Thinking on Sichuan-Chongqing gas pipeline transportation system reform under market-oriented conditions

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Abstract. The gas pipeline networks in Sichuan and Chongqing (Sichuan-Chongqing) region have formed a fully-fledged gas pipeline transportation system in China, which supports and promotes the rapid development of gas market in Sichuan-Chongqing region. In the circumstances of further developed market-oriented economy, it is necessary to carry out further the pipeline system reform in the areas of investment/financing system, operation system and pricing system to lay a solid foundation for improving future gas production and marketing capability and adapting itself to the national gas system reform, and to achieve the objectives of multiparty participated pipeline construction, improved pipeline transportation efficiency and fair and rational pipeline transportation prices. In this article, main thinking on reform in the three areas and major deployment are addressed, and corresponding measures on developing shared pipeline economy, providing financial support to pipeline construction, setting up independent regulatory agency to enhance the industrial supervision for gas pipeline transportation, and promoting the construction of regional gas trade market are recommended.

1. Introduction
Sichuan Basin is the cradle of China’s gas industry. Thanks to the development in more than 50 years, a fully-fledged gas pipeline network system has been formed in this region, and a matched gas pipeline transportation system adaptable to the integrated development of regional production, transportation, storage and sale has been structured. In recent years, the development of gas industry in this region has become further market-oriented, and so there exists a demand for market-oriented reform in the areas of investment system, operation system and pricing system. In this article, the main thinking on Sichuan-Chongqing pipeline transportation system reform under market-oriented conditions and the realization approach are addressed by referring to the features of Sichuan-Chongqing pipeline networks and production and consumption market.

It is necessity to reform Sichuan-Chongqing gas pipeline transportation system. Firstly, increased pipeline requirements resulted from adjustment to supply and demand market necessitates pipeline investment system reform. With the large scale development of high sulphur gas in Longwangmiao and Northeast Sichuan, the import of external source gas into Sichuan, the export of internal source gas out of Sichuan, and the unbalanced development of internal and external gas markets, it becomes more urgent to improve the adaptability of existing gas pipeline networks and construct new pipelines. In addition, both the return on investment and the recovery of capital are slow, and a great sum of money...
will be occupied. In this case, continuous reliance on the two central oil enterprises for investment and construction is hard to satisfy the demand for gas supply and consumption. Secondly, rational pricing and improving the transportation efficiency of gas pipelines call for pipeline operation system reform.

Sichuan-Chongqing gas pipeline networks mainly feature interwoven gathering pipelines for production and transportation/distribution pipelines for consumption. It is hard to distinguish source gas cost from pipeline transportation cost, which has brought difficulties to pricing due to the lack of definite basis for adjusting source gas price and pipeline transportation price. This problem is originated from the system that fails to separate gas production from gas transportation. Furthermore, PetroChina and Sinopec have different clients, and so there exist differences in their supply and demand requirements. It is no surprise to have the situation that gas is imported into and exported out of Sichuan simultaneously, which as a whole will give rise to the waste of pipeline transportation cost and the decrease of pipeline transportation efficiency. Thirdly, construction of regional trade market requires pipeline transportation price reform. China is carrying forward actively a market-oriented gas price reform, and both Sichuan and Chongqing are making separate feasibility research for the setup of regional gas trade market. For the construction of gas trade market, it is necessary to put in place a price system that is “tolerant with both ends but strict with the middle”, which means while the access to upstream and sales markets is deregulated, the prices for pipelining different source gas to different clients should be defined. According to the existing pricing mechanism, pipeline transportation price is included in portal station price. Such a pricing system is too simple, and its structure is unflabeled. With this mechanism, it is unable to identify the actual cost for supplying gas from its source to the client, which is unfair to both the seller and the client. Besides, the construction of new pipelines cannot change the price level of portal stations, which is unfavourable to the investment and construction of gas pipelines. Consequently, it is the inevitable requirements for constructing regional trade market in Sichuan-Chongqing region to further pursue gas pipeline transportation price reform.

2. Main Features of Sichuan-Chongqing Gas Market and Pipeline Transportation

2.1. A fully-fledged gas market in China

In 2015, more than 34 BCM (short for billion cubic meters) of gas was produced, while 23.3 BCM of gas was consumed in Sichuan-Chongqing region. Both the gas production and consumption of this region were among the top ones of China. Gas consumption has accounted for more than 12% in the primary energy consumption structure of this region for a long time, which is above the average level of 5.9% in this country. In this region, there are 159 cities using gas, which means 72% of the total cities in this region are gas consumers. By 2020, the gas production will be about 60 BCM and consumption will also be greatly improved. Moreover, with the further development of market-oriented domestic gas industry, the local governments are planning to build a regional gas trade platform and reforming the gas sales model to promote market prosperity.

