Analysis of power distribution network operation without power cut based on actual engineering data

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Abstract. Distribution Network operation without power cut has gradually become the trend of the future distribution network construction, the investment in distribution network has increased year by year, carrying out the study on the analysis of distribution network operation without power cut, analyzing the benefit of distribution network operation without power cut, it is of great significance to provide suggestions for the future distribution network operation cost lean management. Based on the technical analysis of non-outage operation in distribution network, combined with the social benefits of non-outage operation, this paper gives some suggestions on strengthening the management of non-outage operation.

1. Introduction
In order to improve the reliability and quality service level of distribution network, the principle of "no power cut is the best service" of State Grid Corporation of China is popularized, and "no power cut operation" is more and more applied to the construction of distribution network.

In recent years, with the promotion of the company, the distribution network operation without power cut [1-3] has a more rapid and standardized development. In 2010, the company formulated Q/GDW 520"10 kv overhead distribution lines live Operation Management Code" ; In accordance with the circular of the Ministry of Equipment of the State Grid concerning the comprehensive strengthening of the management of distribution network operation without power cut [4-7] issued by the Ministry of Equipment of the State Grid in August 2019(article 77 of 2019 on equipment distribution) , the future distribution network development will be guided by the idea of "1135" distribution management in the new era, adhere to the customer-centered, to enhance the reliability of power supply as the main line to fully promote distribution network operation without power cut.

In accordance with the development thinking and target of the Power Grid Company's future distribution operation, to the 2021, cities and counties are not less than 85% and 70% respectively, the annual per capita operation frequency will continue to increase, distribution Network operation without power cut has gradually become the trend of the future distribution network construction, the investment in distribution network has increased year by year, carrying out the study on the cost analysis of distribution network operation without power cut, analyzing the cost level and benefit of distribution network operation without power cut, it is of great significance to provide suggestions for lean cost management in future distribution network operation without power cut.
2. Analysis of application status of non-power-off Operation Technology in distribution network
There are 33 items in the "10kV distribution network operation code without power cut" (Q/GDW 10520-2016) issued by the Power Grid Company, according to the tools, equipment's and working methods used, it is divided into insulating pole working method, insulating glove working method and comprehensive operation method without power cut. With the development of science and technology, the structure of technology is constantly optimized, and the mechanized live working may become the trend of the times in the future.

Among them, the robot working without power cut has higher efficiency, which can improve the efficiency of the specific work and upgrade the effectiveness of the management dimension on the basis of ensuring the personal safety of the staff. On the basis of learning from foreign research results, China has also begun to explore the application of robot operation mechanism without power cut to complete the work that can not be accomplished by manual work, and to further optimize the control ability of safe distance on the basis of effectively reducing labor intensity, to effectively improve the actual working efficiency of live working, to ensure the optimization of working model and management mechanism.

On April 28, 2009, the National Energy Administration issued the "20kV and below distribution network project budget quota (2009 edition) " , which does not include the non-outage operation-related sub-items, the lack of systematic basis for the non-outage operation of distribution network pricing. The "20KV and below distribution network project budget quota (2016 edition) " issued by the National Energy Administration on January 3,2017 contains 19 sub-quotas for operation without power cut, and is only applicable to overhead line projects, the pricing standard for cable operation without power cut and comprehensive operation without power cut can not correspond to 33 items in the specification for 10 kv distribution network operation without power cut (Q/GDW 10520-2016) issued by the company, it leads to some problems such as inconsistent charging standard, inaccurate quota application, unable to find the corresponding quota, etc. . In order to improve the scientific and rationality of the cost accounting of distribution network projects in operation without power cut, standardize the compilation of cost documents such as project construction budget, safeguard the legitimate rights and interests of all parties involved in construction projects, and promote and guide the popularization and application of operation without power cut, to promote the healthy development of power construction, in August 2019 the State Grid quota station formulated and published the guiding opinions on the application of the quota for non-stop operation of power distribution network projects of the State Grid Co. , Ltd. (for trial implementation) , based on the "20kV and below distribution network project budget quota (2009 edition) " and the "20kV and below distribution network project live operation supplementary quota (Trial Implementation) " issued by the State Grid Co. , Ltd., 33 projects with no power cut are taken as objects, the principles of quota selection and quota level adjustment are determined one by one, and the reasonable cost is calculated and listed. The continuous improvement of the pricing basis for distribution network operation without power cut has laid a theoretical foundation for the development of the study of distribution network operation without power cut.

