Rudarsko-geološko- naftni zbornik	Vol. 8	str. 117-121	Zagreb, 1996.

UDC 622.243 (439)

*Izlaganje na znanstvenom skupu**

HORIZONTAL DRILLING ACTIVITY IN HUNGARY AND SPECIAL QUESTIONS OF BLOWOUT PREVENTION IN HORIZONTAL WELLS

József SZEPESI

Mining Department, Institute for Petroleum and Gas, 3515 Miskolc-Egyetemváros, Hungary

Key-Words: Horizontal drilling, Achievements, Pitfalls, Casing program, Blowout prevention, Well completion.

Described is horizontal drilling in the world and data on such activity in Hungary. Results show that there is an increase of such activity in spite of complex problems in drilling and completion of horizontal wells. Since these wells are often drilled in partialy exhausted hydrocarbon fluid reservoirs with slightly over-balanced or even with under-balanced conditions, there is an increased danger of blowouts. Prevention methods and suggested procedures are elaborated.

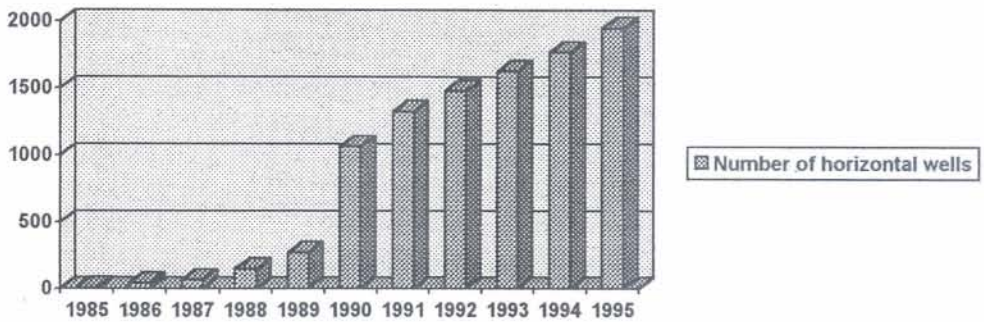
Ključne riječi: Vodoravno bušenje, Postignuća, Skrivene opasnosti, Program učvršćenja zaštitnim cijevima, Sprečavanje izbacivanja fluida, Opremanje bušotine.

Opisano je vodoravno bušenje u svijetu i dati su podaci o toj djelatnosti u Mađarskoj. Rezultati pokazuju da se povećava ta djelatnost uprkos složenim problemima kod izrade i opremanja vodoravnih bušotina. Kako se ove bušotine izrađuju u djelomično iscrpena ležišta ugljikovodika uz isplake s neznatnim pretlakom ili čak i podtlakom na bušene stijene, povećana je opasnost od nekontroliranih erupcija fluida. Opisani su načini sprečavanja tih pojava i preporučeni postupci kod toga.

Introduction

There is no doubt about the future of horizontal drilling and application of horizontal wells in petroleum engineering activities. The number of drilled horizontal wells is increasing very rapidly year by year as it is obvious from Fig. 1 (Ösz, 1995).

Horizontal wells are drilled particularly to minimize water gas coning, to increase oil and gas production from thin reservoirs, to get satisfactory oil and gas production from fissured tight reservoirs etc. Selection of reservoirs - candidates for horizontal wells is a critical point of geologists and reservoir engineers work.



Year	1985	1986	1987	1988	1989	990	1991	1992	1993	1994	1995
Number	6	40	63	145	270	1063	1325	1475	1625	1765	1950

Sperry Sun Houston 1994

Fig. 1. The number of drilled horizontal wells (Ö s z, 1995)

Drillers have to reach targets by horizontal wells with a curvature as small as possible, with smooth wellbore channels, causing as low formation damage of potential production rocks as it is technically approachable. To do that, they have to apply low density drilling fluids. Because of that there is a great danger of blowouts from such wells.

