Monitoring and Balance of Gas Flow in Underground Gas Storage, RWE Joint Stock Company, Třanovice, Czech Republic

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Abstract

RWE a.s. (Joint Stock Company, formerly known as Transgas) is a main gas supplier in the Czech Republic. The company has six underground gas storages in different arreas of the country to ensure stable supply of gas. This paper describes monitoring and balance evaluation of gas flow in RWE Underground Gas Storage Třanovice (North Moravia, the Czech Republic).

Keywords

RWE, gas storage control, gas flow monitoring, balance reporting, dispatching software, flow meter

GAS STORAGE TŘANOVICE, RWE a.s. DESCRIPTION

RWE supplies natural gas and electricity to more than two million end customers through regional companies RWE Energie, Jihomoravská plynárenská, Severomoravská plynárenská and Východočeská plynárenská. Underground gas storage Třanovice is built in depleted natural gas deposits „Žukov“ (near Český Těšín, North Moravia). The natural gas deposit Žukov was exploited from 1949 to 1980. The whole site is linked to the occurrence of Tertiary clastic sediments of the Lower Badenian that fill potholes in the erosive subsoil Carboniferous. The bearings are the type of interlayer, lithologically bounded, the closure of the border are water – gas. Impervious cover is pelitic Lower Badenian sediments, overlaid with waterproof Carpathian layers. Storage rocks are Lower Badenian sandstones and conglomerates of variable thickness that increases from the top edge of the structure of the bearings, and from 5 m to 80 m with an average thickness from 25 to 30 m. Underground gas storage is currently formed with four areas. Between 2010 and 2012 RWE Gas Storage has put in operation 290 million m^3 of newly built storage capacity developed by enlarging the existing underground gas storage - three-year project co-financed by the EU, one of the most extensive capital investments in the company’s history. Gas transmission interconnector between the Czech Republic and Poland was also built [3]. Currently the gas storage operated a total 28 extraction-injection probes.

Gas Storage Třanovice provides two basic functions: underground gas storage and a station for gas transfer. During the summer, when gas consumption is low, the overflow gas between imported and consumed amount is stored in underground storage – this storage operating mode is so called “injection”.

Figure 1- Underground Gas Storage Třanovice, North Moravia, Czech Republic [2]

Figure 2- Aerial view at RWE Třanovice [2]

CONTROLAND MONITORING GAS STORAGE AT PROCESS CONTROL LEVEL

Underground gas storage is divided into four areas. Gas is injected or extracted through the drill holes equipped with a probe. Currently there are 28 probes. In every area the changes of reserves are monitored (by measuring the flow). Every probe also gives information about gas pressure.

Probes are equipped with sensors and convertors by Fisher Rosemount. Gas flow is measured by Annubar sensor and evaluated by converter of a differential pressure ProBar 3051. The control system is connected by loops (4 to 20 mA) and also is monitored using HART Protocol in AMS System (visualization system by Fischer-Rosemount).

Figure 3- Flow sensor Annubar at Probe [1]

Extracted gas is flowing from the probes to a drying column. Drying is performed using triethylene glycol (TEG). Gas is transfering to a central pipe after adjusting humidity, and it is then passed into the distribution grid of SMP Joint Stock Company. The delivered amount of gas to SMP grid is measured by flow-meter Solartron [4].

Direct control of technological process in Třanovice is implemented by multilevel distributed control system of UniControls a.s. (Czech company dealing in development and implementation of process control systems). All commands from the dispatcher operator's station and the response from the technological process taking place in real time. Process control system and visualisation of technological processes is developed by UniControls in SCADA system IGSS (Interactive Graphics Supervision, by Danish company Seven Technologies). This control and monitoring system allows control of underground gas storage technologies in all operating modes.

DISPATCHING INFORMATION SYSTEM

In RWE there was a need for accurate registration of changes in gas reserves and for reporting summary balance sheet data for central dispatching RWE in Prague. This was the reason for Dispatching Information System implementation in 2003-2006. This monitoring system in addition to immediate production monitoring (as hourly gas flow values), depending on the operating modes (extraction, injection or transfer mode), also gives an overview of

the summary balance with the registration of the current status of gas reserves in the underground reservoir.

Direct control of technologies is implemented by IGSS SCADA system. This system is connected with the sensors and provides data collection in real time and provides data for Dispatching System. IGSS system is generating data file containing all measured data by every hour or immediately after the dispatcher control intervention or after change the operating mode of the storage. Data files are processed by Windows service (IGSS_SQL) that evaluates data, transfer and write down into relational database (Microsoft SQL Server). Data stored into database are further processed by storage procedures, which count the averages, aggregate and progressive values.

