WIERTNICTWO NAFTA GAZ • TOM 24 • ZESZYT 1 • 2007

Argentina Tataru*, Marcel Adrian Piteiu*, Dan-Paul Stefanescu*, Ioana Vlasin*

NEW TECHNICAL CONSIDERATIONS OF ROMGAZ COMPANY REGARDING DRILLING, COMPLETION AND TESTING OF THE NATURAL GAS WELLS

1. INTRODUCTION

In our specific activity especially designed for new gas reserves discoveries and also for the rehabilitation of the mature (brown) gas fields there are some special situations encountered in the current practice, beside the general and most common cases.

The paper reveals our new experience in drilling, completion and testing the natural gas wells, through some case studies described in detail.

2. CASE STUDIES

2.1. Side- track

One interesting example refers to an old well located in a relatively marginal zone of one major gas field from Transylvanian Basin.

After a period of production, the well was designed for residual water injection.

The final purpose of the reactivation process was represented by the abandonment of the injection status and opening of a lower horizon containing a considerable amount of the remaining gas resources and reserves and most likely undrained.

In order to put in practice this idea, it was necessary to mill some cement plugs inside the wellbore until 740 m depth (Sarmatian IV).

Unfortunately, the milling process was interrupted by a technical accident happened during this job, which consisted in breaking the drilling string and remaining of the some pipes and the milling tool into the wellbore.

* S.N.G.N. “Romgaz”, Romania

As the fishing job was considered to be too long and would have been involved high operating costs, with low chances of success, creating a **“side-track”** by re-drilling the interval 540–900 m (the bottom of Sarmatian IV + V) has represented the only viable option, which could save the well and represent the real chance of the well rehabilitation.

This meant the milling a window in the production casing of 5: inch with different types of bits, and drilling actually a new well beside the existing one, until the desired depth.

Even if the **side-track** procedure is well known in the gas and oil world practice, it has represented **the first** Romgaz experiment, which actually wasn’t a simple one, because a lot of criterions in terms of drilling fluid, formation pore pressure, current depletion degree of the formation etc., had to be taken into account.

To ask to the above issues, in order to avoid the formation damage, it was necessary to correlate the fluid parameters with the lithology and the physical properties of the formation, so the new well has been drilled with an inhibitive type mud with low density and filtrate. Due to the fluid rheology and also the fast passing through the formation, the initial estimated pressure has been obtained.

In order to achieve the proposed goal, some steps had to be performed, which consisted in:

– A casing inspection with MFCT (multifinger caliper tool).
– A cementing job at depth = 545 m.
– Set at depth = 540 m a **whipstock** with **2,60 m dip** and **170 degrees orientation**.
– Squeezed cementing the **whipstock** on the interval 472–545 m.
– Milling the cement plugs until 536 m.
– The sealing checking, which has indicated a salt water influx, so a lack of sealing.
– A new squeezed cementing job at 477 m.
– Milling the interval 477–543 m and creating a window. The first formation samples have been observed.
– **Re-drilling** the interval 543–873 m, which was the final depth of the new well.

More types of milling bits of tronconic shape and different sizes 110 mm, 115 mm, 116 mm, have been used during the job and also parabolic ones of 115 mm, 118 mm, 120 mm and 122 mm size. For re-drilling, two types of bits have been used: Security 4 $\frac{3}{4}$ in and cone bit MTA 4 $\frac{3}{4}$ inch.

The new well completion design was more special and consisted in setting at the bottom of the well a slim production casing of 2 $\frac{7}{8}$ inch, cemented at the surface (Fig. 1).

The horizontal and vertical projection plot of the well deviation (Fig. 2) allowed us to calculate the distance of **5.86 m** between the old and new well.

The well was perforated based on the petrophysical ELAN interpretation (Fig. 3) of the new open hole logs (S_h = 50–60% and Φ_{ef} = 20–30%) and the final result met our expectations by getting a high gas flow rate of 44.000 stcm/day on 7 mm choke.

