Application Research on Intelligent Management Technology Based on Oil and Gas Pipeline

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Abstract. As artificial intelligence rises to the national strategy, all walks of life are exploring their own development in the fourth industrial revolution. In the 1990s, China’s oil and gas pipelines entered the stage of automatic control from the initial manual operation. After more than 20 years of exploration and development, the reliability and accuracy of the automation system and communication system have been greatly improved; as a result, central control began to replace station control, and centralized control of oil and gas pipelines greatly accelerated the standardization and standardization of operating procedures. The reliable and accurate system and the standardized procedures laid a solid foundation for the intelligent regulation of oil and gas pipelines. This article gives the definition and connotation of intelligent regulation combined with artificial intelligence and pipeline control and gives two design directions from the status quo of oil and gas pipeline regulation. At the same time, it lists the necessary conditions for the realization of intelligent regulation and control.

1. Introduction
With the continuous maturity of artificial intelligence-related technologies, it has become an inevitable trend for social development that machines have replaced part of human brain labor, and will open a new chapter for the liberation and development of productivity [1].

Oil and gas pipelines are running pipelines for many years, and the transportation medium is a threat to the surrounding environment. This requires oil and gas pipeline dispatchers to monitor the pipeline parameters at all times and complete the relevant operations within the specified time. Year-round shift work will disturb the biological clock of dispatchers, which is not conducive to the physical and mental health of dispatchers; surveys have shown that it is difficult for dispatchers to maintain a very sober state at night, and it is difficult to ensure the safe operation of pipelines when fatigued to work. The development of intelligent regulation will alleviate or even eliminate the contradiction between the safe operation of pipelines and the physical and mental health of personnel, which is the future development trend in the field of regulation of oil and gas pipelines [2].

The application of intelligent control has been successful in long-distance water transmission projects, long-distance power transmission, and oil and gas exploitation. This will accelerate the application and promotion of intelligent control of oil and gas pipelines [3].

2. Definition of intelligent regulation of oil and gas pipelines
The intelligent regulation of oil and gas pipelines is the application of artificial intelligence to the operation and management of oil and gas pipelines. It enables dispatchers to shift from daily remote operation and parameter monitoring to the formulation and optimization of operating plans, the
formulation and optimization of operating procedures, the analysis and summary of operating conditions, and abnormal events. Advanced tasks such as tracking and summary.

2.1. At this stage, the intelligent control system should complete the following tasks
Complete operations such as start and stop transmission and process switching according to the transportation plan;
- Adjust the output and pressure reasonably according to the actual situation;
- Handle abnormal conditions in time and notify relevant personnel;
- Make statistics and report on abnormal equipment.

2.2. The benefits of intelligent regulation
Standardize operations. Different dispatchers have different operating habits and methods, and the same dispatcher will have different operations at different times. The differences in these operations increase the risk of oil and gas pipeline operations. Intelligent regulation can eliminate these artificial differences, thereby reducing operations risk. Improve operation comparability. The randomness of the operation difference of the dispatcher will lead to the random change of the trend of the operating parameters. It is difficult to optimize the operation by analyzing the change trend. The intelligent control eliminates the operation difference, so it is conducive to the comparative analysis of data and the summary optimization of the operation. Improve abnormal predictability. The machine's ability to analyze and process data is stronger, and can monitor and analyze multiple parameters at the same time, which will greatly improve the ability of abnormal prediction and emergency response. Liberate post manpower. Dispatchers will no longer be bound by process operations and parameter monitoring, and can spend more time to complete advanced tasks. Ensure the health of personnel. At night, there is no need for long-time monitoring and operation of dispatchers. The dispatchers will say goodbye to the harm caused by shifts, which is beneficial to the physical and mental health of dispatchers.

3. The design direction of intelligent regulation

3.1. Intelligent transformation based on SCADA system
As the name suggests, the SCADA system is upgraded to an intelligent SCADA system, so that the intelligent SCADA system has all the requirements for intelligent regulation and control, and can directly complete all the tasks of intelligent regulation and control.

Advantages: Commands and data are directly issued or uploaded from the intelligent SCADA system to the intelligent SCADA system, with fast response speed and low error rate; no special intelligent system hardware is required, and new equipment is added.
Disadvantages: Most of the existing SCADA systems are foreign systems, which are difficult to reform and low in information security; the system involves a lot of pipeline data and is not universal after the transformation.

