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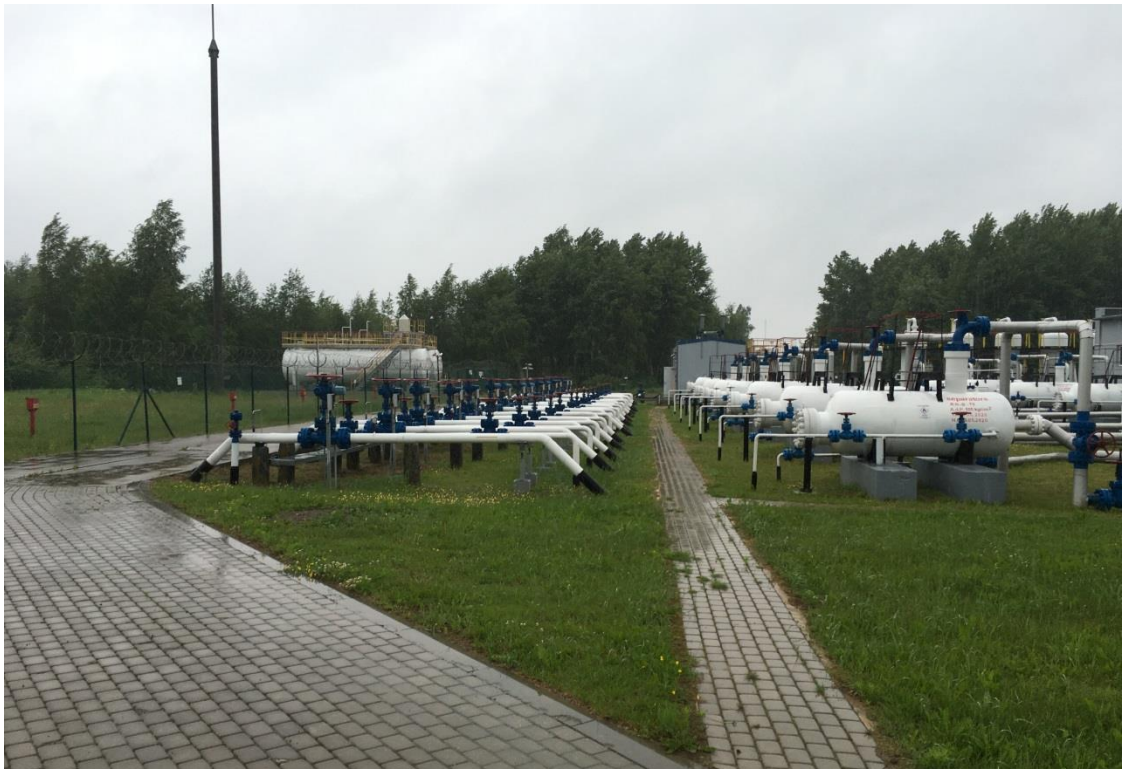
INČUKALNS GAS STORAGE – STUDY OF INCREASED FLEXIBILITY AND USE AS STRATEGIC GAS STORAGE

SUMMARY



RAMBØLL

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conexus BALTIC GRID

– STUDY OF INCREASED FLEXIBILITY AND USE AS STRATEGIC GAS STORAGE
SUMMARY

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1. SUMMARY

With a working gas capacity of 2.3 billion cubic metres (bcm), the Inčukalns Underground Gas Storage (hereinafter - "IUGS") represents the largest available gas storage in the Baltic Sea region. Historically, the IUGS played a key role in covering the natural gas demand from Russia, Latvia and Estonia and - to a lesser extent – also from Lithuania. For decades, the IUGS was owned and operated by Latvijas Gaze. Based on the requirements of the EU Third Energy Package, the Latvian government took the decision in February 2016 to liberalise the Latvian natural gas market and unbundle the formerly integrated business activities of Latvijas Gaze as well the opening of the Latvian gas market to competition. In early January 2017, Latvijas Gaze spun off its transmission and storage business into the newly founded company JSC Conexus Baltic Grid (hereinafter – "CBG"). On April 3, 2017, the non-household segment of the Latvian natural gas market was opened to competition.

