ACTA TECHNICA CORVINIENSIS
– Bulletin of Engineering
Tome IX [2016], Fascicule 4 [October – December]
ISSN: 2067 – 3809

[1.]Penka ZLATEVA, [2.]Siyka DEMIROVA

LOGISTICS CHAIN OF NATURAL GAS IN BULGARIA

[1.] Technical University of Varna, Department of Thermal Engineering, BULGARIA
[2.] Technical University of Varna, Department of Industrial Management, BULGARIA

Abstract: The purpose of this publication is to trace the supply chain of natural gas in Bulgaria. Is described his way - from the extraction in deposits of natural gas to distribution to the end user. Detail elucidated transmission of gas to Bulgaria from its neighboring countries. Is made overview of the types and storage facilities proposed are terms used for gas storage.
Keywords: natural gas, supply chain, gas distribution

INTRODUCTION

One of the causes the growing popularity of natural gas lies in the advantages which he offers in terms of environmental protection. In the composition of the natural gas used in Bulgaria main component is methane (CH4) - about 98% for 1m^3. The methane releases energy when burned around - 8000 (kkal). For thirty years, natural gas has changed the role of co-product to a power source that is used worldwide. The annual consumption of natural gas Bulgaria is about 3 billion cubic meters.

EXPLANATORY

The Logistics chain of gas goes through the following stages:

Yield

In the drilling in gas fields gas pressure reaches 300-500 bar (30-50 MPa), depending on the depth of the productive horizon. After processing, which involves separation of the liquid and the other undesirable components, the pressure was reduced to about 55 bar. With this pressure gas is transported via the gas transmission network in the Republic of Bulgaria [6].

The gas fields can be classified depending on the composition of the gas, condensed gas and clean gas, and depending on where the yield - on land and underwater. Natural gas from gas condensed fields except methane contains a significant amount of higher hydrocarbons - mostly propane and butane (in some cases above 150 g/m^3). These hydrocarbons condense easily upon the increase of pressure and gas cooling [11], [15]. The natural gas from "clean" gas field is composed mainly of methane and content of higher hydrocarbons is below 50 g/m^3 [9]. In Bulgaria, natural gas is extracted in deposits Bhutan, Dolni Lukovit, Balgarevo and Galata.

Transportation

To be productive and efficient transportation of natural gas from production to consumption regions require a complex transmission system. In most cases the natural gas produced from a source must travel a great distance to reach the point of its use. The conventional system for land supply is composed of gas pipelines designed for quickly and efficiently transport from original source to areas with high consumption of natural gas. The present methods for gas transport in the majority limited to pipeline transport, occupying 75% of the trade. Gas pipelines on the territory of Bulgaria are classified as transmission - transporting the natural gas in various regions and the border of the Republic of Bulgaria; and distribution - provide delivery to the end users [5].

Choice and features of the route of the highway gas pipelines

The route of the main gas pipelines should be chosen with maximum rectilinearity, possibly open area with calm relief. It is necessary to avoid crossings deposits of minerals, landslides, marshes, irrigated arable land, real estate with valuable farm crops, saline soils, ravines and other natural obstacles.

The passage of gas through natural or artificial obstacles is performed by one or several sections. Upon crossing the railway lines and highways first and second category the distance between parallel gas pipelines is taken not less than 30m, in water barriers - from 30m to 50m. Not permitted the laying of gas pipelines on the territory of villages, industrial areas them through railway and automobile tunnels, together with electric cables and other pipelines in automotive and railway bridges.

© copyright Faculty of Engineering – Hunedoara, University POLITEHNICA Timisoara

Between the route of the pipeline and gas regulation lines of settlements and urban-industrial agglomerations, construction sites and facilities is necessary to have a distances from 25m to 250m depending on the diameter and pressure of the gas pipeline and the type of facilities.

Than those identified linear closing armatures such as providing for more deviations from the route of the the gas pipeline to the gas distribution station as well as on both sides of the intersections of natural and artificial obstacles in special purpose shafts. All major facilities, compressor stations and regulating stations along the route of the gas pipelines have encircling sections (bypass) with off (shut off) armatures. With purpose release of the gas and blowing him from damaged areas in repair and restoration works between two consecutive switchgear are mounted flush candles (nozzles) with shut-off armatures. To remove condensation moisture in the gas pipeline at the lowest point along the route in special chambers are mounted and water accumulation devices.