2.2. With a well-developed gas pipeline network system

2.2.1. Cobwebbed pipeline network. In Sichuan-Chongqing region, an integrated pipeline system with the functions of gas production, transportation, sales, and dispatching has been constructed. Besides, the market is connected to other major markets outside of Sichuan Basin via Zhong-Gui gas pipeline, Zhong-Wu gas pipeline and Sichuan-East gas pipeline. By the end of 2015, about 9,000km gas pipelines with the transportation capacity of 30 BCM had been constructed in this region. By 2020, its gas transportation capacity will exceed 35 BCM[1].

2.2.2. Complicate investment and operation system. For a long time, the main loop network and most short branch pipeline networks have been operated by Southwest Oil and Gas Field Company of PetroChina. Sinopec has also constructed its own small regional gas supply pipeline networks in West and East Sichuan. Since 2014, both the two major oil companies have carried out a diversified ownership
reform in the pipeline transportation sector. As a result, Sichuan Gas Investment Company and Chongqing Gas Pipeline Company were founded successively to take charge of the construction of branch Sichuan-Chongqing gas pipelines. As gas production area near to consumption area, PetroChina sets up a 3-tier pipeline transportation management system: The production, operation and pipeline management departments are responsible for the management of gas dispatch, pipeline transportation and pipeline development; the gas transportation and mining area departments are responsible for executing gas pipeline transportation and operation; and the subordinated operation sectors and transportation/distribution stations are responsible for specific site operation.

2.2.3. A leader in transportation price reform Sichuan-Chongqing region has led three reforms in gas pipeline transportation prices. The first reform resulted in a unitary pipeline transportation price. It was first originated in Sichuan Basin in 1963. Later, the operators of Chang-Na gas pipeline, Wei-Wu gas pipeline and other gas pipelines began to charge their clients at this unitary price[2]. The second reform resulted in a pricing method based on transportation distance. In 1976, this pricing method was first implemented in Sichuan with the issuance of a provision on charging gas consumers based on pipeline transportation distance by the Ministry of Petroleum and Chemical Industry[3]. The third reform has resulted in the current stamp pricing system. In 2012, a portal station price reform was carried out in Sichuan and Chongqing. According to this new pricing system, the pipeline transportation cost is included in the portal station price, which means 0.17rmb yuan/m³ and 0.16 rmb yuan/m³ major pipeline network transportation fee respectively and 0.11 rmb yuan/m³3 administrative fee for gas distribution. In addition, Sichuan province has also stipulated the transportation prices for 22 short inter-provincial gas pipelines.

3. Thinking on Sichuan-Chongqing Gas Pipeline Transportation System Reform
Sichuan-Chongqing gas pipeline transportation system reform should take market development trend into consideration. Initiatives should be taken to meet the requirements for allowing diversified ownership of pipeline transportation industry, separating gas pipeline networks from their operation, improving energy transportation efficiency and developing regional trade market. The system reform should focus on the areas of investment, operation and pricing to attract more investment. Sichuan-Chongqing pipeline networks should be subject to overall planning, operation and dispatching. More fair and rational pipeline transportation pricing system should be worked out to promote the further development and high efficiency of Sichuan-Chongqing gas market.

3.1. Pipeline investment system reform
Main ideas
- Deepen pipeline investment decision-making system reform;
- Build a consolidated investment and financing platform for Sichuan-Chongqing gas pipeline construction;
- Improve the investment and financing mode for pipeline construction;
- Expand continually the financing channels for pipeline construction;
- Encourage private capital’s access to Sichuan-Chongqing branch pipeline construction; and
- Minimize pipeline asset volume to share development.

3.1.1. Develop jointly the pipeline construction plan to guide investment and decision-making Local governments of Sichuan and Chongqing may unite PetroChina, Sinopec, joint venture pipeline companies and major sales companies to establish a pipeline construction planning consultation committee, whose major functions are developing jointly five-year and ten-year Sichuan-Chongqing gas pipeline construction plans based on production and market change trends and under the premise of guaranteeing return on investment and supply security, making adjustment to and executing them stage by stage, ensuring the guidance of these plans to investment decision-making, simplifying approval procedures for planned projects, and offering necessary support.
3.1.2. **Set up consolidated pipeline investment and financing platform** Based on the existing diversified investment entities in Sichuan-Chongqing region, gas pipeline network investment companies invested respectively by PetroChina, Sinopec, government capitals and private capitals should be consolidated to found a subsidiary pipeline company jointly with local clients or local governments to attract more funds for pipeline construction. The consolidated pipeline network investment company can serve as a regional subsidiary of the state pipeline network company in the future.

