation in real time
- 4、 the site construction vehicles can be monitored in real time inside the key position of construction activity devices and early warning information
- 5、 Warning and alarm for personnel and equipment that may appear beyond the safety distance
- 6、 The control room can quickly conduct audio and video intercom with the site operators and site managers
- 7、 Storage of equipment, personnel history track and historical abnormal data
- 8、 It can be quickly installed and disassembled

At the same time, the system has the characteristics of rapid deployment, in a pilot substation after the completion of implementation, can be quickly promoted and deployed.



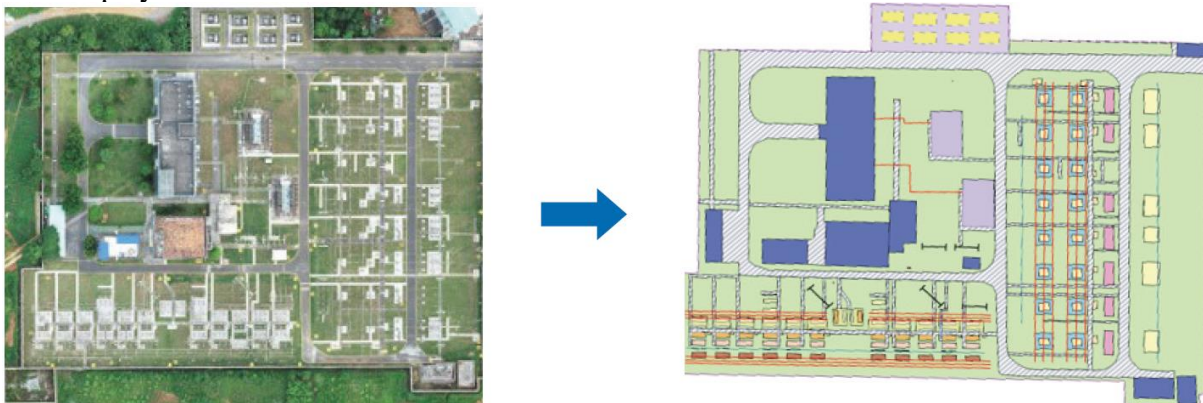
Topology of Indoor and outdoor integrated solution



Substation Personnel Location Management System

3. DATA COLLECTION AND MANAGEMENT OF SUBSTATIONS

Distinct from the previous data collection model, there is a lot of paperwork and data collection and management are troublesome. Running the management technology of GIS, using a series of hardware devices and software platforms combined to develop a comprehensive system from front-end data collection to automatic data uploading to system data display.



Substation 3D Model

Combined with a series of intelligent hardware, in the data collection at the same time, can also be real-time field information, through audio, video transmission to the backstage platform, to achieve data interoperability, state sharing of internal and external industry linkage.



Power Station GIS Integrated Solution

The following are some of the data collection terminals and tools that staff are equipped with on a daily basis

Product	Qpad	Qmini	Qbox	Qhat
Picture				
Meter	✓	✓		
Sub-meter		✓		
DM		✓		
CM	✓	✓	✓	✓
Type	Tablet	Handheld	Wearable	Protection

Smart GIS Integrated Termianl

4. INSPECTION OF POWER EQUIPMENT AND THE MONITORING OF POWER INFRASTRUCTURE

The management of power lines and facilities is divided into two main categories, one is the inspection of power lines and the other is the 24/7 monitoring of power infrastructure.

On the inspection of power lines, lidar is usually used for inspection, and the general workflow is as follows: automatic route planning by importing the operating range, intelligent data collection, automatic trajectory data resolution, point cloud analysis, and inspection report generation.



Point cloud data of power lines

On the all-weather monitoring of power infrastructure, running GNSS monitoring technology to achieve 7/24 real-time monitoring, in order to ensure that in heavy rain, snowstorm and other natural disasters, can also remotely understand the situation of all infrastructure, and the first time to receive information about the damage to facilities, so that can arrange emergency repair immediately.



GNSS Monitoring for Electricity Infrastructure

5. CONCLUSION

With the development of economy, the scale of the power grid has continued to expand, and the operation level has been greatly improved. Within long-distance and large-scale power transmission system, every kilowatt-hour of electricity generated from power plants is transmitted at a speed of 300,000 kilometers per second, through several or dozens of substations over long distances and finally arrives at the users. The running process of the power system consists of several parts, including power generation, transmission, transformation and distribution. The substation is a base link between power plants and users, responsible for changing and distributing electric energy. With its main function to gather, step up, step down and distribute electric power, it is the core link in the entire grid power system. The power supply plays an important role in various industries, and its quality directly affects the economic benefits of the enterprises. On-site operation safety of substations must be attached great importance, cause only by doing a good job in the safe operation of substations can we provide companies and users with safe, reliable, and qualified electrical energy.

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