Ramboll with KBB was awarded the study INČUKALNS GAS STORAGE – STUDY OF INCREASED FLEXIBILITY AND USE AS STRATEGIC GAS STORAGE in May 2017.

The objectives of the study are to analyse the possibility of increasing the flexibility of the IUGS in order to meet the needs of a changed gas market and the flexibility of sources in an ever more interwoven electricity system, as well as enhancing the use of the storage for regional security of supply. All results are subject to the data made available by JSC Conexus Baltic Grid.

1.1 Market Analysis

Looking ahead, the commercial market for gas storage is turning into a combination of traditional storage for seasonal heat dependent volumes, high withdrawal flexibility for power producers and parking of regasified LNG to obtain a high utilisation of the LNG plant. Given the infrastructure and market structure changes during 2016 and 2017 and the expected future changes, it is clear that the IUGS faces a new situation. In summary, we identify 3 areas of different usage:

Short-term usage:

a. LNG parking: The current use of the Klaipeda LNG terminal, Lithuania, complements the use of IUGS. As the storage volume of the LNG terminal is non-steady and the terminal receives more cargos than previously, the LNG terminal is working as a relatively constant supply of gas, rather than storage of gas.
b. Power plant usage: IUGS can use the Nordic electricity market as outlet for gas via the thermal power plants in Latvia and Lithuania. On the contrary, the possibility of import of electricity from the Nordic system to Latvia can make it necessary to store gas, if bought with low flexibility. Hereby, the use of IUGS will become very dependent on the market situation in the Nordic system.
c. Commercial short-term optimization: The market players have different contracts, of which some are oil-indexed and some are linked to European hub market quotations. Furthermore, there is a difference in demand due to calendar, weather and commercial issues, which opens up for commercial short-term optimization and consequently a need for storage.
d. Peak demand. Peak demand situations occur rarely. If shippers fail to deliver during such a period, the TSO will be required to make gas available. It cannot be expected that the market will take the (potentially) costly precaution and secure volumes and withdrawal capacity for such peak demand occasions. The IUGS is a source for the TSO to keep appropriate level of reserves.

Seasonal usage

There may still be a Russian market for gas storage depending on the development of new storage facilities in Russia and the development of Nord Stream II. From the viewpoint of the

Baltic countries, Nord Stream increases the physical security of supply, as the Russian system in the North will be upgraded. IUGS will continue to be used as commercial seasonal storage to service e.g. the Latvian market, however, we expect that this will most likely be to a lesser extent than in the past. The summer winter spread facing the shippers will determine how the commercial players will use IUGS for seasonal purpose.

Security of supply usage
The security of supply in a situation with liberalised markets can take several forms and shapes, one being strategic storage and filling requirements. Strategic gas storage is the physical stockpiling of gas for use only as an emergency measure, released by a decision of the related Member State, i.e. not available for use during normal market conditions. Filling requirements can be implemented as part of the products or via the legislation and de facto storing obligations. Experience from elsewhere shows that market participants do not necessarily take this responsibility themselves. Following the EU regulation in this area, IUGS may play a key role within this context, not only for Latvia but for the entire market area (the Baltics and Finland).

1.2 Security of Supply

The security of gas supply analysis shows that there is a need for IUGS, even if the Klaipeda LNG import terminal is operational and LNG can be acquired, and even if the Poland-Lithuania gas pipeline is established. The following conclusions can be drawn from the security of gas supply analysis:

