

Safety research of pipeline

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Abstract

Oil and gas pipelines are widely distributed in China, including a lot of long distance transmission pipeline. At the same time, the safety of the pipeline become a problem that we have to consider. This paper focuses on the failure mode of the pipeline and the factors that affect the safety and reliability of the pipeline. In addition, pipeline integrity management method is mentioned. It also provide a theoretical basis for the economic and effective protection of the safety of the pipeline.

Keywords

Pipeline failure; Integrity management; risk evaluation; The safety of pipelines; Pipeline adaptability.

1. Introduction

With the development of economy and the demand of people to travel, oil and natural gas have become an indispensable resource for people's life. China's oil dependence on foreign is 59.6%, natural gas is 32.2%. And China has 120 thousand kilometers of oil and gas pipelines. During 12th Five-Year, the construction of the northwest, northeast, southwest and offshore four major import channels have speeded up. At the same time, west-east natural gas transmission pipeline, Sichuan to east natural gas transmission and Shan-jing natural gas transmission pipeline are constructed as the backbone network of the great arteries. China's current natural gas conditions is: Based on domestic and overseas use; west-east gas transmission; north to south; ocean gas for debarkation and nearby supply. The natural gas is imported from Turkmenistan, Kazakhstan, Russia in the form of pipeline transport. Because of the large number of the pipeline, the long route length and the complex route terrain, the reliability of the pipeline has become a problem we have to consider. Pipeline leak, will cause serious economic, safety, environmental and ecological impact, and even lead to fire, explosion and other vicious incidents, resulting in casualties, oil and gas supply interruption. In recent years, more and more domestic and foreign pipeline accidents, so enterprises begin to pay more attention to the reliability of the pipeline.

2. Pipeline Failure

2.1 The form of pipeline failure

The main factors that affect the safety of pipelines are design, manufacture, construction, pipeline environment, operation management and maintenance, third party damage. Thereinto, the design factors are the main strength of pipeline safety margin, maximum allowable operating pressure and the actual operating pressure margin, pipeline stress change and frequency, pipeline settlement and so on. The main manufacturing factors include internal and surface defects, weld defects, pipe deviation and quality control. The construction factors are pipe laying, welding, fill port, inspection, backfill, pressure test, supervision, construction team qualification and so on. And corrosion is divided into internal corrosion and external corrosion. The internal corrosion is related to the corrosion resistance and corrosion protection measures. The external corrosion is related to the protection of the cathode, the quality of the outer layer, the corrosion resistance, the current interference, the stress corrosion and so on. Management and maintenance exist the risk caused by

the management level, technical level, staff quality and inadequate supervision mechanism. Third party damage is refers to pipeline structure and performance damage caused by human activities in regions near the pipeline. And the fundamental main factors are pipe of minimum buried depth and human activities, public education, ground pipeline facilities.

2.2 Safety and reliability of piping system

The safety of pipeline includes pipe body safety, public safety, supply security, political security. According to the previous pipeline accident statistics, the factors that affect the safety of the pipeline are different, and the proportion of corrosion and third party damage is the largest. Pipeline reliability includes risk management, safety, pipeline integrity, pipeline adaptability.

Statistical analyses and the experiment result shows that a "bathtub" shape curve existed between the characteristic of pipeline failure and time. With the increase of pipe age, the failure rate of the pipe first decreased gradually, and then, at a certain period of time to maintain a relatively stable low value, finally a large rise. The shape of the curve and the bathtub is similar, so we call it the bathtub shape curve. This phenomenon is due to the pipeline has just put into use and the transmission of oil and gas have a Run-in Period. After this process, pipeline in regular and irregular dimensional repair process failure rate in the small range of floating, and remained at low level, so the tub of the pelvic floor is formed. As the pipe age continues to grow, when the pipeline near the service life, the failure rate of the pipeline will be greatly increased, the increase is mainly caused by the aging pipeline.

3. Pipeline integrity management

The integrity of the pipeline mainly include not only risk management but also pipeline safety and adaptability. The main steps of integrity management are as follows. At first, based on the collection, inspection and integration of existing data, the preliminary risk assessment of pipeline is carried out. Then the evaluation results are analyzed and classified. The high risk pipeline should be tested immediately. The corresponding maintenance or repair measures are implemented after the pipeline is damaged. After completing the above steps, the risk assessment of the pipe section is carried out again. This cycle, until the risk value of the pipeline is within the safety limits of the pipeline. The risk value is higher but does not exceed the security value of the pipe does not need to immediately carry out maintenance, but should be regularly monitored.

3.1 Risk Assessment of Pipeline

Risk is equal to the failure probability multiplied by the failure consequences. Pipeline risk management includes the safety and economy of the pipeline. Based on the risk, optimized arrangement and management of testing procedures. High risk and high consequence pipeline should be focused on testing. In addition, appropriate attention to lower risk management. So we can ensure the reliability and safety of pipelines under the condition of high efficiency and small investment.

Risk assessment methods include qualitative risk assessment, semi-quantitative risk assessment and quantitative risk assessment. The qualitative risk assessment is simple but complete evaluation can not be carried out, besides, the subjectivity is too strong, the reliability of the evaluation is not high, and the practicability is not strong. The quantitative risk assessment can identify the cause of pipeline failure factors, determine the pipe failure probability, judge pipeline acceptable level of risk. And the qualitative and quantitative evaluation of pipeline failure consequence are given. In addition, risk reduction measures are put forward to the risk level is not acceptable. Also these measures can be optimized. Therefore, quantitative risk assessment is usually adopted.

There are many methods of quantitative risk assessment, including the fault tree analysis method, failure mode analysis, effect and criticality analysis, Heinrich risk analysis and scenario analysis method, index method, probability risk analysis, probability of structural mechanics, structural reliability and risk assessment.

3.2 Safety and adaptability of pipeline

Pipeline safety is to consider the safety of the pipeline to the people and the environment. Specifically refers to under the operating conditions, the pipeline has the ability that the possible harm to human life, property and environment is lower than the maximum tolerance limit of human beings. Pipeline adaptability is the study of pipeline transport efficiency. It means the service pipeline with defects or damage can have structural integrity.

The integrity of the pipeline inspection, and then the integrity of the evaluation of the pipeline, and finally give maintenance decisions. The safety and adaptability of the pipeline can be guaranteed by this method. And the integrity of the evaluation includes the safety of the corrosion coating, residual strength and residual life.

Pipeline detection

Detection is divided into internal and external detection. The outer detection of pipeline is through the detection of the protection layer and the effectiveness of cathodic protection, to achieve the purpose of detecting the defect of the pipe. Pipeline inner detection is mainly to detect the corrosion of pipelines and other defects. The basic principle of the inner detection is the magnetic flux leakage, ultrasonic, ray, electromagnetic sonar, eddy current.

4. Conclusion

The safe operation of gas pipeline is related to the country's economy, people's quality of life and safety. So the safety of the pipeline needs further improvement and attention. So we need strictly control each link of long distance transmission pipeline. Regular monitoring and maintenance of the pipeline is also essential. Repair personnel need professional requirements and publicizing and training for them. Besides, we need to study the use of fast and efficient and safe maintenance of the repair technology. So as to make the pipeline system more reasonable, standardized and efficient operation, to better play the maintenance system of the maintenance of the pipeline safety operation of the support and protection.

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