Basic part of Dispatching System is a server (Compaq Proliant ML 370 with Microsoft Windows Server operating system and hardware RAID to guarantee data safety). Clients are standard computers and an application layer is programmed in Visual Basic. All the applications allow export displayed data into Excel sheet to further process and using graphs.

Current status of gas deposit is counted from flow-meter measuring of the flow. Probes are equipped with electronics that integrate the flow. The probes provide verified value of hourly gas flow. The Dispatching System algorithm could recount two-hour average, daily progress value, flow amount during month, year and working season.

In RWE Třanovice there are three measurements of gas flow. For a sales purpose, in output pipeline, there is a flow-meter (Solartron). On probes there is Annubar with sensor ProBar (Fischer Rosemount). Gas output from probes is supplied to drying and there is ultrasonic flow-meter (formerly Panametrics, since 2007 MicroMotion with processing unit FlowBoss). Gas flow value measured on the probes should have the same value as the flow measured by MicroMotion. A difference indicates operational problems, leaks or error in measurement.

The two main applications was programmed, (developed in 2003-2004 and reworked in 2011 during the reconstruction of gas storage technology). First application is designed for dispatcher and is use to monitoring gas flow balance, status of total gas reserves and progress value of flow (by day, month and year, depending on operating mode). Software also gives the dispatcher a information about gas pressure on output and signalizes changes in operating mode (start and finish the injection, exploration, transfer, I/O or test mode).

Figure 4- Flow meter MicroMotion with FlowBoss [1]

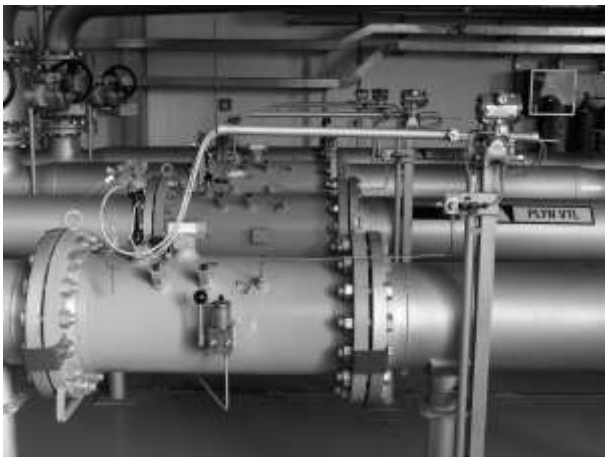


Figure 5- Gas flow measurement using Solartron for sales purpose [1]

The second application was programmed for geologist (2003, new version in 2007 and 2009). Application shows detailed value from the probes (an hourly flow, an integration value and a gas pressure). System counts flow values and gives basic data for reporting. Also there is an reporting about the status of gas reserves at every of four separated areas and total reserves based on information from probes. This should be the same value as value in the first application mentioned above. Side benefit is checking the measurement of flow in different places with a different equipment (probes Annubar, Micromotion FlowBoss on input to drying and Solartron on output from the storage).

Data could be exported to Excel sheets with selected periods, areas or selected probes. Geologist can also enter the correction in the gas deposit (differences due technological loss and measurement calibration – flow during the calibration is not monitored by the system).

Since 2011 new software has been run (authors by Danel – Řepka) for recording pressure on a rising pipes in the drill holes and annulus in probes. In this software there has collected data for last ten years with possibility of graphical presentation of differences and trends.

