

RESEARCH ON THE CURRENT STATUS AND DEVELOPMENT TECHNOLOGY OF LONG-DISTANCE NATURAL GAS PIPELINE AUTOMATION

Kwang Kim

Department of Electrical Engineering and Computer Science, Seoul National University, 599 Kwanak-ro, Gwanak-gu, Seoul, 151-742, Korea.

Abstract: In order to comprehensively promote the further development of China's long-distance natural gas pipeline automation technology, first of all, from the current status of automation control technology, the selection and application of instrument systems, and data acquisition and supervisory control systems (SCADA) From the perspective of system application, long-distance natural gas pipeline The current situation of pipeline automation is analyzed, and the application foundation of automation technology for long-distance natural gas pipelines is discussed. Finally, the automation technology of long-distance natural gas pipelines is analyzed. Conduct a comprehensive study on the development trends of automation technology to lay the foundation for further development of automation technology in the pipeline field. Research shows: Yes For long-distance natural gas pipelines, after the introduction of SCADA systems and various types of instrument systems, The level of automation has been improved to a certain extent In the future, we need to start from the perspectives of optimizing pipeline structure, innovating automation technology, improving software performance, and introducing advanced experience and technology. Take various types of measures to further improve the automation level of long-distance natural gas pipelines.

Keywords: Long-distance natural gas pipeline; Current status of automation; SCADA system

1 ANALYSIS OF THE CURRENT SITUATION OF AUTOMATION OF LONG-DISTANCE NATURAL GAS PIPELINES

At present, the complexity of my country's pipeline system is gradually increasing. For long-distance pipelines, the situation along the pipeline is also relatively complex. Complex and affected by the internal and external environment of the pipeline, safety risks arise The probability of problems is also relatively high. Number of accessory facilities along the pipeline The volume is relatively large. If some accessory facilities are controlled manually, Error problems are prone to occur, and the human resources required are relatively large. There are many, and the skill requirements for personnel are relatively high, so improving the pipeline The level of automation helps ensure the efficiency of pipeline operation and and safety [1]. At present, my country has made great achievements in the field of pipeline automation. has made great progress, in order to further improve the level of automation High, it is necessary to understand the current application status and future development of automation technology Conduct in-depth research on trends.

1.1 Current Status of Automatic Control Technology

At present, China's long-distance pipelines have introduced SCADA systems. The introduction of this system has gradually improved the automation level of the pipeline. However, through analysis of the system, it was found that its functions It is not perfect. During the use of this system, the pipeline may be Comprehensive collection of operating parameters can be carried out automatically on the pipeline. Active management and monitoring, for stations along the pipeline, can To achieve unattended functions, thereby meeting the needs of human resources The quantity required can be reduced, and at the same time, the work intensity of personnel can also be reduced. Ultimately promoting further development in the pipeline field. In fact, due to There are relatively many factors affecting safety during pipeline operation, so Therefore, pipeline operation has relatively high technical requirements [2].

1.2 Selection and Application of Instrument System

The use of instrumentation systems is very important for the automated operation of pipelines. Various types of instruments can mainly collect pipeline-related parameters. Through data analysis, the effect of safe operation of pipelines can be improved. At the same time, they can also provide data support for pipeline regulation. Flowmeter is an important part of the instrument system. Common flowmeters can be divided into three types, namely orifice flowmeter, ultrasonic flowmeter and turbine flowmeter. By using various types of flowmeters, the transmission of pipelines can be measured. gas volume Measurement. In the process of using the flow meter, it is necessary to perform comprehensive Comprehensive maintenance and management ensure that the flow meter operates efficiently status to reduce flow monitoring errors. For ultrasonic flowmeter Generally speaking, the accuracy of its use is relatively high, and the amount of maintenance is relatively small. less, the measurement error range is relatively wide, and can be applied to long-distance transmission Pipeline flow monitoring and station flow monitoring and other fields. Pass Through research in the field of energy measurement, it was found that the flow measurement process. Transaction disputes are