- The security of supply shall be ensured for the entire region of Latvia, Estonia, Lithuania and Finland according to the new EU security of gas supply regulation
- The security of gas supply shall be seen in the context of other energy sources in the Baltic area, which is dominated by hydro power. Coal used to be an important back-up fuel but with the closing of coal-fired power plants, this energy storage has almost vanished. Biomass, which has replaced coal in some countries, has less storage capacity. Consequently, gas and more expensive oil storage are becoming the most important back-up fuels for renewable energy in the region.
- IUGS is necessary to ensure gas supply during a two-month disruption period of Russian gas supply during winter
- IUGS is necessary in case of a full year disruption of Russian gas supply, as LNG and the Poland-Lithuania gas supply can only be fully used by storing gas from summer to winter. To do so, there is a need for upgrading of the pipeline between Lithuania and Latvia
- Strategic storage may be an advantage, as events that occur with a small likelihood cannot be expected to be taken care of by market players.
- For technical reasons, volumes for strategic storage in IUGS need to be limited to around 400 mcm (to ensure the necessary level of hydrostatic pressure)
- Filling requirement in addition to the seasonal storage should be considered to ensure that there is sufficient gas in storage at the beginning of the winter. Also, filling requirements should be considered to ensure that filling of storage is not postponed to the end of the summer - as seen in 2017
- The combination of strategic storage and filling requirement should be 800 mcm at the start of the winter.
- To fully cover a normal winter situation with a two-month disruption of supply from Russia, it will not be sufficient even with full use of the Klaipeda LNG terminal. There will still be 7.8 TWh missing. If the disruption takes place in August to October, and if injection into the storage has not been initiated early in the injection season, there will be a deficit of up 10.7 TWh in the storage. Therefore, there should also be filling requirements early in the summer to ensure that a two-month disruption of supply in late summer does not create lack of gas at the start of the winter.

- The strategic storage and filling requirement should be shared between the countries in the region.
- Cold winters have not been seen in recent years. Market players may not have paid sufficient attention to this.
- A dry and cold year in Sweden and other Scandinavian countries may result in increased need for gas to power generation in Latvia and Lithuania. The availability of fuel is an important issue, which should be included in the electricity TSO's upcoming work on Nordic power market generation adequacy. Initially, we find that up to 150 mcm should be secured in storage as filling requirement for the Swedish and Finnish markets - either by electricity TSOs or market players.

1.3 Technical analysis

To understand the current flexibility and potential gaps with respect to potential new market areas, technical studies of the surface facilities and a reservoir study were performed.

Generally, we find that the storage can in many ways be used as a flexible storage. However, to increase the flexibility, some further issues should be addressed:

- Withdrawal rate with low filling is limited
- It is not possible to change on short notice between injection and withdrawal, due to technical requirements and manual operation of the storage.
- Injection of gas during winter is not possible at present, as the compressors are not operational at low temperatures. The injection season is therefore limited to the period from May to October
- Limits on injection and withdrawal of small daily volumes

Additionally, looking at how to increase the withdrawal capacity of the storage even with a low filling ratio, it could be necessary to carry out investments such as:

- Modernisation of 36 wells to improve efficiency and flexibility
- Establishing a new collection point 4
- Modernisation of collection point 3
- Adding smaller compressors than the existing ones to allow for more flexible injection
- Establishing of new reservoir model, or upgrade existing model
- Improving the understanding of the use of the storage by implementing a process model (HYSYS or similar) for simulation of production

Finally, IUGS performance with respect to flexibility, energy efficiency and emissions can further be improved by the following investments:

- Change compressor configuration to be used also for injection into the gas transmission system, which allows for a further decrease of the withdrawal pressure
- Electrification of compressors, which will require connection to the high voltage power transmission system
- Upgrade of the gas transmission system from 40 to 55 bar, which it was originally designed for, in order to allow for higher gas supply to Estonia/Finland and Lithuania. Becomes important, when new pipelines are becoming operational
- Ejector system
- Waste Heat Recovery Unit (WHRU)
- Turbo expanders

1.4 Reservoir Analysis

A model was built in order to test the flexibility of the reservoir. The model was used to simulate and to analyse the flexibility of the storage in two cases; firstly, the confirmation of the full

usability of the stated storage capacity in terms of the stated 2.3 bcm working gas volume; and secondly, a hypothetical use with a reduced working gas volume comparable to how the storage has been filled during the past two years, when the full capacity of the storage has not been used.
The results of the analyses were:

- The generic simulations showed that the flexibility of the storage as well as the working gas volume can be maintained without an injection of additional cushion gas
- Furthermore, an investigation on a hypothetical scenario starting with the storage level at the end of the winter 2016/17 and injection an additional volume of working gas (WGV) of 0.93 bcm, the storage could be operated with maximum withdrawal rates of 15 or 20 mcm/day down to a pressure of 50 bara. Thereafter, another 0.37 bcm could be produced at lower rates and at a minimum tubing head pressure of 25 bar

1.5 PCI status

We recommend that the project of enhancement of IUGS should be maintained as a PCI project, as it is important to security of supply for the region, to the increase in supply diversification, and to increase competition.