Case analysis of gas pipeline network reform project
-The gas system of Changling county

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Abstract. With the call of energy saving and emission reduction, natural gas, as a kind of clean energy with abundant green and environmental reserves, has gradually become the main source of domestic fuel for Chinese residents. The urban gas pipeline network system has also become a part of the urban basic service facilities, providing energy for the city. The safe operation of the gas pipeline network is closely related to the daily production and life of the people. Because of the economic and other reasons, there are many old gas pipelines in the central city of Changling County. In addition, there is no effective renewal for a long time. These pipelines are running ill, the overall gas distribution is seriously reduced, and there is a leakage phenomenon. There are great potential safety hazards, which also causes a great waste of energy. Therefore, in this context, the government of Changling County takes active measures to solve the problem of the old gas pipeline network in the central city, and promotes the task of gas pipeline network transformation.

1. Introduction
In response to the call of "energy saving and emission reduction", natural gas, as a kind of clean energy with abundant green and environmental reserves, has gradually become the main source of domestic fuel for Chinese residents. The urban gas pipeline network system has also become a part of the urban basic service facilities, providing energy for the city. The safe operation of the gas pipeline network is closely related to the daily production and life of the people. Because of the economic and other reasons, there are many old gas pipelines in the central city of Changling County. In addition, there is no effective renewal for a long time. These pipelines are running ill, the overall gas distribution is seriously reduced, and there is a leakage phenomenon. There are great potential safety hazards, which also causes a great waste of energy. Therefore, in this context, the government of Changling County has taken a series of active measures to promote the task of gas pipeline network transformation task for the problem of the old gas pipeline network in the central city.

2. Analysis of the present situation and existing problems of old gas pipeline network

2.1. Present situation of old gas pipeline network
Pressure level system of natural gas pipeline network in central city of Changling County is medium-low pressure secondary system, medium-pressure transmission and distribution, low-pressure entry. The pipeline network is laid directly and arranged in circular and branched form. By the end of 2014, the total length of natural gas pipeline network is 62 km, including 27 km medium pressure pipeline network, 35 km low pressure pipeline network, cast iron pipe and PE pipe, 0.1 MPa medium pressure pipeline network and 0.002 MPa low pressure pipeline network[1]. The status of gas pipeline...
network is shown in Fig 1.

Fig 1. Current status of gas pipeline network in the central city of Changling County

2.2. Problems existing in old gas pipeline network:

- Pipeline beyond service life. A part of the gas pipeline network in the central city of Changling County was laid in the late 1990s. It is still in operation. The pipeline has exceeded its service life and has potential safety hazards.

- Pipe material. In the past, due to the restriction of technical conditions at that time, cast iron pipes and steel pipes were mostly used in the old gas pipeline network, which made the overall level of pipeline construction low. After a long period of corrosion of pipes underneath, the aging and cracking of cast iron pipes and joints appeared, and accompanied by gas leakage.

- Sealing of nozzle. The main sealing methods of gas pipeline network interface in central city are blue lead interface, cement interface, rubber ring blueprint interface and so on. Under the condition of long-term laying, the apron is extremely prone to aging and deterioration, while the green lead interface and cement interface have poor toughness and are easy to fracture, resulting in gas pipeline leakage.

- Use of medium pressure pipeline to reduce pressure. Due to the early construction of the pipe network, the backward development of the pipeline technology and the pipe, etc. The pipeline must be operated with a step-down or even low-pressure operation to ensure the normal operation of the pipe network system.

- Backwardness of urban gas pipeline network. With the rapid development of urban modernization, the demand for urban gas has also increased. In the early design of the pipe network system, there was a lack of long-term planning, which could not meet the needs of the current urban gas.

- High investment cost and low economic benefit. Due to the high input cost of the city gas pipeline network facilities and the large expenditures for the later maintenance, the investment cost is greater than the original planning situation, and the overall benefits are not satisfactory.

3. Reform scheme of gas pipeline network

3.1. Reform principles and methods
Pipe replacement for cast iron pipes and steel pipes exceeding the service life and pipes with aging, cracking, etc. For the selection of pipes, the best principles should be followed. The gas pipeline needs to bear a lot of pressure and transport toxic, flammable and explosive gas, so the pipe of the selected gas pipeline should have sufficient tensile strength, impact toughness and corrosion resistance. The PE pipe not only has good ductility, but also can meet the basic requirements of the pipe pipe regulations, and it is also convenient to widen the pipe range and prevent pipe blockage[2].