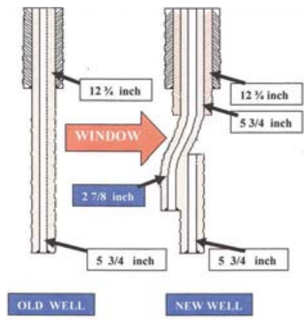

Fig. 1. Old and new well completion

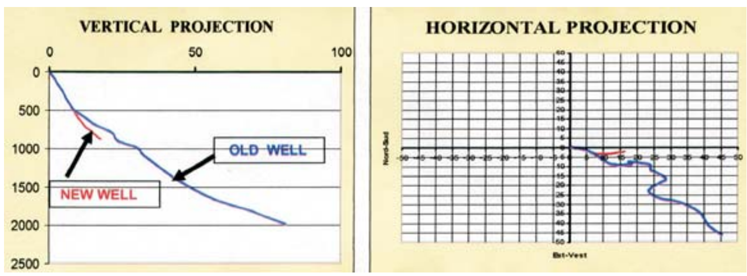

Fig. 2. Vertical and horizontal projection

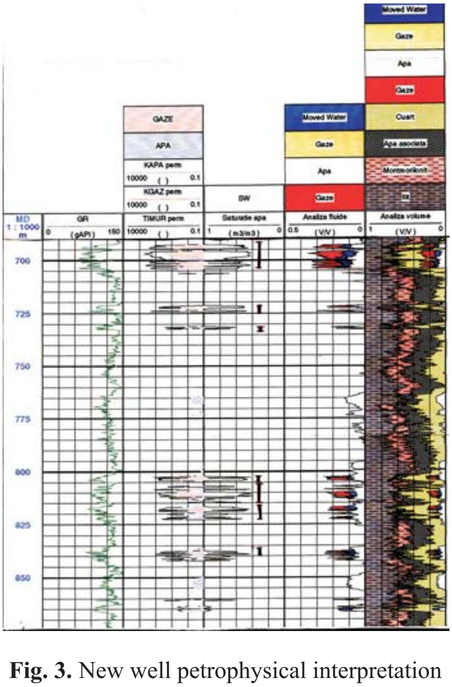

Fig. 3. New well petrophysical interpretation

2.3. Dual completion

Other case study describes a special completion design of a new drilled well, located also in the Transylvanian Basin and tested with positive results.

After checking the entire potential of the well by perforating more sarmatian and buglovian layers, it was decided to set a 7 inch liner and reperforate some existing sarmatian and buglovian zones and perforate one buglovian layer in addition.

At the same time two sarmatian layers have been reperforated through 9 $\frac{5}{8}$ inch casing.

Among a total of 20 gas potential layers, three are producing from Sarmatian horizon and two from Buglovian.

The well has a dual completion, with parallel production tubing strings in order to produce from both horizons:

- Buglovian, by packer set at 1825 m.
- Sarmatian, by tubing set at 1090 m (Fig. 4).

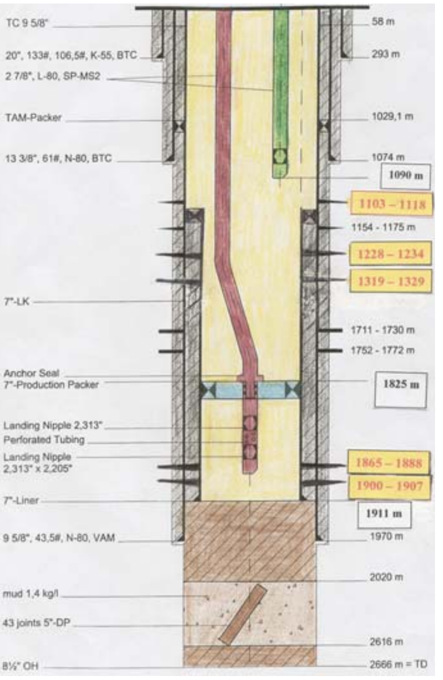

Fig. 4. Dual production string

2.3. DST – New acquisition

A new and modern equipment, recently acquired by our Company, has allowed us to increase the quality of well testing by using a special combined system with TCP guns (**Tubing Conveyed**) and DST (**Drill Stem Test**). The fluids identification, determination of the reservoir pressure, temperature and flow rates, getting the samples for analysis represent the main goals of **DST**.