3.1.3. **Define investment interfaces for various pipeline companies** Pipelines constituting Sichuan-Chongqing gas pipeline networks can be divided into two categories in terms of application, i.e. transportation/distribution pipelines and client branch pipelines. The former is defined as the inter-area gas transportation/distribution pipelines inside the Basin to serve the five areas of Northwest Sichuan, Middle Sichuan, South Sichuan, Northeast Sichuan and Chongqing, while the latter refers to the independent sales pipelines connected directly to clients inside each area[4]. It is recommended that construction and operation of the former should be executed solely by the central enterprises, while construction and operation of the latter should be executed by existing joint venture pipeline companies themselves or by their joint ventures with local clients. In this way, the investment enthusiasm of joint venture pipeline companies at all tiers can be aroused to share development, and functions of different investors involved can be defined clearly[5]. The central oil enterprises are mainly responsible for securing safety and supply, while other investors can participate in pipeline construction in a more market-oriented way. Based on the principle of interface dividing, client branch pipelines owned by the central enterprises should be subjected to restructuring or stripping to realize the reduction of pipeline assets by means of property right transfer or acquisition.

3.2. **Pipeline operation system reform**

**Main ideas**
- Make down-to-earth efforts to improve pipeline operation, so that the existing 3-tier management system (administrative office management + mining area operation) adopted by oil and gas field companies for their own can be gradually transited to operation by entities;
- Identify pipeline operation cost composition;
- Simulate market-oriented operation and consolidate the operation agencies of Sichuan-Chongqing pipeline networks at a proper time in the future, so that the independent operation of Sichuan-Chongqing pipeline networks can be achieved gradually; and
- Improve the entire pipeline transportation efficiency.

3.2.1. **Carry out experiment on the independence and professionalization of pipeline operation teams**

Professional operation companies (as tier-2 units or wholly-owned subsidiaries) responsible for pipeline operation should be founded at a proper time for such experiment. They are supposed to provide professional dispatching service for the operation of gas transportation/distribution pipelines. Operation of the professional companies will cover the main loop network (excluding gathering pipelines) and client branch pipelines in Sichuan-Chongqing region. In the long run, the gas transportation/distribution pipeline operation teams of PetroChina and Sinopec should be consolidated to establish a Sichuan-Chongqing gas pipeline network operation company. Oil and gas field companies should only reserve their ownership of pipelines and assign their operation and management rights to the operation company. The trend is expressed in Figure 1. In doing so, repeated investment in pipeline assets could be avoided, operation cost composition could be identified clearly, professionalization level of operation could be improved gradually, implementation of third party access system could be facilitated, and pipeline operation efficiency could be improved.
3.2.2. **Set high efficiency and low cost operation objectives**

Firstly, gas production status should be fully taken into account. Under same price conditions, nearby areas should become the first choice for gas sales. Surplus gas could be sent into the main Sichuan-Chongqing pipeline networks for transportation and dispatching. Secondly, gas sales status should be taken into account as well. Unloading from the loop network and transportation of source gas should be arranged in a way to achieve the lowest pipeline transportation cost. In the future, if operation becomes independent, operation companies will be able to balance the gas production and sales status of oil companies and other shale gas enterprises and realize the overall planning for gas transportation and dispatching inside the Basin to avoid the situation of gas importing into and exporting out of Sichuan simultaneously, reduce the entire transportation cost, and improve the overall efficiency.

3.2.3. **Adopt market-oriented operation mechanism**

Firstly, a market-oriented pipeline transportation sales mechanism should be put in place. Clients can make a reservation with the operation companies for pipeline transportation capacity whose market transaction should be allowed inside Sichuan-Chongqing region. Secondly, economic levers should be used to balance gas supply. If clients’ actual gas demand is more or less than the transportation capacity reserved by them, operation companies can give them economic punishment [6]. Thirdly, profit models of operation companies should be closely related to their sales volume (i.e. They can get certain percentage of dispatching and operation fee for every cubic meters of gas sale.), or pipeline companies should procure operation companies’ operation and dispatching service by competitive bidding. In the long run, pipeline companies may consider sharing the added values of pipeline transportation income with oil and gas companies. For example, new benefits could be created by optimizing operation management and selling surplus pipeline transportation capacity. A certain percentage should be taken from such benefits as the incomes of operation companies. Fourthly, cost accounting should be independent. Labour cost, repair cost, loss and all other costs incurred during operation and dispatching should be accrued to operation companies, and be used as key indicators for performance evaluation and supervision.