Horizontal drilling in Hungary is increasing year by year. Up to now there are 15 horizontal wells completed, 12 of them in the Algyö field.

Some data on horizontal drilling activities

(Book of Records, Drilling, July/Aug. 1989)

The longest single run footage drilled with a steerable downhole motor was 2894 m in 134 drilling hours with average ROP of 21,6 m/hour.

The longest extended reach well horizontal displacement was 4683 m with the measured depth (MD) of 5922 m. The MD to total vertical depth

Izlaganje na znanstvenom skupu "Drugi dan naftnog rudarstva" dne 15. ožujka 1996. u Zagrebu

(TVD) relation was 2.8 to 3.1 up to now in the North Sea region. The longest final displacement of a horizontal well was 4693 m.

The longest casing in a horizontal section is 781 m in an 1/2 inch diameter hole.

The fastest penetration in a horizontal section was 232 m in 17.7 hours (ROP=13.1 m/hour) with a 6 1/8 inch diameter PDC bit.

The longest successful coring in a horizontal section has had a 22.2 m long core recovering.

Pitfalls in horizontal drilling

(Petrol. Eng. Intl.', Nov. 1991)

Some wise directional driller has told: "*Experience teaches you to recognize a mistake when you're made it again*". Not long time ago it was a fairly serious mistake to find your bit face in a position 90^0 from the vertical. Today it is an everyday's task and goal.

To make a horizontal well, and that is a well with final part of it in horizontal position, is recently a matter of experience. So you can make a horizontal well where you want, when you want and how you want it. But there are particular pitfalls in horizontal drilling.

Lack of experienced personnel at the rig

This is the first reply to the question on reason of successful and unsuccessful operations

Impatience

To achieve a high ROP in drilling a horizontal well should not be a primary task on driller's priorities. "If your driller is trying to beat someone's record time (to TD) across the field, you've got a problem".

Overrunning the downhole motor

Fluid volume prescriptions inherent to each of downhole motors are essential to prevent of creation of more cuttings than fluid flow rate can lift.

Data concentration

Recently applied downhole equipment is feeding you with almost more bits than floor personnel can handle. Drillers on the floor have to be alert particularly on change of condition during build up stage indicated by surface indicators.

Deviation from the program

Deviation from the program can cause costly course corrections, missing of the target or even forced side tracking.

Wrong or incomplete geological data

Reliability of available geological data is essential for success of horizontal drilling. They should be considered seriously by the whole planning team.

Choice of the bottomhole assembly

Ask at least two directional drilling service company what assembly is the mostly suitable for reaching your target and be prepared to get more than one design as answer. An engineer has to be flexible, listen to experts and be prepared to make changes for the final design of the bottomhole assembly (BHA) which has to be applied.

Overkill/Underkill

There is a tendency of engineers to use to much rig and pump power for any of operation needed, to overplan it or, on the other hand, to make a "poor boy" operation and to apply not enough power. Whichever of these can give unsatisfactory or unsafe results.

Loss of well control

Improper blowout prevention equipment and/or improper knowledge on causes of blowouts and lack of training of personnel in blowout prevention and control can lead to a catastrophe.

Hungarian experience in horizontal drilling

In Hungary we want to use advantages of horizontal wells and sometime "give a new life to dry or abandoned wels" and to reduce costs. Till now we have 15 horizontal wells, most of them (12) were drilled in *the Algyö field*. In Algyö the aim was to produce oil with an economical flow rate from the Lower Pannonian, low permeability sand formation.