3.2. Independent intelligent system
This design is to keep the existing SCADA system unchanged, plus an intelligent system on the upper layer. The transportation plan is issued to the intelligent system, and the operation instruction is formed by the analysis of the intelligent system, and then the instruction is issued to the SCADA system to complete the operation; the pipeline data is provided to the intelligent system by the SCADA system, and further operations are determined by the intelligent system analysis and processing.

Advantages: There is no need to modify the existing SCADA system; the intelligent system does not need to integrate too much pipeline data, and it has strong versatility and little difficulty in joint research and development.

Disadvantages: There are many new hardware facilities and large investment in fixed assets; instructions and data are transmitted once more, the response speed is reduced, and the error rate is increased.

4. Necessary conditions for intelligent regulation
At present, although the machine has advantages over people in experience learning, data statistics and analysis, there is still a gap between the ability to adapt to people and people. To achieve intelligent regulation, it is necessary to reduce the operations that require adaptability, so the following conditions need to be met.

4.1. To ensure the reliability of equipment and reduce the probability of unknown events.
There are many equipments involved in the pipeline system. Every equipment failure will threaten the pipeline operation. Common failures have corresponding treatment methods and can be programmed into the program. It may be difficult to foresee that this will become a risk factor for pipeline operation. Guarantee equipment
The reliability can effectively reduce this risk factor.
4.2. Ensure the smooth transmission of data and instructions, and avoid the operational risks caused by communication problems.

The communication system is the information exchange hub between the intelligent system and the field equipment. If communication is not smooth or untimely, the instruction or data transmission will be delayed, or even lost. Safe operation poses a serious threat. Ensuring smooth communication is a necessary prerequisite for intelligently controlling oil and gas pipelines [4].

4.3. Standardize and standardize all possible operations to ensure the smooth completion of the control tasks.

The arbitrariness of operation is another factor that threatens the operation of the pipeline. To ensure the uniform operation of the same control task can make the data changes in the operation process have reference significance, so that the problems in the same operation can be discovered in time. Routine operations and some emergency operations for the regulation and operation of oil and gas pipelines already have relatively uniform operation tickets and operating procedures, which has laid the foundation for the standardization of operations.

5. Conclusion

Intelligent regulation has just started in the scheduling operation of oil and gas pipelines. Due to the many equipments in the oil and gas pipeline system, the complex process, the special transmission medium, and the stability and reliability requirements of the pipeline operation process, the intelligent process of oil and gas pipeline regulation can only be a process of small steps forward and steady development. Therefore, the development of intelligent regulation in the future will be in the exploration stage. Intelligent regulation and control are inseparable from the reliability of the equipment, the smooth communication and the operating standards. Only if these three cornerstones are stable and reliable can the steady development of intelligent regulation and control be guaranteed. Therefore, the primary task now is to continue to simplify the system and update the equipment to ensure the reliability of the equipment; optimize the communication network, update the communication equipment to ensure the reliability of the communication; standardize, standardize and program the pipeline operation to ensure the same operation consistency. The two design directions of the intelligent transformation SCADA system and the additional intelligent system have their own advantages and disadvantages. From the perspective of the current oil and gas pipeline industry’s requirements for operational reliability and stability, the intelligent SCADA system has more advantages, but this model is difficult to transform. It is not conducive to the rapid development of intelligent regulation of oil and gas pipelines, so it is not necessarily the best choice. Which one is more suitable for intelligent regulation still needs practice to test.

References
[1] Yu Wanji, Yu Qi. Principles of night shift health artificial intelligence regulation technology [J]. World Journal of Sleep Medicine, 2017, 4 (5): 267-269.
[2] Yuan Mancang, Guo Changbin, Li Hui, Ang Yang, Li Ligang, Dai Yongshou. Current status and development trend of oil and gas pipeline network control technology [J]. Electronic Design Engineering, 2013, 21 (14): 4-8.
[3] Wang Hao, Lei Xiaohui, Shang Yizi. The key technology of intelligent regulation and emergency dispatching of the South-to-North Water Diversion Project [J]. South-to-North Water Diversion and Water Conservancy Technology, 2017, 15 (2): 1-8.
[4] Cui Jianxi, Chen Qifeng. Research on the integrated operation and management mode of power grid intelligent regulation and control [J]. Electromechanical Information, 2014 (18): 174-175.
[5] Wang Hao. Application research of intelligent inspection system in pipeline oil transportation [J]. China Management Informatization, 2019 (16).
[6] Fang Shusong. Research on Development and Intelligent Trend of Management System Automation of Oil Pipeline Substation [J]. Standard and Quality of Petroleum and Chemical Industry, 2013 (14): 213.