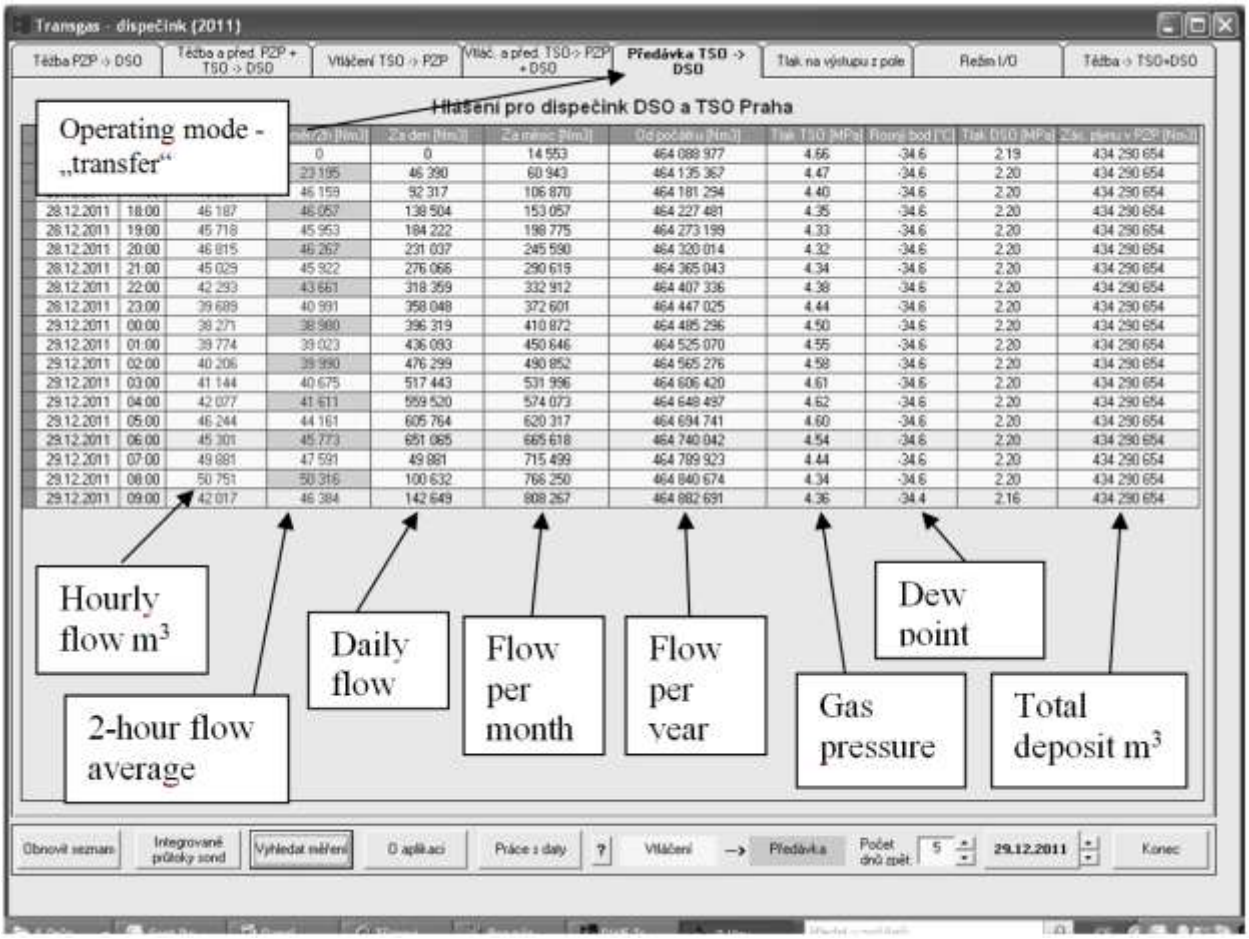


Figure 6- Dispatching SW – monitoring of gas flow