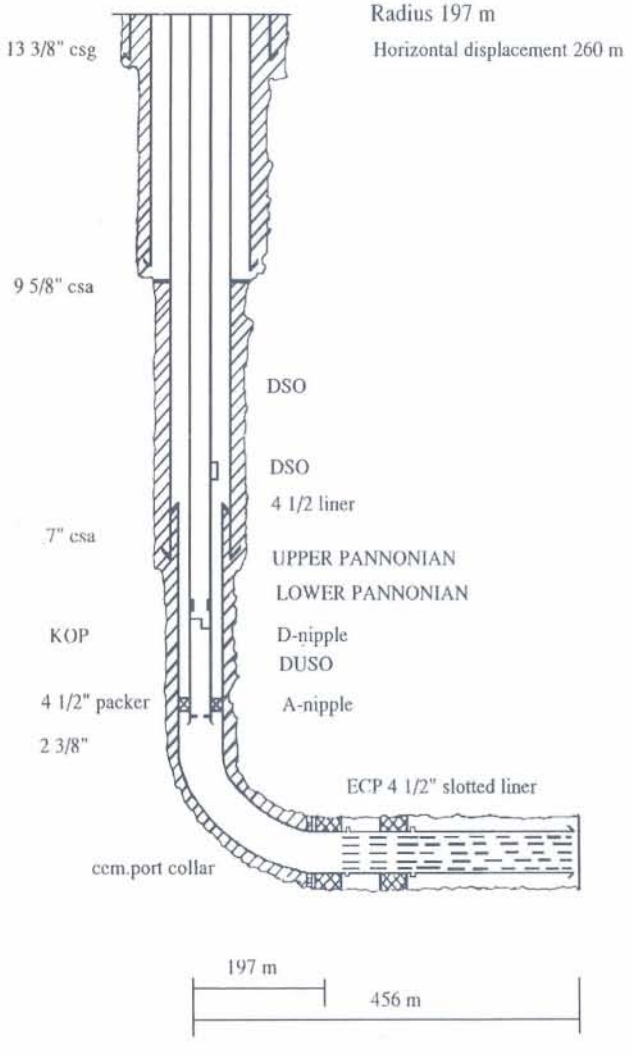


Fig. 2. Scheme of a horizontal well in the Algyö field

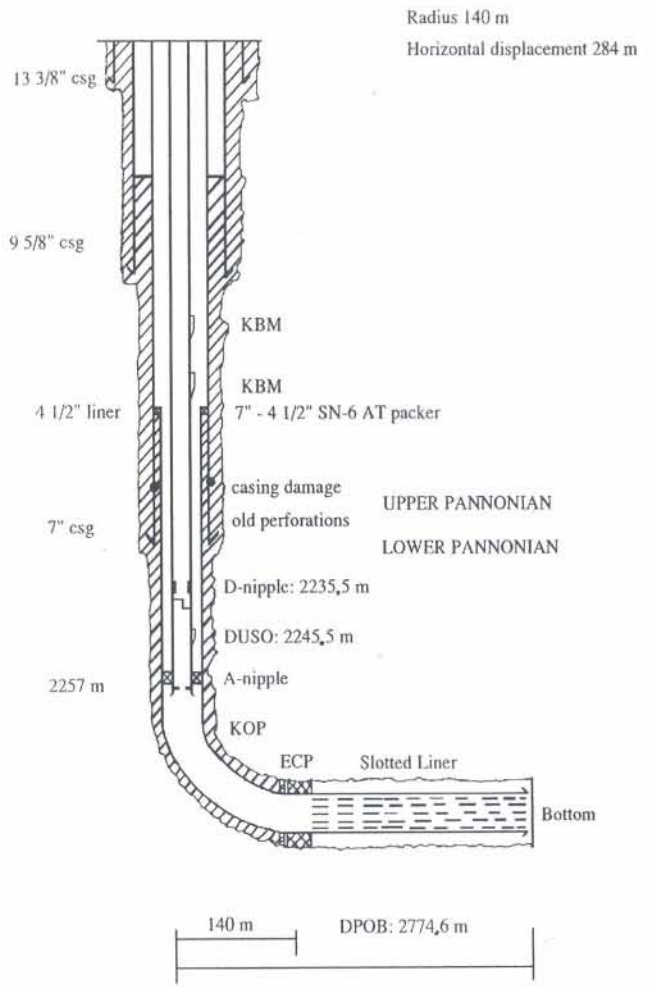


Fig. 3. Scheme of a horizontal well in the Algyö field

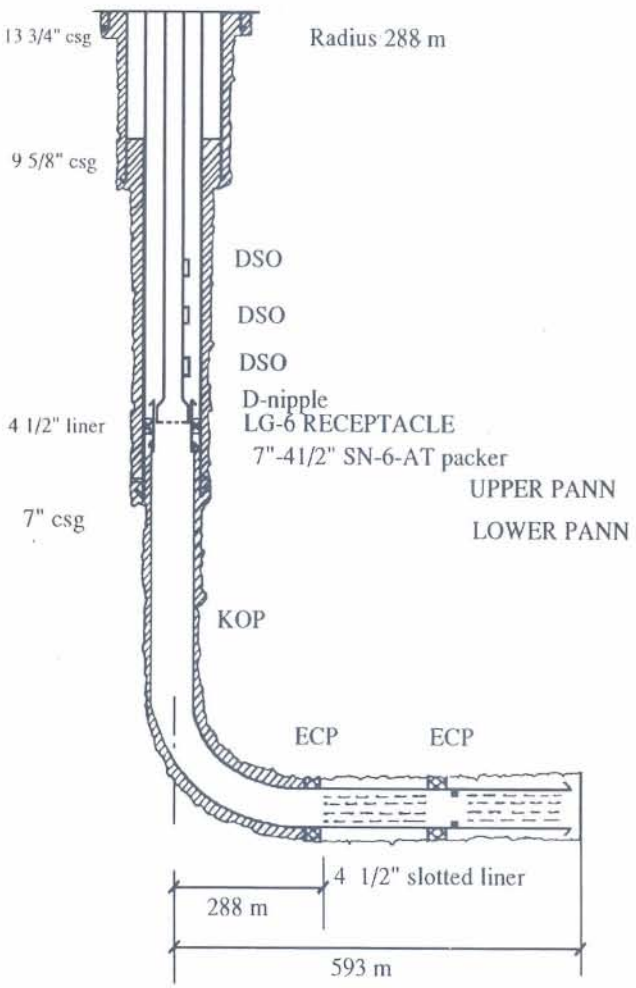


Fig. 4. Scheme of a horizontal well in the Algyö field

As it is presented on Figs. 2, 3, and 4. horizontal wells have been drilled from the bottom of old wells, curved section have been cased with intermediate cemented liners, and lateral section of wells have been cased with slotted liners. In one case there was only one expandable casing packer (ECP) set at the begining of the slotted liner, and in two cases there were set one ECP at the begining and one more ECP along the slotted liner.

The question about use of an openhole completion, a slotted liner, a perforated liner or a cased and cemented completion in the lateral section in an evergreen question (F e d e r e r, 1991, F e d e r e r et al., 1993). The openhole completion may be the best in some cases, but in our circumstances, having unstable sand layers in the Lower Pannonian formation, that was unacceptable. Including of ECP and propper positioning of them on the liner is an important point of completion planning.

There are two horizontal wells in *Dorozsma field* (close to Szeged) too. One of them is an oil production well from very hard and abrasive fractured Precambrian metamorphic reservoir, and the other, Do-64 well (Fig. 5), is a water injection well (V i n c e, 1990).

One interesting well was drilled in the *Szank field* (Figs. 6 and 7) into Miocene sandy carbonate reservoir. From this well hapened the first kick of salt water and oil mixture from a horizontal well section in Hungary (S i m o n and M u n k a c s i, 1995).

There is a plan to drill horizontal wells in *Zsana field* for an underground gas storage. These wells (Fig. 8) will be the first wells drilled with a short radius curvature in Hungary.