3. Analysis of distribution network operation without power cut
Improving the reliability of power supply and increasing the contribution to GDP can effectively improve the reliability of power supply, provide customers with stable electricity consumption, help effectively improve the Customer satisfaction and reduce substantive complaints.

Distribution Line is a direct customer-oriented power infrastructure. With the increasing popularity of power facilities for production and living, the demand for power supply reliability is getting higher and higher. The development and popularization of operation without power cut can effectively improve the safety, reliability and economy of distribution network operation, realize continuous power supply to users, avoid disputes between power supply and demand, and improve social benefits.

According to figures released by the National Energy Administration and the National Bureau of Statistics of the People's Republic of China, the country's GDP in 2019 was 99.09 trillion yuan, and the total electricity consumption of the whole society was about 7,225.5 billion kwh, or 1 kwh of electricity,
creating an economic value of about 14 yuan of GDP, it is of great significance to effectively carry out the operation without power cut to enhance the contribution of power supply to the Gross Domestic Product.

Enhancing the business environment and enhancing the sense of ownership of quality electricity services. The Access to electricity index is one of the key indicators in the World Bank's doing business report. In recent years, the company has been actively implementing the central government's deployment, implementing the two-year action plan to optimize the business environment of the power sector, speeding up the construction of the "online state grid", deepening the "one-line network operation", promoting operation without power cut and comprehensive energy services, etc., continuously improve customers' sense of power acquisition.

If the traditional power outage is still used, the need for at least 7 days in advance of the public announcement of power outage, will seriously restrict the "access to power" index. For this reason, the company has gradually expanded the scope and proportion of operation without power cut, carrying out operation without power cut for 0.4 kv low voltage projects, 10 kv overhead line projects with live working conditions, and cable line projects with bypass and power supply working conditions, and gradually expand to complex operations and integrated operation projects without power cut. In 2019, the State Grid Co., Ltd. has been fully implemented in all provinces without power outage operations, by 2020 industry expansion without power access rate of more than 90%.

Operation Without power cut can avoid a large number of switching operations caused by power cut, reduce maintenance time, reduce the work intensity and work pressure of maintenance personnel. At the same time, the operation without power cut need not wait for the power cut plan, so that the fault line or equipment can be repaired in time, the defects and hidden troubles of the line or equipment can be eliminated in time, the running time of power facilities with disease can be shortened, and the probability of trip can be reduced. In a word, with the maturity and large-scale application of Operation Technology, the construction cost will decrease gradually, and the economic benefit of operation will become more and more prominent.

4. Empirical Analysis
The maximum load day is July 22, the maximum current is 252.39 a, the minimum load day is February 4, the minimum current is 53.46 a, the maximum load day is September 6, and the maximum current is 239.50 a. On the day of the project (September 18, 2019), the current of the industrial line was 239.50A on the highest load day in September 2019.

The vacuum switch on the 14th pole and the isolation switch on the 13th pole are required to be installed from 0900 to 1700 hours on the day of construction. If the operation of power cut, loss of active power 3940.73 kw, loss of electricity 31525.86 kwh, purchase price difference 0.3 yuan/kwh calculation, can cause economic loss of 9457.46 yuan.

The above losses can be avoided by operation without power cut, in addition, the construction of operation without power cut can omit a series of switching operations and load adjustment in common operation without the need to carry out a large number of distribution and contact of power cut notices, reduce Unnecessary Operation Manpower, operation equipment and switch equipment consumption, improve labor productivity.

Referring to the relevant provisions of the "guidelines for the application of non-stop operation quotas for distribution network projects of the State Grid Co., Ltd. (Trial Implementation)", "the transformation of loaded linear poles into tensile poles and the installation of isolating switches on columns" and "the transformation of loaded linear poles into tensile poles and the installation of switches on columns" need to be carried out simultaneously, the norm guiding price is 43702.82 yuan, from the economic benefit point of view, it is not appropriate to carry out complex operation without power cut.

In terms of social benefits, the county-level city achieved a gross domestic product (GDP) of 76.810 billion yuan in 2019, with a grid power supply of 7.5 billion kwh, generating an economic value of about 10.24 yuan of GDP per kilowatt-hour, and social benefits of about 322,800 yuan. Flexible use of
technical means of operation without power cut, in a variety of projects to achieve less power cut, while ensuring the construction of the project.