prone to occur in China. Therefore, our country has begun Conduct a comprehensive study on the energy measurement method and compare it with the flow measurement method. Compared with the energy measurement method, the scientific degree is relatively high [3]. In addition to the need for In addition to monitoring the flow rate, it is also necessary to monitor the operating pressure of the pipeline. Conduct comprehensive monitoring. Through pressure monitoring, we can understand Pressure information for pipeline operations to allow a comprehensive assessment of pipeline pressure adjustment, comprehensively improve the management of pipes on the premise of ensuring transportation efficiency. The safety of pipeline operation is also an important factor in preventing pipeline leakage. Measures are needed. As the length of the pipeline continues to increase, the entrance and exit of the pipeline The pressure difference at the location is relatively large, which affects the pressure at the entrance and exit. Reasonable management of flow and pressure can ensure long-term pipeline period is in stable operating condition. Compressors are very heavy along the pipeline Essential equipment, the main function of the compressor is to improve energy output To deliver pressure, the longer the length of the pipeline, the greater the pressure required along the pipeline. The greater the number of compressors, the more energy is required during use of the compressors. The demand is relatively high, therefore, energy-saving compressors are introduced It is also very critical that during use of this type of compressor, Large changes in medium temperature and pressure can be avoided, thereby Prevent the medium from generating hydrates in the pipeline. The occurrence of hydrates will Causes pipe blockage problems, ultimately affecting energy transmission efficiency Serious impact. Adjustment of pressure and flow can not only improve pipeline The safety of transportation can also ensure the stability of downstream energy supply. performance, and ultimately meet users' energy needs. The leak is caused by the pipeline common risk issues during operation. Before leakage occurs, In the future, the concentration of natural gas will continue to increase until the concentration reaches an explosive level. After the limit, the probability of fire and explosion problems is relatively high. The problem of pipeline leakage will not only have serious consequences for the environment along the pipeline damage may also cause casualties. Therefore, the management Comprehensive monitoring of leakage issues is also critical. gas fraction The analyzer is a key instrument for leakage monitoring. This instrument is mainly used in In the stations along the pipeline, the concentration of natural gas in the stations reaches After a certain value, the system will issue an alarm, and the staff A comprehensive inspection of the site can be carried out to detect system leaks in a timely manner. question. During the operation of pipelines, it is also necessary to check the quality of the medium Conduct a comprehensive inspection. Quality inspection mainly refers to the media To monitor the components, the online gas chromatography analyzer belongs to Important quality inspection equipment that can check the components of the medium Conduct a comprehensive analysis [4]. Through the analysis of pipeline safety risks, it was found that corrosion is an important factor threatening pipeline safety. Therefore, a certain number of cathodic protection systems need to be installed along the pipeline. The system mainly conducts comprehensive inspection of pipelines from an electrochemical perspective. For surface protection, during the use of the cathodic protection system, if it Large changes in the data will cause the problem of cathode protection failure, because Therefore, comprehensive monitoring of the parameters of the cathodic protection system is also required. After the automatic control system is introduced, the parameters of the cathodic protection system can also be Carry out comprehensive collection and conduct reasonable analysis of parameters. After there is a problem with the operation parameters of the protection system, you can check the cathode protection system Make reasonable adjustments so that the cathodic protection system can fully play its role use.

1.3 Application of SCADA System

In the process of using the SCADA system, you can The parameters of system operation are collected in real time, and the parameters are fully analyzed. Based on the comprehensive analysis, the computer in the dispatch center can The overall situation of pipeline operation is adjusted. The system and terminal equipment Only when used in conjunction with equipment and communication systems can its effects be achieved fully use. On the other hand, data analysis can also In order to find leakage problems along the pipeline, for long-distance pipelines, their operation stability is relatively strong, and the relevant parameters are not There will be no major fluctuations. Data analysis is to look at temperature, Changes in parameters such as pressure and flow, through the use of flow Equations and energy equations for leakage problems along pipelines identification, this leakage monitoring method also needs to be used in conjunction with The SCADA system is connected, and the relevant parameters collected by the SCADA system are The data needs to be transmitted to the leak monitoring system. For the control center In other words, mainly through the use of computer networks to conduct pipeline system For control and regulation, the control center adopts a three-level control plan. The first-level control system belongs to the central control system and can control the entire management system. Supervise the operation of the pipeline system, and at the same time, it can also monitor the pipeline along the Reasonable control should be carried out at the stations along the line. Secondary control system control The authority is mainly determined by the dispatch center. This control system belongs to the station. Control level can exert the effect of station control. Three levels of regulation The system is a local control system, which mainly controls the pipeline operation process. Monitor fault problems in the pipeline system to prevent risk problems in the pipeline system After the problem is solved, reasonable emergency measures can be taken to ensure that the management road operation safety.

2 BASICS OF APPLICATION OF AUTOMATION TECHNOLOGY FOR LONG-DISTANCE NATURAL GAS PIPELINES

2.1 Build the Hardware Management Organizational Structure

Hardware facilities are an important basis for ensuring pipeline operation automation. Therefore, it is very important to reasonably improve the hardware facilities. In the process of improving the hardware system, it is necessary to automatically Conduct a comprehensive analysis of the automation functions and conduct a structural analysis of the hardware system Perform comprehensive optimization. At the same time, it is also necessary to improve the hardware equipment as much as possible The advanced nature of the equipment and hardware facilities are an important guarantee for the quality of data collection and transmission. Since the investment in hardware facilities requires a large amount of Funds, therefore, the improvement and upgrade of hardware facilities need to be considered Functions and financial investment and other factors, the final realization The purpose of pipeline operation optimization.