Blowout prevention

The last of pitfalls cited, the loss of well control is the most dangerous pitfall and its overcoming is the most expensive operation in drilling activities usually. A blowout, an uncontrolled flow of wellbore fluids at the surface, is a consequence of a higher pressure in drilled rocks pores than it is realised by drilling fluid in the borehole on those rocks and of our disability to overcome this overpressure by surface equipment (wellhead, blowout preventers, valves, orifices, etc.).

The traditional blowout prevention technology is based on the primary pressure control of drilled

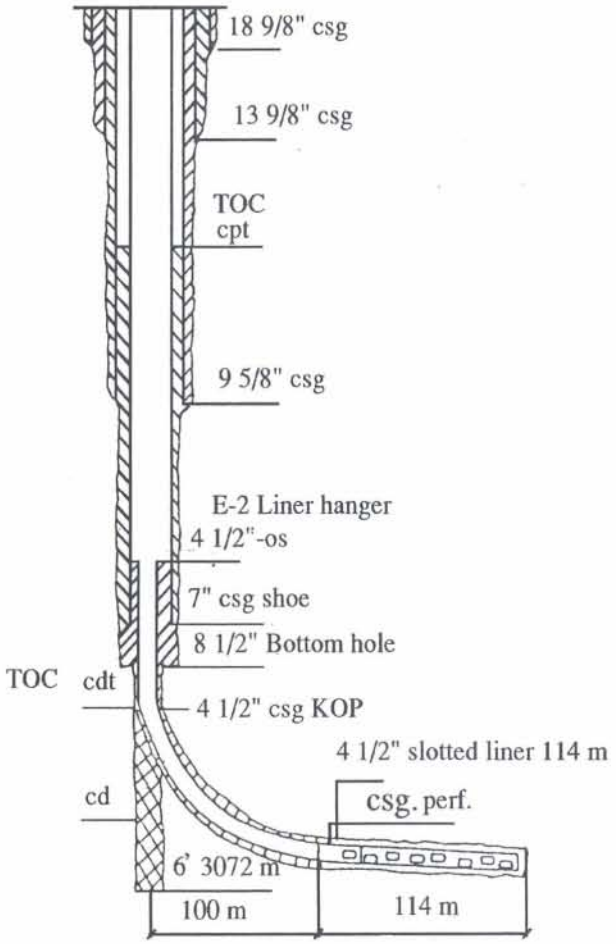


Fig. 5. Scheme of the DO-64 horizontal well

formations, and it goes further to a secondary control in presence of a kick. The recognition of a kick in a vertical hole is a clear thing and we have to overcome it by a pressure depending on height of drilling fluid column, density of it, and -in some occasions- by an overpressure realized by a choke. In the horizontal section of a hole the height of the drilling fluid column remains the same along that section, and some differences in geological structure may occur pressure differences in drilled rocks. These diferences can be a cause of a blowout or a fluid loss.

Differences in blowout prevention and control in vertical and horizontal wells are described in literature (S n y d e r, 1994). In horizontal wells hydrostatic pressure for killing the kick will be reached much sooner than in vertical wells. The friction effect will not be realized untill killing fluid will be circulated along the whole length of the well. Both, the Wait and Weight Method and the Driller's Method, can be applied in killing horizontal wells, but the Well Control Worksheats have to be addapted.