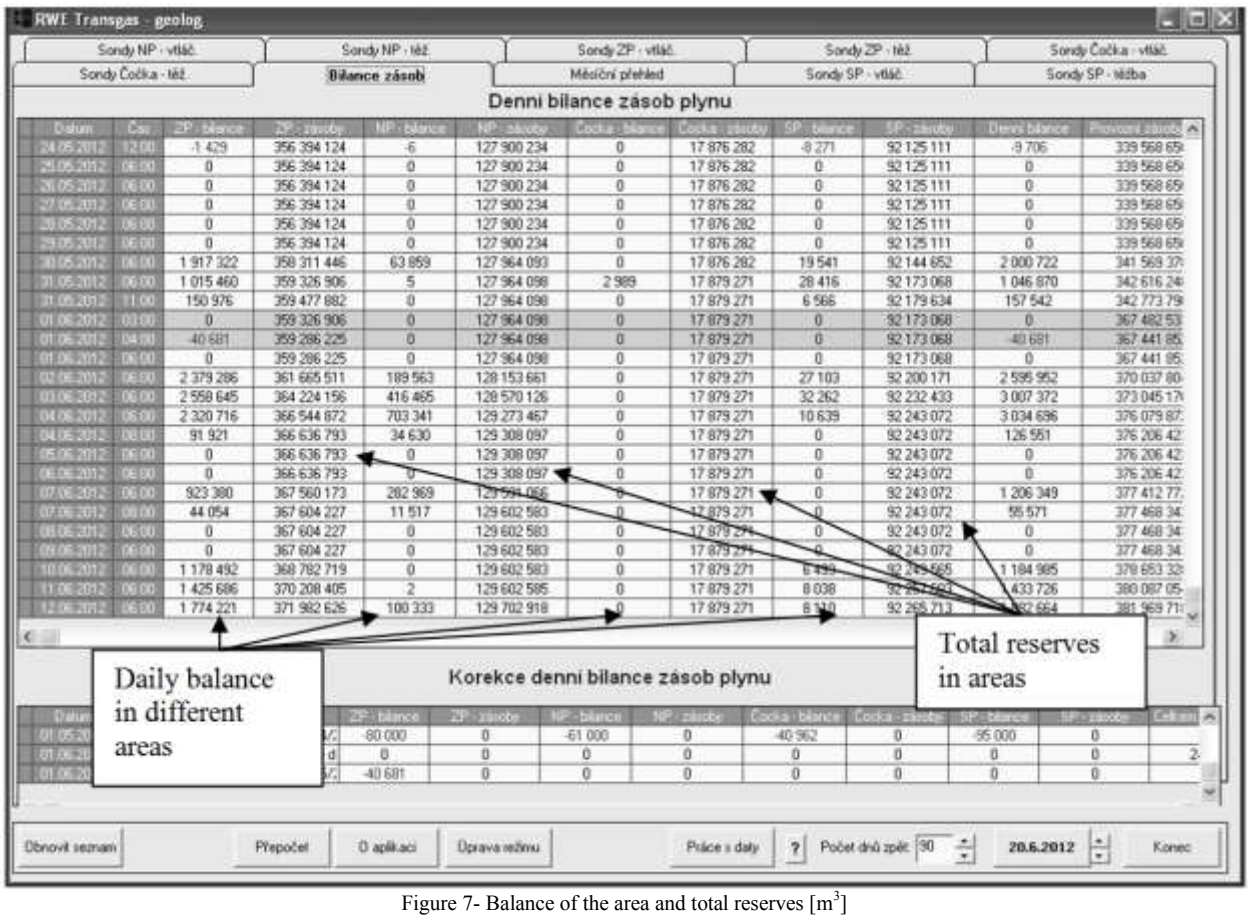
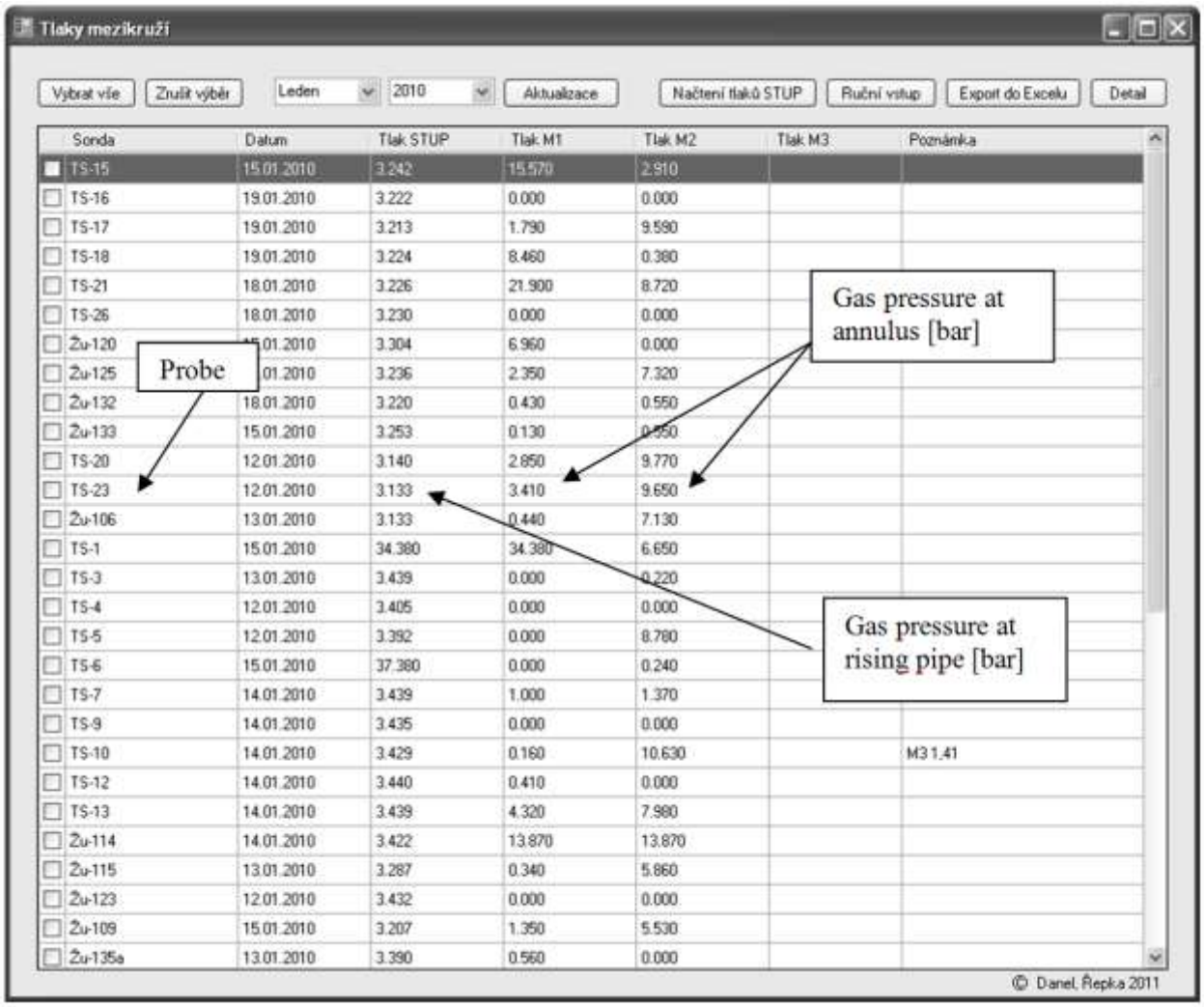