The passage of the gas pipeline under the tracks of railways and roads going through the protective casing (steel pipe) with a diameter of over 100 to 200 mm diameter of the gas pipeline. The space between the two pipes are mounted centering dielectric suffixes for protection against Cohesion (deformation) and stray currents. The ends of this space are sealed with a stuffing box, as to one side (left or right depending on the relative density of the gas) is arranged ventilation pipe.

When crossing water obstacles trunk pipelines are laid under the bottom of the river, lake, canal. Such underwater transition is known as "siphons". The width of the water barrier over 50m, siphons be implemented in two, while navigable rivers - in three parallel branches. Depending on the diameter of the gas pipeline and the width of the water obstacle the distance between branches of siphons accepted by 30m to 50m. To ensure the sustainable position the branches of siphons, apart from supporting blocks in bends additionally on their path are placed weights. Such load against emergence is made in flooded areas with high groundwater.

If necessary, an additional connection to the main gas pipeline of relatively small users of gas (50 to 100 m^3/h) are developed not big gas regulation stations delivered along the route in prefabricated form [7].

Transmission of gas from neighboring countries of Bulgaria

After the gas crisis in the winter of 2009, with EU assistance, it was decided to build local networks for transfer of gas with Romania, Turkey, Greece and Serbia [12].

The gas pipeline with Romania - IBR, will be only 24 kilometers and will connect Rousse and Giurgiu will pass 1.2 kilometers beneath the Danube. 15 kilometers will be on the territory of Bulgaria. Will have a capacity 1.5 bcm. The project is about 27 million euros and is expected to be completed in 2018.

In 2012. Romania has acquired 10.9 bcm, in their own consumption from 13.5 bcm. In the Black Sea drillings have already proven reserves to 80 bcm, and its possible reserves of shale gas are estimated now to 1,400bcm - rank third after those of France and Poland.

From January 2014. gas connection between Kulata and Valovishta in Greece is reversible, with a capacity of 3,000,000 m^3 per day. Does Greece backup gas to Bulgaria? In 2012 the state has spent 4.4 bcm gas as 3.0 bcm (a little more than annual consumption of Bulgaria) is used to generate electricity. Question of Bulgaria's agreement to swap electricity, whose production it has plenty of capacity for natural gas. Separately, Greece is now the second country in the EU after Italy's share of production of electricity from photovoltaics, which reduces the proportion of its electricity produced from gas naturally.

The other link with Greece - IGB is long stagnation due to unclear reasons. The gas pipeline has a capacity of 3-5 bcm per year, reversible and will be 168.5 km long, 28.5 km of which 140 km in Greece and in Bulgaria. Will start from Komotini, will pass through Haskovo and reached to Stara Zagora. Its price is estimated at € 200 million, with about 25 percent will be covered free of charge from the EU. The last start of construction is delayed to the autumn of 2016. The project is particularly important because it will provide to Bulgaria indirect connection to all providers in the world liquefied gas. In 2011 Greece specially upgraded its LNG terminal in Revythousa, 45km west of Athens for capacity from 5.2 bcm a year in order to facilitate the supply of liquefied gas for Bulgaria and Turkey. The reconstruction involves the construction of a third tank that increase capacity by 40% to 225,000 m^3 LNG. It is also considering the construction of a new LNG terminal in northern Greece, a large share of incoming liquefied gas there could be directed to Bulgaria at IGB. In northern Greece will pass and TAP pipeline with an initial capacity of 10 bcm per year, which will be increased with additional compressor stations then to 20 bcm per year. In this pipeline will be completely reversible and will allow transfer of gas from Italy to Greece and Bulgaria. Construction is expected to start in his 2016-2017 and end in 2019-2010, and will provide Caspian gas from

Greece to Bulgaria through its local connection in Komotini with IGB.

The gas pipeline with Turkey - ITB can provide gas to the country from Azerbaijan and indirectly connected to the terminal with LNG. It is envisaged that its capacity is 1-3 bcm with the possibility to increase to 5 bcm. The project provides gas to go through back in 2017.