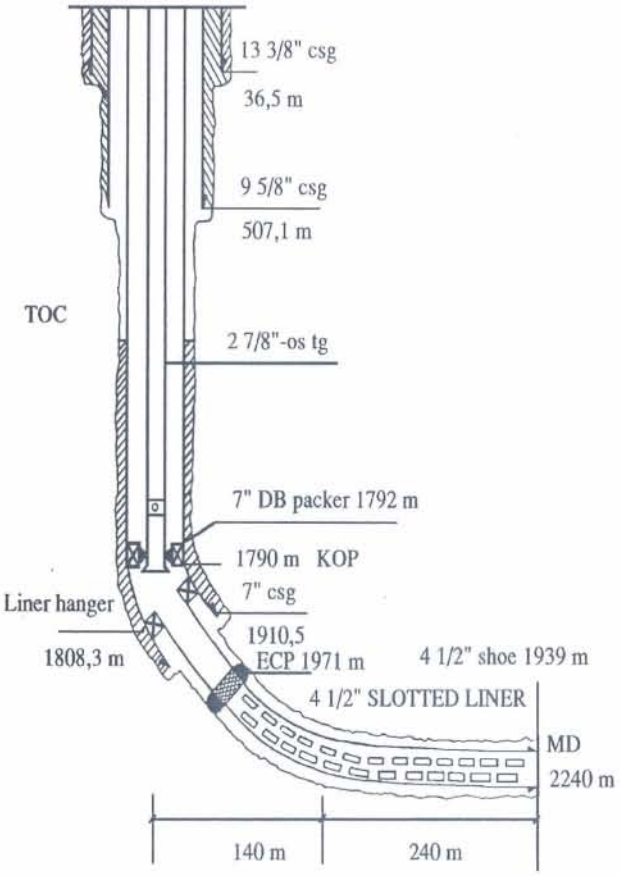


Fig. 6. Scheme of the SZK-45 horizontal well

Recently developed well control simulators are suitable to be applied in horizontal well blowout control training and planning procedure.

Conclusion

Horizontal drilling and application of horizontal wells in oil and gas production have become an everyday's practice with economical results. Modest experience gained up to now in Hungary with the first 15 wells has proved that too.

Since there is a danger of blowout from horizontal wells as well as from the vertical ones, consideration was given to particularities of blowout prevention and control. Hungarian drillers are trained in prevention of blowout from horizontal wells and there is a special group of skilled profesionals for blowout control.

Received: 1996.04.03.
Accepted: 1996.06.25.

REFERENCES

*** Book of Records (July/Aug. 1989) *Drilling*, 16-20.

F e d e r e r, I. (1991): Two Phase Flow in Horizontal Wels. Resource Report, IFP, Rueil Malmaison, France

F e d e r e r, I., R o n d y, P. and C h o l e t, H. (Oct. 1993):Optimization of Heavy Oil and Gas Pumping in Horizontal Wells. SPE paper 26555, SPE Ann. Techn. Conf. and Exhib., Houston, TX.

***Horizontal Well Completion and Stimulation Technology (1991) Dowell Schlumberger.

Ö s z, A. (Aug. 1995): Vizszintes fúrasok kitörésvédelme. *Köolaj* és földgáz 28 (128), pp. 285-296.

