Description of the methodology and process used by Eustream to calculate the technical capacity.

The technical capacity.

The technical capacity of the gas transmission system is represented by mutual interaction of the sources of energy for gas transmission (compressor stations) and energy consumers (mainly pipelines). This interaction leads to restoring of the necessary pressure for transportation of gas before each section of pipelines which is provided by the compressor stations.

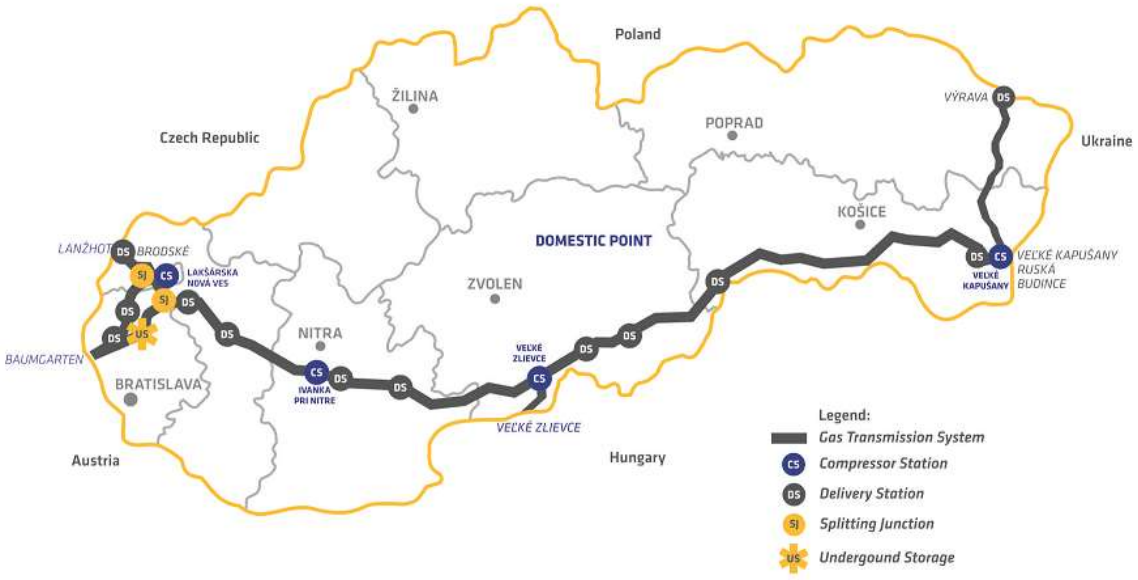

Fig. No. 1: Scheme of transmission system

The transmission system (Fig. No.1) consists of four, in some parts also of five, parallel lines of gas pipelines, four compressor stations, six cross-border connections to transmission networks in neighboring countries and domestic connections to the distribution network and storage facilities. The complex analysis of the above-mentioned interaction, which leads to published technical capacity, is based on the SIMONE software.

Compressor stations

Calculation of the compressor station parameters is based on the detailed compressor model includes a detailed presentation of compressor performance curves, drives and gas coolers with all the restrictions involved. Multi-compressor operation in any type of series or parallel configuration is simulated with realistic load distribution control. Model also includes an air temperature influence on the available maximum power of the compressor drive.

Pipelines

In addition to the geometric values of the pipeline (lengths, diameters) the effect of inclined positions, the roughness of the pipes (influence on the pressure drop) and the equation of state for real gas are taken into account in order to provide accurate determination of the technical capacity. The SIMONE thermal dynamics module also calculates heat transfer between the pipeline and its surroundings and the Joule-Thomson effect.

Calculation principles and reliability

SIMONE software is the widely used tool for analyzing gas flows through transmission system, e.g., during the design of a pipeline system for the required technical capacity or for calculation of the technical capacity of the existing network.

The simulation of gas transmission in pipelines is based on non-linear partial differential equations. These equations describe the conservation of mass, momentum and energy. The behavior of the real gas is described by an equation of state including real composition of the gas. The pressure drop caused by flow resistance is calculated by utilization of the friction factor which depends on roughness of pipeline, pipeline diameter, flow velocity and gas properties.
The following system parameters are used in the calculations in SW SIMONE:

- Calculation of the adiabatic exponent (KAPPA) – Equation of state
- Formula for gas viscosity (VISC) – Lee66
- Pressure loss equation (LAMBDA) – Nikuradze
- Formula for compressibility factor (ZET) – AGA8-DC92

On the basis of a fundamental analysis of the properties of this equation system, the developers of SIMONE have produced an implicit, original method of integration optimized for the task. The method features high accuracy, numeric stability and processing speed. For details see http://www.simone.eu/.

The simulation results (pressures at all nodes of the network and all flows through network elements, such as pipes and compressors) are continuously compared to real data in order to prove the reliability of the calculations. This complex approach regarding technical capacity calculation utilized in order to provide as much available capacity to the market as possible.