The gas pipeline to Serbia - Sofia - Dimitrovgrad - Nish will be reversible, with a capacity of 1.8 bcm and the ability to rise to 5 bcm per year. It will be 150 km long as 50 km will be in Bulgaria. The link will also extremely important as it would give the state access to large gas transmission and trading center in Baumgarten, Lower Austria.

In implementing the these links will be possible to organize a free competitive market in the Balkans, similar to those existing in Western Europe and the US [8], [13] [14].

Storage

The storage of natural gas is an important step in the process of gas supply. The gas as energy can be stored for an unlimited period of time. The Storage applied to meet the needs at times of peak consumption or difference in seasonal needs. Another positive effect of storage of natural gas is the balance between consumption and flow received from gas companies. In the absence of storage facilities each peak and decline in gas supply would lead to sanctions for the supplier. Market speculation is not excluded by the storage of gas purchased at a lower price and spreading at increasing the market value.

Terms used in the storage of natural gas:

- full capacity of gas storage - represents the maximum amount of gas that can be stored in the facility. It depends on the volume of the tank and methods of processing gas.
- buffer gas - the volume of gas that is permanently available to maintain adequate pressure and constant flow rates in seasonal withdrawal from the tank.
- Working amount of gas - formed like a full capacity subtracting the buffer gas. This is the amount of gas that can be delivered to market within the specified time.
- losses of gas - gas penetrated into cracks and pores of the gas pocket that can not be recovered.
- extraction rate - measuring the amount of gas that can be provided by gas storage for 24 hours.
- degree of filling - measuring the amount of gas that can be injected into the storage.

The most common types gas storage are underground tanks. They are divided into 3 types:

- depleted gas fields - this type stores are the most important and common. The use of this reservoir has a big advantage because of the relatively easy conversion of already built facilities for the extraction of gas in such storage, which significantly reduces the initial investment and project costs. Another positive factor is their location - geographical and physical characteristics they are now widely studied by geologists and petroleum engineers, which defines them as the cheapest and easy for developing, operation and maintenance of the three types of underground gas storage facilities.

For proper operation of depleted fields have 50% of the natural gas to be stored as a buffer. Usually these facilities are used based on annual consumption will be filled during the summer months and emptied during the winter.

- Aquifers - underground formations with a porous structure, which are essentially water tanks, but in some cases can be used as storage facilities. In developing such a storage facility is necessary to be done geological analysis, construction of new facilities such as wells and equipment for loading and unloading of the tank, dehydrators and compressor stations, which significantly raises the cost of investment for this type of storage.
- Salt formations - the underground salt pans are a good reservoir for gas storage due to the strong and solid walls, which prevents of the gas to penetrate into them, as with other types of underground gas storage facilities. Once open subterranean formation from salt creation of gas storage is done by injecting water under high pressure in place by dissolution of the salt forms a cavity which is used for storage. Water soluble salt may be used for other purposes. This type of storage facilities need to 33% buffer gas, which makes them highly effective. The disadvantage is their small size compared with the depleted fields, but that can be filled and emptied several times a year makes them competitive.
- Artificial repositories - containers for liquefied natural gas supply offer gas at any time no matter the season can build up in key positions close to consumers store large quantities, there is no need to provide for a buffer gas and provide access to world markets. The disadvantage is their high operational and structural value.
- Pipe capacity - the gas can be temporarily stored in pipelines through a process of sealing the line. A larger amount of gas can be sealed only if the pressure in the pipeline system. This method can be used at times of low load in anticipation of short-term peak. Not enough resources for long-term high consumption [1].