2.2 Improve Software Program Management System

The hardware facilities along the pipeline need to be controlled by the software system Only under control can it operate reasonably. Therefore, the software system needs to be To carry out reasonable construction, in the process of building software system, it is necessary to Carry out reasonable regional division of pipelines and construct different regions separately software systems, and then make reasonable adjustments to different software systems Combination can improve the overall integrity of the software system. Software Department The system is mainly composed of different subsystems, and can control the related Parameters are collected, and the parameters collected by each subsystem will be fed back to the general management system. Through reasonable planning of software systems points, which will help improve the maintenance of software systems.

3 RESEARCH ON THE DEVELOPMENT TREND OF AUTOMATION OF LONG-DISTANCE NATURAL GAS PIPELINES

3.1 Pipe Structure Optimization

In order to comprehensively improve the automation level of pipelines, it is necessary to The traditional piping system is reasonably optimized through the piping system The optimization method can prevent the problem of unreasonable pipeline control. problem, in the process of optimizing the pipeline system, it is necessary to Conduct a reasonable analysis of the layout pattern and gradually eliminate the For older equipment, comprehensively update the hardware equipment to and upgrade. In fact, the main purpose of piping system optimization is to Improve the transmission performance of automation systems and improve the quality of data transmission The throughput and transmission efficiency have been further improved, and the system has been optimized Work is needed to improve the operational efficiency and operational safety of the piping system All based on the premise.

3.2 Innovative Automation Technology

At present, most pipeline operation automation technologies in my country are It is introduced from abroad, and independent research in this field needs to be increased in the future. Although the relevant technologies in developed countries are relatively advanced, due to my country's relatively complex geographical situation, the imported advanced technologies may not necessarily meet the needs of my country's pipeline operations. Since the field of pipeline automation involves relatively many disciplines, in the process of independent research and innovation, pipeline management companies need to establish cooperative relationships with scientific research institutes and promote the comprehensive development of technology in the field of automation through multi-party cooperation.

3.3 Improve Software Performance

The software system is very important for automated control. Therefore, it is necessary to further improve the performance of the software system. After perfecting the automation program, in addition to meeting the demand for command control, the automation system can also self-optimize the pipeline operating parameters according to the task requirements of pipeline transportation. This is an improvement. The key to high pipeline operating efficiency. In realizing transmission automation In the process, it is necessary to improve the advanced nature of the communication system as much as possible, To improve the efficiency and security of data transmission, in my country's pipeline network system On the premise that the complexity of the system is increasing, the complexity of the communication network is also Improvement, which puts forward higher requirements for communication systems.

3.4 Introduce Advanced Experience and Technology

In the process of building an automation system, it is necessary to pay attention to Taking the advanced experience of developed countries, although there are certain differences between our country's pipelines and foreign pipelines, after introducing advanced experience, we can make reasonable improvements to foreign systems to make them better meet the needs of our country's pipeline operations. Through this measure The time required to build an automated system can be shortened, and the stability of the system during use can also be improved to a certain extent.

4 CONCLUSION

To sum up, improving the level of automation is an important factor for my country's natural gas growth. An important development trend in the future of pipelines, despite the introduction of SCADA After the system and instrumentation system, the automation level of pipelines has been It has been comprehensively improved, but it is still far away from achieving comprehensive automation. There is still a certain gap, therefore, there is a need for Carry out comprehensive innovation in relevant technologies and introduce advanced automation System construction experience promotes further development in the field of pipeline transportation in my country develop.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

REFERENCES

- [1] Liu Pengyou. sky Ran gas long lose Tube road country Produce SCADA soft Software development status and prospects. *Petrochemical Automation*, 2016, 52 (2): 7-10.
- [2] Zhou Wei, Miao Quancheng. Exploration on the construction of digital unattended stations for long-distance natural gas pipelines. *Management Science and Engineering*, 2021, 10(2): 183-187.
- [3] Xing Jianfen. Current status of automation of natural gas long-distance pipelines and Prospects. *Instrumentation Users*, 2012, 19(6): 10-14.
- [4] Zhang Wenzhe, Lu Muhao, Huang Tianxiang. Long-distance natural gas pipeline Current status and development trends of automation. *Chemical Engineering Design Communications*, 2019, 45 (9): 37-38.