The equipment is composed of one downhole assembly run into the wellbore with a tubing or drill pipe string, which is consisted in principal of a retrievable packer with hydraulic setting, pressure and temperature gauges and more operating valves (or testing and circulation).

At the same time, the system requires a special surface equipment, including a 3 $\frac{1}{8}$ inch well head, closing system for emergency cases and also one unit designed for fluids separation and electronic measuring of gas flow rates and liquids.

The bottomhole assembly is usually run together with a TCP gun hydraulically activated, so only a single job can assure the well perforating and also the hydrodynamic research of the well.

After setting the packer and checking its sealing by applying into the annulus a pressure of about 70 bar, the gun will be detonated by pressuring nitrogen inside the tubing string. Once perforating job is finished, the nitrogen pressure will be released through the surface unit, followed by testing the well flowing through more chokes and shutting the well, for build up test recording.

Some main advantages of using DST equipment are represented by:

- **very short** testing times (usually 2 hours flowing/one choke and 2 hours shutting, followed by the same times for the other choke etc.),
- an **accurate** evaluation of reservoir parameters,
- **no need swabbing** (tubing is empty),
- **one run = more jobs**,
- **underbalance perforating**,
- **performing interference tests** between the wells.

As a first Romgaz application, the case described in the paper represents a real example of a recently drilled well, tested with this type of bottom hole assembly.

The reservoir static and dynamic pressures and also temperatures are measured continuously during the test and represent the input data for obtaining the flowing parameters of the reservoir: skin effect, permeability, A and B coefficients, the type and also the limit of the reservoir (Fig. 5).

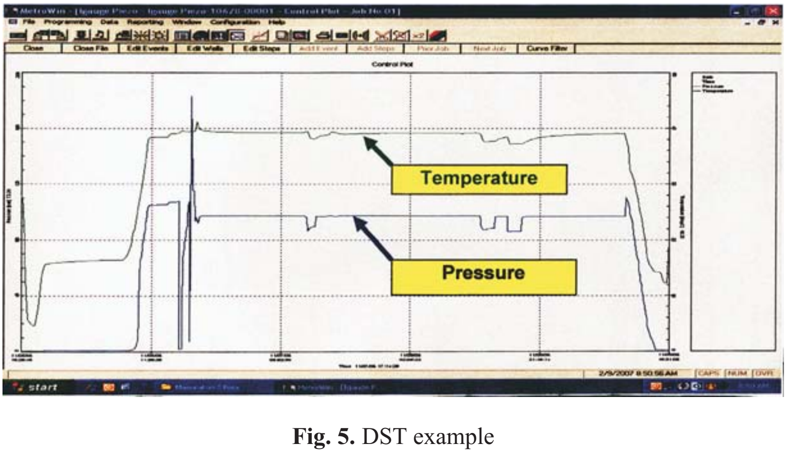

Fig. 5. DST example

3. CONCLUSIONS

1) In the context of the laborious rehabilitation process of our mature gas fields, the need of applying the new methods and technologies becomes today a major priority of ROMGAZ strategy in this direction.
2) Only a better understanding of the geological and physical model of the reservoir help us to choose the right and optimum solution, in order to avoid the formation damage and increase the wells performance.
3) All the above mentioned issues emphasize also the real contribution of our experiments for discovering the new gas reserves and the increasing the existing ones too.
4) Even if not all the attempts are successfully, they represent important steps and real experiments, which help us to analyse and think in depth in the future.

REFERENCES

[1] Macovei, Neculai: *Deviated drilling*. Ploiesti, Publishing House of Oil and Gas University 2003
[2] Romgaz geological archives
[3] Romgaz gas fields reservoir studies
[4] Technical literature regarding wells completion and testing