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Issue **Article**

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SELECTION OF THE DESIGN OF PRODUCTION WELLS FOR THE DEVELOPMENT OF MULTI-LAYER DEPOSITS BY DUAL COMPLETION OPERATION

***Abstract**: The article considers the choice of an operational well design for the development of multi-layer deposits by simultaneous separate operation. Based on the parameters of reservoir pressures according to the calculations carried out, the corresponding depths for well №200, the values of the equivalents of reservoir pressure gradients were obtained. The developed design of the well is effective for the development of wells by the method of dual completion (DC) with two elevators by pumping and compressor pipes. This work can be applied to drilling operations at multi-layer deposits in order to accelerate the development of deposits.*

***Key words**: hydraulic fracturing, well profile, regulations, combined schedule, intermediate column, parallel elevator, rock strength.*

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Introduction

One of the most important tasks for successful drilling operations in areas with multi-layer productive horizons is a reasonable correct choice and design development for simultaneous and separate operation of wells. The initial data for the design of the well structure are; the purpose of drilling and the purpose of the well, the design horizon and depth of the well, the diameter of the production column, reservoir pressures and hydraulic fracturing pressures of stratigraphic horizons, methods of completion of the well and its operation, the profile of the well and its characteristics, characteristics of rocks by strength [1, 4, 9].

Data for the calculation (pressure and temperature by depth) of the investigated well №200 on the Northern Goturdepe area, compiled on the basis of data from previously drilled wells №№29, 97, 101 Northern Goturdepe are shown in Table 1.

Table 1. Pressure and temperature in the section of the well №200 of the Northern Goturdepe area

Interval, m		Pressure gradient				Temperature at the end of the interval, °C
		formation		pore		
		kgf/cm^2 per m		kgf/cm^2 per m		
from (top)	up to (bottom)	from (top)	up to (bottom)	from (top)	up to (bottom)	
0	500	0,00	0,105	0,00	0,105	32
500	1170	0,105	0,110	0,105	0,110	44

1170	1500	0,110	0,112	0,110	0,112	51
1500	2330	0,112	0,115	0,112	0,115	66
2330	2460	0,135	0,135	0,135	0,135	69
2460	2510	0,115	0,115	0,115	0,115	70
2510	2610	0,135	0.135	0,135	0.135	72
2610	2830	0.115	0,120	0.115	0,120	76
2830	2940	0,120	0,123	0,120	0,123	78
2940	3200	0,123	0,125	0,123	0,125	83
3200	3600	0,125	0,125	0,125	0,125	90
3600	4180	0,125	0,126	0,125	0,126	101
4180	4300	0,126	0,130	0,126	0,130	104
4300	4650	0,130	0,135	0,130	0,135	110
4650	4800	0,135	0,155	0,135	0,155	113
4800	4900	0,155	0,160	0,155	0,160	115

The development of the well design begins with the solution of two problems; the determination by calculation of the nominal diameters of the casing strings and the diameters of the rock-breaking tool.

When choosing and justifying the design of the well №200 Northern Goturdepe, the requirements of the "Safety Rules in the Oil and Gas Industry", the Regulations for calculating intermediate columns when Drilling wells in the oil and gas areas of the western part of Turkmenistan were taken into account and geological and technical information on previously drilled wells in the Northern Goturdepe area was used.

Based on the parameters of reservoir pressures at the corresponding depths, calculations were made for well № 200, the values of the equivalents of reservoir pressure gradients. The results obtained are shown in Table 2.