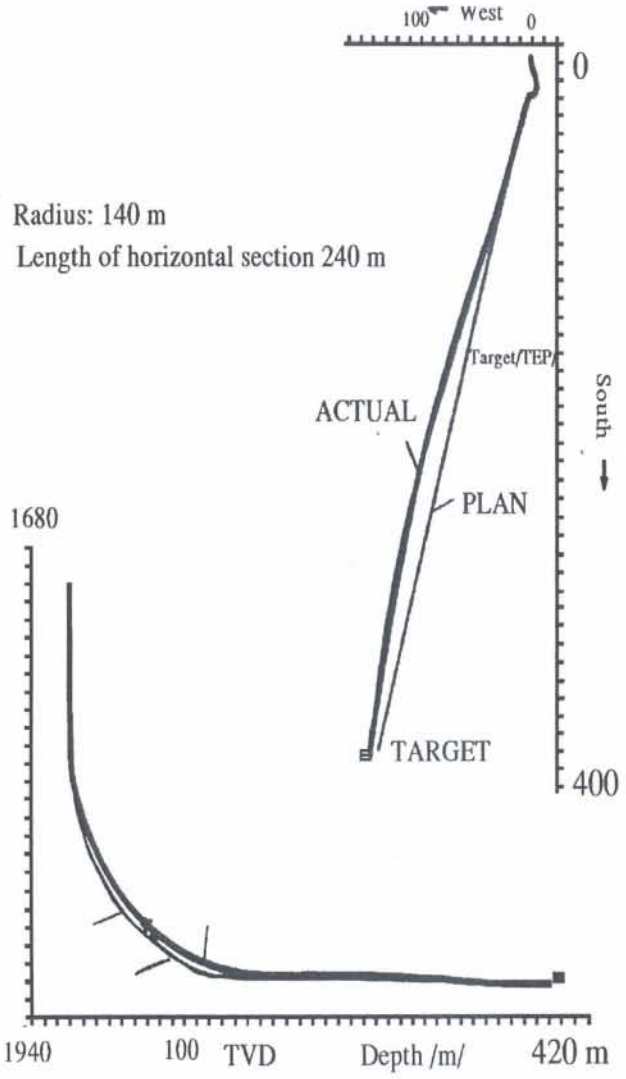


Fig. 7. Scheme of horizontal well in Szank field

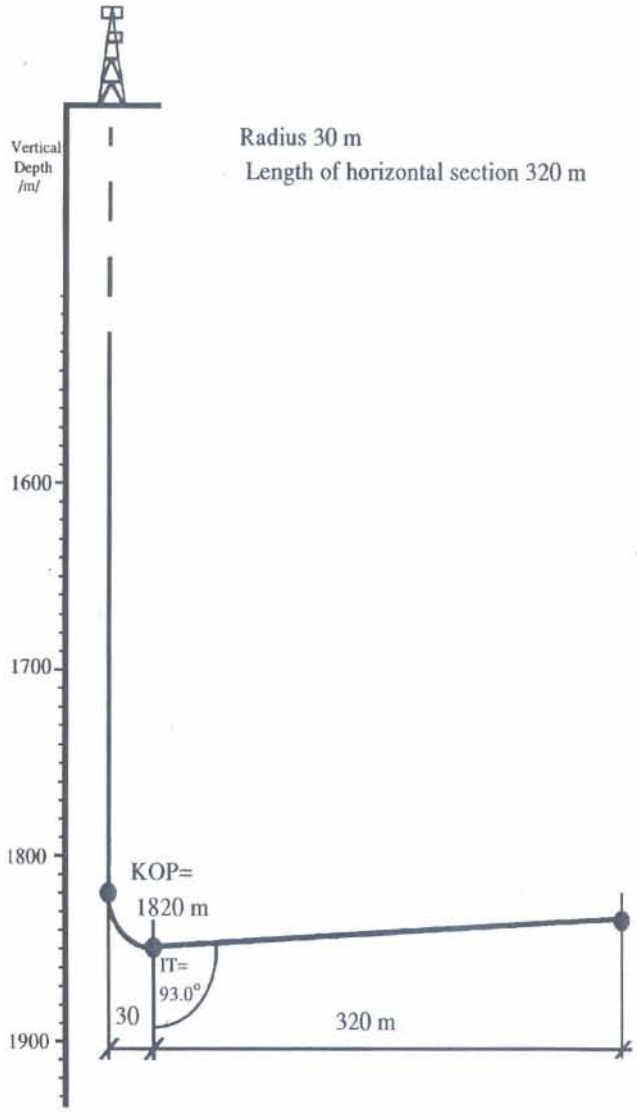


Fig. 8. Scheme of a horizontal well in Zsana gas storage

***Petroleum Engineering International (Nov. 1991) 17.

S i m o n, B. & M u n k á c s i, I. (Oct. 1995): Horizontal Wells in Hungary, Historical Outlines. Drilling Conference, Tihany, Hungary.

S n y d e r, R.E. (June, 1994): What is New in Well Control. *World Oil*, 105.

V i n c e, J. (1990): Horizontal Drilling in Hungary. Diploma Paper, University of Miskolc.