Figure 7- Balance of the area and total reserves [m^3]



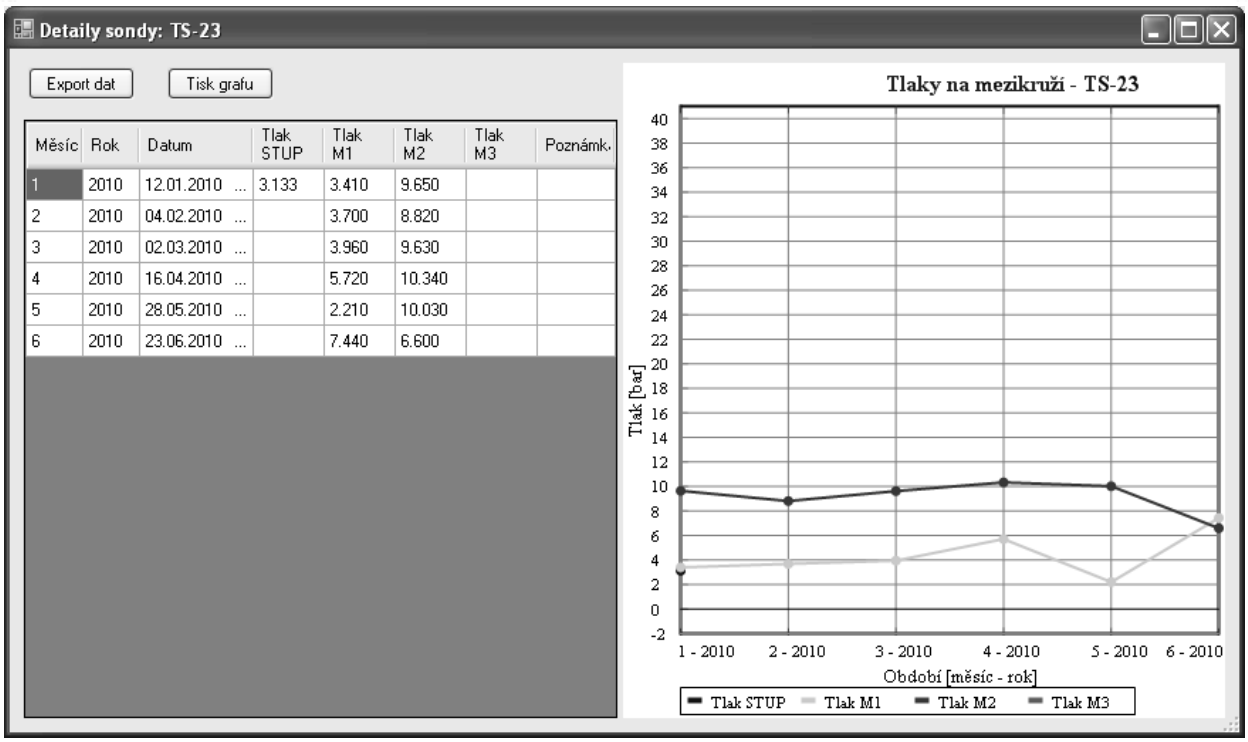


Figure 8- Application for monitoring and evaluation the gas pressure at probes and detail data from probe TS-23

CONCLUSION

Dispatching System developed for RWE has given improved monitoring and control of Underground Gas Storage. Key benefit is immediate on-line calculation of gas reserves. Another benefit is checking the status of flow meters by comparing the amount of flow. In 2011 was system fulfill with new software for checking the gas pressure in probes.

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