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Research on the Applicability of Integrated Earth Lifting Machine for 500KV Transmission and Substation Project in Highland Area

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Abstract

In the power construction project, the tower foundation deep pit operation is a fundamental and important process, because of its operation point of the geological foundation structure complex and changeable, large amount of work, many dangerous factors and difficult to observe and identify, the construction is easy to cause safety accidents. State Grid Gansu Power Company has developed a set of intelligent equipment for deep foundation pit operation which is easy to operate, safe, reliable and complete in function, relying on the equipment to actively and timely discover the danger and early warning, and automatically take effective measures to strengthen the protection of personnel, crack the problem of safe operation of deep foundation pit and prevent the occurrence of infrastructure safety accidents. Since this project is located in the plateau area of Tibet, it is intended to study the applicability of the integrated deep foundation pit operation intelligent machine in the plateau area through this project. This project adopts "integrated deep pit operation intelligent machine"; this equipment is specially designed for a series of problems encountered in deep pits and other limited spaces, it integrates a number of practical functions: electric lifting, real-time gas detection, intelligent air supply, automatic sound and light alarm, emergency rescue, differential hanging point, soft ladder hanging point, lighting power, etc. It aims to protect the lives of construction personnel, improve the safety and reliability of construction, enhance construction efficiency, and is a kind of equipment with convenient transportation, installation and operation, diversified and integrated functions and intelligent control.

Keywords

Smart Devices; All-in-one; Highland Areas; Safety and Reliability; Improve Construction Efficiency.

1. Review of the Level of Domestic and International Research

In the 1950s, European and American countries and the former Soviet Union began to build AC ultra-high voltage (EHV) transmission lines from 350kV to 500kV, and by the 1970s, European and American countries conducted a lot of research and development on AC 1000kV level extra-high voltage (UHV) transmission technology[3]. China's transmission line construction is late, and the first 220kV transmission line designed and constructed by China itself in 1954 is a milestone in the history of China's transmission line construction. With the country's continuous development, China's power grid construction has now entered a new era of large power grids, large power plants, large units, high voltage transmission and highly automatic control[4].

The integrated deep foundation pit operation intelligent machine developed by State Grid Gansu Electric Power Company in 2020 provides a solid and reliable guarantee for manual digging operation. The device integrates many practical functions such as fast and stable lifting, real-time gas detection, intelligent air supply, automatic sound and light alarm, emergency lifting of construction personnel, differential hanging point, soft ladder hanging point, etc.,

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realizing transportation, installation and operation convenience, functional diversification, integration, and intelligent control, perfectly solving a series of safety problems encountered in the process of deep foundation pit operation on site, and fully complying with the requirements of safety technical measures for deep foundation pit operation in power transmission line projects. It is strongly recommended by the State Grid Corporation in the mainland and fully promoted in the infrastructure site to further reduce the construction safety risk and enhance the essential safety level of deep foundation pit operation. Combined with the fact that this project is located in the plateau area of Tibet, it is of far-reaching significance to study the applicability of this device in the plateau area and provide a strong guarantee for the development of infrastructure construction in the plateau area.

2. Theoretical and Practical Basis of the Study

Sichuan-Tibet Railway Changdu to temporary section construction power supply project (phase II) package 5: Lancangjiang ~ Bomi 500 kV line project (crowded village - crowded village), starting from the crowded village near the N2023 tower, ending at the crowded village N2104 tower. The whole line of new towers 81 bases, 10 bases for rock inlay foundation, 4 bases for infill pile foundation, 67 bases for artificial excavation foundation. The location of the project is 4100m-4900m above sea level, high altitude, mechanized construction is difficult, manual digging hole risk, low efficiency, safety risk control. In view of the good performance of the integrated deep foundation pit operation intelligent machine in the mainland, it was put into use in the plateau area to observe the applicability of the equipment in the plateau area and to summarize and analyze, so as to reduce the safety risk, improve the construction quality and provide a reliable tool for the construction of artificially dug hole foundation in the plateau area[5].