Gas distribution

The gas distribution is the last step of the way of the natural gas to consumers. Although some large

industrial users receive gas directly from the main gas pipelines, the average user is supplied by local distribution companies. The function of these companies is to transport gas from the main gas pipelines to households and the business sector through thousands of miles of gas pipelines with a small diameter [10]. The placein which connects the distribution company to gas pipelines is called the "urban bias" and is an important hub for charging of the natural gas for cities. Before the settlements, for lowering the pressure to permissible distribution networks (16 bar), build automatic gas regulating stations / AGRS / after which the gas fed into urban distribution networks. By these were powered consumer of natural gas. It is used in the chemical industry and as fuel in industrial, residential and public administration sectors [2], [3], [4]. Due to the need for distribution of gas in many directions at relatively large area, approximately half of the costs of accession of households are intended for distribution. The supply of natural gas to the end user like transportation. The differences consist in that in the distribution move smaller amounts of gas at lower pressures, shorter distances, a larger number of consumers. After the "urban bias" the gas is odoration with substances such as mercaptans that underlie the familiar scent. This is done because the natural gas is essentially colorless and odorless. In the odoration aims to detect a leak before it has reached 5 times lower concentration of explosive in the air. The distribution of the natural gas takes place mainly through: closed (ring) and branched (antenna) networks. The most effective is the use of a combination of the two types of networks. Depending on the maximum working pressure urban gas distribution gas pipelines are divided into 4 categories:

- up to 0,01 MPa;
- from 0.01 to 0,2 MPa;
- from 0.2 to 0,5 MPa;
- do1,6 of 0.5 MPa;

Depending on the number of degrees of pressure control gas distribution networks are single-stage, two-stage, three-stage and multi-stage.

CONCLUSIONS AND ANALYSIS

Based on the above-described, may be made the following findings and analysis:

1. The logistics chain of natural gas in Bulgaria is extremely expensive, as only one terminal would cost billions of levs, and the state is not ready to put large investments in building gas distribution infrastructure.
2. The logistic chain of liquefied gas costs about 100 Levs to 1000m^3 as the price varies depending on the distance of its transport. It is necessary to take measures for more efficient management of the entire logistics chain, which would lead to optimization of transmission costs.
3. The market for natural gas in Bulgaria at the beginning of 2016 has monopolized and the company - monopolist in the period 2006-2041 has exclusive rights to conclude deals: with extraction companies and traders of natural gas for the purchase of natural gas for the sale of natural gas with customers; for transmission of natural gas transmission and distribution companies; for storing of natural gas with storage operators and others.
4. Lowering the price of natural gas on the London Stock Exchange at the end of 2015 automatically lead to reduced the price of Bulgarian market. Proof of this is consumer attitudes towards the use of "blue fuel" for domestic and industrial needs.

CONCLUSION

The study of the logistics chain of natural gas in Bulgaria is of particular importance because the gas distribution network in Bulgaria is facing a number of challenges. It is necessary the logistics chain to larger scale studies because one of the most important indicators of its effectiveness that it should be shortened. This would lead to flexibility of the chain, lowering the price of natural gas and increased consumption.

References

[1.] APICS Dictionary. The Industry Standarts for More than 3500 Terms and Definitions, 11 th edition, The Association for Operation Management, 2005
[2.] Bowersox Donald J., David J. Closs, M. Bixby Cooper, "Supply Chain Logistics Management", International edition, McGraw – Hill, 2002
[3.] Chopra, S., P. Meindl, "Supply Chain Management - Strategy, Planning, and Operation", 3-rd Edition, Pearson Prentice Hall, 2007
[4.] Coyle, J., E. Bardi and C. John Langley Jr., "The management of Business Logistics", 6-th Edition, West Publishing Company, 1996
[5.] Dimitrov D., Atanasov B., Transport and storage of compressed / liquefied natural gas, National Review for Young Explorers "Energy, Economics and Mathematical Modeling 2015
[6.] Energy Strategy of Bulgaria until 2020
[7.] Journal. Energy Review - Issue 3, May 2013
[8.] IGU World LNG Report – 2013 Edition", International Gas Union
[9.] Nikolov, D. "Distribution and use of natural gas," Uconomics C, 2007
[10.] Vitasek, K., "Supply Chain Management. Terms and Glossary", CSCMP, Updated: August 2013
[11.] www.bgenh.com
[12.] www.capital.bg www.gas.bghot.com
[13.] www.gas.bghot.com www.gie.eu
[14.] www.gie.eu
[15.] www.naturalgas.org

copyright © University POLITEHNICA Timisoara,
Faculty of Engineering Hunedoara,
5, Revolutiei, 331128, Hunedoara, ROMANIA
http://acta.fih.upt.ro