In view of the urban development, the increase of buildings, the expansion of the road width and other reasons, the original pipe network cannot meet the requirements of the current pipe network specification, and the gas pipe network needs to be expanded. The principle of transformation should follow the idea of combining old and new, which can make the gas pipeline network obtain higher efficiency and the overall structure of the pipeline network is more complete[3].

For the reasons of large flow of people, large number of residents and complex terrain in the central city, we should follow the method of hierarchical transformation according to local conditions in the process of transformation. At the same time, we should be forward-looking, coordinate with the construction of other surrounding cities and towns, and improve the service system of urban gas pipeline network.

In view of the problem of investment cost, the original pipe network system and PE pipe can be used to save the cost of reform and anti-corrosion.

3.2. Renovation technology and requirements

The methods of gas pipeline repair or renewal are mainly divided into excavation repair and trenchless repair.

3.2.1. Excavation and repair technology

Excavation and repair technology mainly refers to the use of road surface excavation to update pipelines. With the standardization of municipal management, the traditional excavation renewal technology is gradually replaced. In the case of satisfying reconstruction conditions, excavation repair can be used; In the absence of excavation repair conditions, trenchless repair technology must be adopted.

3.2.2. Non-excavation update technology

Trenchless repair technology refers to a kind of maintenance method adopted by comprehensive economic analysis to make full use of pipe allowance when the environment in which pipelines are used cannot be upgraded by excavation, repaired or excavated. The common trenchless repairing methods for gas pipeline network include pipeline insertion technology, cracked pipeline repairing technology and reversed lining repairing technology.

Pipeline Interruption Technology. Pipeline interpolation technology can be divided into different diameter trenchless interpolation and extrusion interpolation technology according to the diameter of the interpolation. Non-trenchless interpolation is a method of grouting and stabilizing new and old pipelines with larger diameter and smaller diameter. The non-trenchless extrusion interpolation technology fully adapts to the plasticity of PE pipes, and the compressed and restored pipes do not affect the technical indicators of PE pipes.

Repair technology of cracked pipe method. The principle of the split pipe method is to cut the old pipe with a set of cutter wheels and expand it, then replace or expand the old pipe with a new hall with the same diameter or a higher level. Cracked pipe construction is not only small in excavation area, simple in construction and short in construction period, but also has obvious economic and social benefits.

Reversal lining repair technology. Reversal lining method can be used to reconstruct and renew old pipelines in situ only by excavating working pits on the pavement. Its working principle is advanced and its application range is wide.
In summary, combined with the real-time situation of old gas pipeline network renovation in Changling County[4], to meet the conditions of excavation and repair, all the projects adopt excavation and repair technology, and the construction process strictly meets the requirements of specifications, set up special management to strengthen coordination and cooperation, eliminate hidden dangers in all links.

4. Conclusion

4.1. Pipe network reconstruction engineering quantity
The total length of gas old pipe network reconstruction in the central city of Changling County is 25 kilometers, all of which are laid for more than 15 years. The planning plan for the old gas pipeline network in the central city of Changling County is shown in Fig 2. The construction of the new pipe network provides guidance at the planning level. Provided a guarantee for the sound development of Changling County gas project.

4.2. Economic benefits
- After adopting PE pipeline, it fundamentally solves the occurrence of safety hazards such as air leakage, corrosion and aging, improves the quality of safe gas supply in towns, and avoids waste of resources. Because PE pipe has high anti-corrosion performance, it can save a lot of anti-corrosion work and is easy to maintain.
- Adopting the principle of combining old and new, the gas pipeline utilizes the original pipe network system to save gas reform cost and anti-corrosion cost of gas pipe network.
- The gas pipeline network after the transformation has strong gas supply capacity, and the daily gas supply rate increases, which increases the efficiency of natural gas and promotes the national economy.

4.3. Social benefits
With the advancement of the transformation, the safety hazards such as running and dripping are effectively controlled, and prevention should be our focus. Increasing the quality of gas supply and reducing safety risks will bring more comfortable and reassuring gas supply to the public[5].
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