3. Lift System Accident Analysis

3.1. Human Error

For example, a driver's failure to follow the regulations may lead to an over-roll accident in a short period of time. In order to avoid such accidents, the training of workers should be strengthened to raise their awareness of responsibility.

3.2. System Failure

System failure mainly refers to the control system failure, if the control components or the system itself has problems, it will affect the stable operation of the hoisting system. In the hoist control system, the application of CNC technology can effectively reduce the occurrence of overwinding accidents, but there are still problems such as brake failure or friction wheel slippage.

3.3. Mechanical Failure

Using the multi-rope friction hoisting system as the object of study, the in-roll accidents mainly include the following types: low-speed over-roll, when the control system can play a role. For example, when the hoisting container operation stops, the driver makes an operation error, but can quickly take measures to start the brake system of the hoist. Full-speed over-roll accident, when the lifting container needs to slow down, due to special reasons did not slow down, at this time will be subject to the braking system, protection device double action, let the container running stop. If the role of the control system does not occur at this time, then the operation of the motor will stop, resulting in braking force is not up to expectations, the need to use the protection device to stop the container running, which will make the hoist lifting force increase, and lifting force and hoist wire rope, friction wheel coefficient between the two related, if the

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over-roll device strength is not enough, then it will lead to lifting container accidents. In addition, over-speed over-roll is also an important cause of accidents, when the skip is in a full state and put down in the shaft, when the shaft skip is in an empty state, then it is easy to over-speed over-roll phenomenon and deform the anti-collision beam.

4. Equipment Suitability Analysis

4.1. Winch Power Analysis

The rated power of the winch in the integrated earth moving machine is 1.5kw, and the actual power is 0.9kw-10.5kw according to the efficiency reduction of 30%-40% in the high altitude area, and the actual construction power is only 0.7kw to meet the normal construction according to the Efficiency Reduction Analysis of Power Grid Construction Machinery in Alpine Areas. The maximum lifting height of the integrated earth lifting machine is 24m, while the maximum depth in the actual construction process does not exceed 15m, so the lifting height is satisfied. The specific construction machinery is shown in Figure 1.

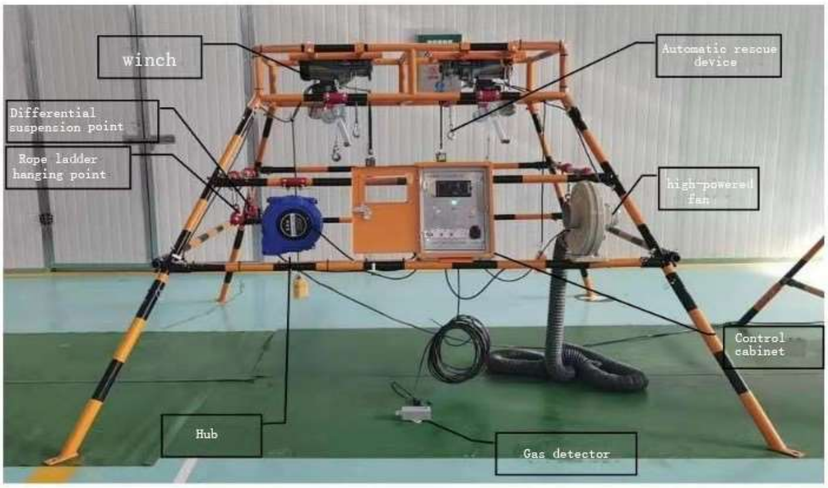

Figure 1. All-in-one earth lifter

4.2. Hanger Force Analysis

The equipment is arranged with limit blocks on the frame beams. In order to increase safety and reliability, the frame beam is locally strengthened at the pivot points with the same material as the original steel structure. Table 4. 4. 1 Strength index for steel design, low-alloy high-strength structural steel Q345, thickness 40-63mm, tensile, compressive and flexural strength design value f=290MPa. One of the integrated earth lifter nameplate is shown in Figure 2.