3.3. **Pipeline transportation pricing system reform**

Main ideas

- Build rationally price structure for Sichuan-Chongqing pipelines of different properties;
- Adopt a service cost-based pricing method and provide strict regulation to reflect the difference in pipeline transportation costs for different clients in different areas; and
- Guide the market-oriented allocation of gas resource.
3.3.1. Stipulate regional price ranges for loop network, and set prices for client branch pipelines based on transportation distance

Sichuan-Chongqing gas pipeline transportation price is mainly comprised of the transportation price of transportation/distribution pipelines and the transportation price of client branch pipelines. Five gas transportation/distribution price ranges should be set for the five consumption areas of Northwest Sichuan, Middle Sichuan, South Sichuan, Northeast Sichuan and Chongqing, while the pricing of client branch pipeline transportation should be distance-based. See Figure 2. Besides, a pricing method based on season and gas supply quality (such as discontinuous or continuous gas supply) is also applicable.

Figure 2. Combing of region-based price and distance-based price.

3.3.2. Regulate and set prices for pipeline companies of independent legal entities based on service costs

In Sichuan-Chongqing region, the two major oil companies, joint venture pipeline companies and subsidiary branch pipeline companies organized by joint venture pipeline companies are all independent legal entity companies. Maximum allowable incomes or total service costs should be determined for pipeline companies, whose services should be subject to separate pricing. The maximum allowable incomes of each pipeline company mainly include pipeline operation expenditure, pipeline depreciation, income tax expenditure, other tax expenditure and income from investment calculated from multiplying the net pipeline assets by the regulatory return rate [7]. A pipeline transportation price adjustment mechanism should be put in place to adjust the overall price level every two or three years based on the service cost and profit change of pipeline companies. If the design for operation system reform is executed, pipeline operation expenditures will be the total costs paid to operation companies, and so strict regulation will be necessary [8].

3.3.3. Set entrance/exit pipeline transportation prices for purchased/sold gas at major hub points

According to the tie-in conditions of Sichuan-Chongqing pipeline networks with main national pipeline networks, Zhongxian (Zhong-Wu gas pipeline), Guangyuan, Nanbu, Nanchong, Tongliang, jiangjin (Zhong-Gui gas pipeline) and Dazhou (Chuan-East gas pipeline) are all major junction points with external markets. With the development of market-oriented gas trade in Sichuan-Chongqing region, there will be more connections between the internal and external markets. The workload for source gas dispatching at these connection points will be increased significantly to impact the production, transportation and dispatch of source gas inside the Basin and add to operation difficulties and cost. Because the increased cost should be borne by clients of these hub points, it is necessary to set pipeline transportation prices separately for the gas flowing into or out of these hub points. To be specific with price form, entrance and exit pipeline transportation prices for purchased and sold gas can be set separately at these hub points. Such pricing should be mainly based on labour cost, loss and the depreciation cost of supporting facilities associated with the special service.

For example, if a client of Nanbu (Sichuan province) directly purchases gas from external market through Zhongwei-Guiyang gas pipeline, and the purchased gas enters Sichuan-Chongqing pipeline network via Nanbu hub and is finally supplied to the client, the pipeline transportation fee incurred by this client will be the total of Nanbu hub entrance fee, Chuanzhong price range gas transportation/distribution fee and the distance-based client branch pipeline transportation fee.
3.3.4. Learn from European management model for gas pipeline transportation pricing under market-oriented conditions With the deepening of market-oriented development and the further adjustment of Sichuan-Chongqing gas sales system, gas sales business will become more market-oriented, and independent gas retailers or profiteers may emerge. In this case, Sichuan-Chongqing gas market structure can be guided to develop in the direction of British gas market structure[9,10], and the pipeline transportation price should be subject to corresponding adjustment. An entrance/exit pricing system can be switched to, and such important junction points as Yucheng, Suining and Jiangjin can be selected for entrance/exit pipeline transportation pricing. The pipeline transportation pricing system for regional gas distribution should be subjected to further subdivision based on price ranges.

4. Conclusions and suggestions
As to the fast development of gas industry in Sichuan-Chongqing region, it is an important acting point to speed up the reform of pipeline transportation system. Furthermore, from the viewpoint of new situation and new requirements facing the gas industry in this region, it is urgent to implement a reform for the gas pipeline transportation system. In this article, we recall the history and the feature of natural gas transmission industry of Sichuan-Chongqing region, and then we study the ways of pipeline transportation system reform, including investment system reform, operation system reform and pricing system reform. In general, the pipeline transportation system should be more liberalised. Furthermore, there are some recommendations on guarantee measures for reforming. At first, streamline the administration, deregulate pipeline markets and strive to develop shared pipeline economy. Secondly, provide financial support to pipeline construction. Meanwhile, we should establish independent regulatory agency to strengthen industrial regulation for gas pipeline transportation. Finally, regional trade market is necessary and important, as it is obedient to the market-oriented future of gas industry in China [11].

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