JSC GAZPROM LONG-TERM GAS RESERVATION SYSTEM AS FACTOR OF RELIABILITY AND ECONOMIC SUSTAINABILITY

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ABSTRACT

In order to reduce JSC Gazprom risks that might emerge in gas production and transmission the technology for the deployment of long-term gas reserves is proposed and being implemented. These reserves generated in the specially chosen underground gas storage facilities provide for compensation of possible disruptions in the planned development of the production complex for the period of up to two years. Besides, such reserves make it possible to execute the renovation of the gas transmission system without disruption of gas deliveries to consumers. Various aspects of the generation and operation of long-term gas reserves are considered in the paper.
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1. PREFACE

The present-day field development process is continuously complicated by harsh mining and geological conditions, with gas production provinces nowadays discovered in areas with an extremely unfavorable climatic environment. All this leads to considerable environmental and technological risks in the up- and midstream sectors.

Furthermore, the evolution of gas production and consumption systems points to the occurrence of persistent disproportions provoked by the uneven and spasmodic development of new gas extraction provinces. Developing a new gas production area as well as constructing a prominent gas transmission network implies broader opportunities for gas supply but insignificant changes in gas consumption. Alternatively, a shortfall in gas supply is observed in most cases prior to commissioning a new gas supply network.

In order to avoid disruptions of the gas supply and export system and to shave multiyear supply and demand disproportions, a gas supply network should contain appropriate gas reserves, with underground gas storage facilities being the most rational location for stockpiling those. Along with developing a system of UGS facilities to shave seasonal disproportions and supply peak gas consumption (Fig. 1, 2), Gazprom has been lately active in creating the so called 'long-term reserves'.

Fig. 1. Underground gas storage network in the RF
2. GAS STORAGE FACILITIES FOR LONG-TERM GAS RESERVATION

UGS facilities for long-term gas reservation should meet a range of major requirements, which are as follows:

- storage of additional gas shouldn’t cause any gas losses, i.e. the long-term reserve must be retained in full;
- storage of long-term gas reserve should not lead to substantial increases in capital investment and operational cost;
- high degree of reservoir deliverability.

Apparently, these requirements are met in the majority of cases by gas storage facilities built in depleted gas fields. However the multiyear experience of operating a large aquifer-based UGS facility and supporting calculations point to the possibility of creating long-term reserves in such gas storage facilities as well.

In Russia a substantial amount of long-term gas reserves is stockpiled at a UGS facility built in a former gas field. The main feature of this UGS facility is a big storage capacity with a relatively small reservoir depth allowing both to operate the UGS facility under a regular withdrawal/injection profile and to create long-term reserves without incurring substantial costs. Gas is injected into the UGS facility under the pipeline gas pressure throughout the spring-summer period. Up to 30% of the gas retrieved can also be piped to consumers by local low-pressure gas transmission networks, without utilization of compressor equipment. The United Gas Transmission System (UGTS) receives gas through compressors, with significant volumes of stored gas and low depths enabling to ensure operating stability and high deliverability of compressors.
Deploying reserves in the gas transmission network is also of key significance. During the creation of long-term reserves priority is given to facilities located at gas transmission system junctions, which enables to re-direct gas flows during injections/withdrawals.

One of the UGS facilities used for the long-term gas reservation purposes is built at gas transmission junction linking gas pipelines with various working pressures and with appropriate compressor stations. This allows operating the UGS facility without the need for a special-purpose compressor station, through the use of pipeline compressor stations by injecting gas to the UGS capacity from a high-pressure compressor station and retrieving through the station with a lower working pressure.

3. LONG-TERM GAS RESERVE UTILIZATION TECHNOLOGY

In practice, there are two schemes of long-term gas reserve utilization:

1. Retrieving the long-term reserve from the UGS facility immediately after the autumn-winter heating season is over.
2. Not injecting gas into the UGS facility during the summer period and operating the UGS facility with minimum losses in daily capacity and gas withdrawal volume, in contrast to normal (average annual) operation, during the winter period.

The second scheme is more preferable from the technological viewpoint as there are no high gas retrieval costs under harsh conditions and injection costs. Moreover, if gas isn't injected into the UGS facility during the summer period, the long-lasting dead time will create an environment for higher pressure in well location zones, improving, thus, withdrawal conditions in winter period.

Undoubtedly, the first scheme may also and must be applied, for instance, in case of an accident in gas transmission network providing gas supply of a region.

According to calculations made for the aquifer-based UGS facility where the long-term reserve accounts for some 20% of the total working gas volume, it takes roughly 60 days to effect the accelerated withdrawal of long-term reserves upon finalization of the normal operation period. In case when during the summer period the long-term gas reserve volumes are not injected into UGS facility, this facility can be operated on a regular basis practically in the course of the entire withdrawal period except for the last 15-20 days when in most cases gas supply strain cease to exist.

Giving an outline of the long-term gas reservation system so far created by JSC Gazprom, we can assert that said system makes it possible to provide sustainable gas deliveries to Russian and foreign consumers in the event of a gas production or import deficit (versus the forecast) and to supply up to 4% of Russia’s annual consumption within a two-year period. This scenario can be implemented as follows (Figure 3). While during the summer period gas (making up 2% of annual consumption) is not injected into the UGS facilities for long-term gas reservation the working gas volume is fully replenished in other UGS facilities. During the winter period, given existing spare daily capacities, gas is withdrawn from UGS facilities for offsetting the shortage of gas provoked by the deficit.

Calculations show that within the first year the UGS average annual operation, accompanied by additional gas injections, is effected in full. In the second year the UGS facility can be operated in the same way until mid-February when there emerges the possibility of a gas deficit, which is however relatively low due to certain weather changes occurring during this period.

In case of favorable long-term forecasts as to the sufficiency of gas resources, long-term gas reserves will help implement a program on gas pipeline repair within UGTS. Given existing UGS gas injection capacities, two high-pressure gas lines can simultaneously be taken out of operation for repair purposes over a period allowing to perform sophisticated repairs.
4. CONCLUSION

Stockpiling long-term gas reserves within UGS facilities enables to achieve a high degree of gas supply reliability and to improve UGS operation conditions.

Gas production and transmission expenses to create long-term gas reserves are inconsiderable since gas is injected into UGS facilities when there are spare production and transmission capacities.
5. LIST OF FIGURES

Figure 1. Underground gas storage network in the RF

Figure 2. UGS contribution into settling seasonal gas consumption and export disproportions

Figure 3. Utilization scenario for the RF UGS long-term gas reserve