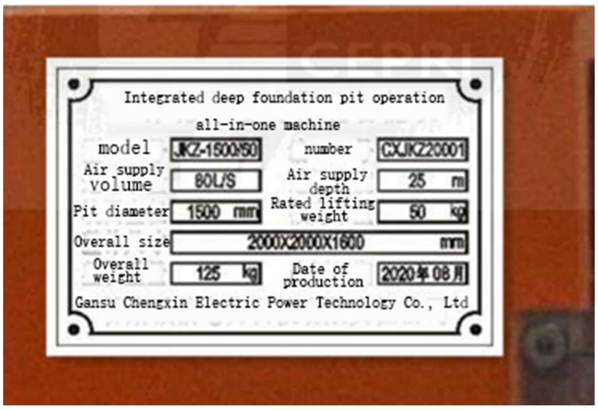

Figure 2. All-in-one earth lifter nameplate

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5. Lift Process Control

5.1. Upgrade Preparation

Before lifting, debug the one piece hoisting system, check the connection of each place, and whether the direction of motor spindle rotation is correct; check whether the action of solenoid valve and shut-off valve is normal, and the installation and firmness of guiding frame, steel strand, ground anchor, pipeline and valve block, temporary facilities, etc. Before the structure is lifted, the lifting system and auxiliary equipment should be fully checked and commissioned. One of the actual construction sites is shown in Figure 3.

Figure 3. Actual construction site

5.2. Official Promotion

(1) After checking the work and system testing, calculate and determine the required motor power (considering the loss of efficiency in the plateau area) and the contraction amount of the cable strand.

(2) When starting to lift, the winch starts, in order to 40% of the required power. In the case that everything is normal, you can continue to load up to 80% and 100%.

(3) Stop lifting after the soil is vacated, and conduct a comprehensive inspection of the equipment lifting system and structural system to confirm that there is no problem with the stability and safety of the overall structure of the equipment before continuing to lift.

(4) In the process of synchronous lifting, pay close attention to the horizontal sliding of the equipment. Ensure that the lifting is stable and the steel strand is kept vertical during the lifting process to avoid friction damage to the steel strand and avoid generating lateral force.

5.3. Enhancement Process Monitoring Methods

After all preparations are completed and after a systematic and comprehensive check to ensure correctness, the site commander checks and gives the order, the official hoisting can be carried out.

1) Through the self-locking device and mechanical self-locking system set in the equipment circuit, the hoist can automatically lock the steel strand for a long time when the hoist stops working or encounters a power failure, etc. to ensure the safety of the hoisted components.

2) In the lifting process, pay attention to the observation of the integrated earth lifting machine equipment, etc., and carefully do the record work.

3) During the lifting process, the operator in the hole should pay attention to observe the height of the soil from the ground and pay attention to the lifting status of the steel strand.

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4) During the lifting process, close attention should be paid to the working status of the lifting steel strand, hoist, safety anchor, control system and sensing detection system, etc. Communication tools should be kept by special person to ensure the signal is smooth. In the whole lifting process should always pay attention to the overall stability of the platform of the upper lifting point; the overall stability of the equipment lifting process, whether the equipment frame is deformed seriously, etc.; lifting load-bearing system is the key component of the lifting project, it is important to do serious inspection and careful observation.

6. Summary

Comprehensive analysis of the above analysis, the analysis of its equipment technology can be seen, in high altitude areas lifting system conditions allow the use of integrated lifting machine than the general scheme investment is small, less difficult to achieve, good system adaptability. The use of integrated earth lifter can also increase the lifting speed and primary lifting volume to meet the construction requirements of higher requirements for lifting capacity and quality of dug piles. At the same time, in high altitude areas with less oxygen content, the use of mechanized operation can reduce labor intensity, protect workers and improve construction safety.

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