For example, it is necessary to remove 610 kv lines and many low voltage lines in the project of line relocation within the construction scope of the contract project—a certain city’s 7 expressway. A City Company has adopted a total of 29 live-line operations, including 5 live-line pole with load to be replaced by a tensile pole and the installation of a switch on the pole, and 2 live-line groups to set up a live-line pole operation, 6 times of live connection of no-load cable line to overhead line, 8 times of Live cut-off of no-load cable line to overhead line, 5 times of normal elimination and installation of accessories, 3 times of live connection of lead line, more power supply 91170 kwh, reduce the number of households when power failure 324 hours. Only this operation, a city company invested in operation funds more than 300,000 yuan, to avoid more than 1400 enterprises and residential power along the power outage.

According to statistics, in 2019 a certain city company used power-on-demand operation 1,219 times in the contract project. Under the premise of ensuring the reliability of power supply, it fully ensured the progress of all kinds of municipal engineering construction and ensured the economic and social development.

(1) To carry out the construction of large data on the construction of large data on the construction of large data on the construction on the non-stop operation of power distribution network, carry out the construction of a database framework to clarify the basic flow of data from collection to management to application; second, promote the transfer of cost data collection from offline to online by means of information, so as to realize the decentralized collection and centralized storage of data resources, to enhance the sharing and handling of data; third, to attach importance to the importance of data analysis, and gradually expand from simple volume and price analysis to the analysis of the entire cost index system, after the data sample quantity and quality reach a certain scale, we will deepen the study on the cost of distribution network operation without power cut.

(2) Strengthening the high-quality construction of the technical and economic team of the distribution network high-quality construction of the distribution network without power cut operation project cost high-quality management needs the support of the technical and economic team of high quality. In recent years, driven by the internal and external environment, it is imperative to systematically promote and build a high-quality distribution network technical and economic team.

(3) Regulating non-power-off operating expenses itemizing 1 is to strengthen the examination of design and construction drawings and live-line operating budget itemizing, and each company shall add non-power-off operating funds itemizing and construction schemes to all types of projects that can be studied, make it clear as the necessary content of the project internal audit. The other is to strengthen and deepen the cost analysis of operation without power cut, to analyze the use of the cost, to verify the deviation between the analysis and the budget, and to improve the cost control level. Third, carry out statistical analysis of non-power operation costs, monthly statistical analysis of non-power Operation Funds Decomposition Implementation, decomposition of the situation, implementation, settlement and other evaluation and analysis.

(4) To cultivate professional construction teams without power cut and establish a sound professional team review system to prevent teams with poor safety management, weak construction force or repeated personal injuries and deaths from participating in construction work. We should reasonably cultivate professional construction teams without power cuts, speed up the formation of a unified and open market system with orderly competition, establish a fair competition guarantee mechanism, improve the mechanism whereby prices are mainly determined by the market, and break down regional segmentation and industrial monopolies, help to improve the efficiency of construction operations, reduce construction costs, is conducive to the rapid development of non-power operation costs.

5. Conclusion
(1) The cost of distribution network operation without power cut is higher, however, to effectively improve work efficiency, special materials such as insulating gloves, insulating safety caps, insulating
clothing, insulating blankets and insulating tighteners, as well as special machinery for non-power-cut operations such as insulating boom cars, should be used for non-power-cut operations, at present, the price of special materials and machinery is at a high level, which is the basic reason why the construction cost is higher than the traditional one. Among them, some special materials for operation without power cut need to be purchased from abroad at present. In the future, with the localization and large-scale application of such materials, the cost of materials for operation without power cut will gradually decrease, thus the construction cost of operation without power cut will be gradually reduced.

(2) The social benefit of distribution network operation without power cut is significant, which is helpful to enhance the customer experience. Operation Without power cut can effectively improve power supply reliability, provide customers with stable power consumption, help effectively enhance the Customer satisfaction, reduce substantive complaints, avoid power supply and demand disputes, significantly enhance social benefits. Operation Without power cut can improve service efficiency and quality and establish a good image of power supply enterprises. The implementation of operation without power cut can quickly meet all kinds of operation needs related to the power grid without power cut by surrounding enterprises and residents, which will greatly improve service efficiency and quality, and better fulfill the purpose of providing good power supply and service, set up a good corporate image.

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