Table 2. Calculated values of hydraulic fracturing pressures, gradients of reservoir pressure, hydraulic fracturing of rocks and the density of drilling fluid at well № 200 Northern Goturdepe

Interval, m		Hydraulic fracturing pressure		Pressure gradient				Temperature at the end of the interval, °C
				Reservoir pressure		hydraulic fracturing of rocks		
		kgf/cm^2 per m		kgf/cm^2 per m		kgf/cm^2 per m		
from (top)	up to (bottom)	from (top)	up to (bottom)	from (top)	up to (bottom)	from (top)	up to (bottom)	
0	500	49,0	76	0,00	1,05	1,49	1,52	1,26
500	1170	76	182,5	1,05	1,10	1,52	1,56	1,26
1170	1500	182,5	235,5	1,10	1,12	1,56	1,57	1,26
1500	2330	235,5	370,5	1,12	1,15	1,57	1,59	1,26-1,45
2330	2460	370,5	423,1	1,35	1,35	1,59	1,72	1,45
2460	2510	423,1	399,1	1,15	1,15	1,72	1,59	1,45
2510	2610	431,7	449,0	1,35	1,35	1,72	1,72	1,45
2610	2830	449,0	458,5	1,15	1,20	1,72	1,62	1,45
2830	2940	458,5	482,1	1,20	1,23	1,62	1,64	1,45
2940	3200	482,1	608,0	1,23	1,25	1,64	1,90	1,45
3200	3600	608,0	684,0	1,25	1,25	1,90	1,90	1,45
3600	4180	684,0	794,2	1,25	1,26	1,90	1,90	1,45
4180	4300	794,2	825,6	1,26	1,30	1,90	1,92	1,45
4300	4650	825,6	906,7	1,30	1,35	1,92	1,95	1,45
4650	4800	906,7	984,0	1,35	1,55	1,95	2,05	1,62
4800	4900	984,0	1014,3	1,55	1,60	2,05	2,07	1,68

In order to conduct research and select the design of wells for simultaneous operation of several productive formations on one well, a thorough study of previously drilled wells was carried out and new types of well designs were selected with a full analysis of geological and geophysical materials.

The length of the conductor and the height of its cementing are chosen in such a way that it is strong enough and can reliably withstand the forces that may arise when the preventer is closed under the influence of the pressure of productive layers. The possibility of a gas breakthrough from the well through the annular space or through cracks connecting the borehole to the surface should also be excluded.

To select the number of intermediate technical columns and the depth of their descent, a combined graph of changes in reservoir pressure, hydraulic fracturing pressure and hydrostatic pressure of the drilling fluid column is constructed in the coordinates "depth is equivalent to the pressure gradient".

The choice of the well design was carried out in accordance with the intervals of compatibility of the well section according to the mining and geological drilling conditions, based on the forecast curves of reservoir pressure of rock rupture, and the following design was justified.

- the shaft direction Ø720 mm descended to a depth of 10m, is fixed with butobeton.

- the elongated direction of Ø 530 mm descended to a depth of 30m, in order to overlap unstable, sandy-clay deposits and prevent erosion of the wellhead when drilling under the conductor. The height of the cement lifting is up to the wellhead.

The conductor Ø426 mm descended to a depth of 592 m, provides overlap of the upper part of unstable sandy-clay quaternary deposits, isolation of the borehole from hydrostatically connected with the surface waters and installation of anti-blowout equipment.

The technical column Ø324 mm descended to a depth of 1998 meters to cover the swelling and collapse of "black clays", is equipped with anti-blowout equipment and provides effective well management in case of possible manifestations. The height of the cement rise behind the column is up to the wellhead.

The descent of a technical column with a diameter of Ø244.5 mm was carried out to a depth of 4189 meters, into the roofing part of the productive horizon IX d + e with an adjustment according to logging data. The shoe of the technical column is installed in clay deposits. The casing Ø244.5 mm column was selected according to calculations for the perception of all loads arising during drilling and operation of wells. The height of the cement rise behind the column is up to the wellhead.

The descent of the operational shank Ø139.7 mm was carried out to a depth of 4332 meters (the length of the shank 4170-4332 meters), with the installation of a suspension device for 50-100 meters inside the casing Ø244.5 mm.

The developed design of wells with two elevators for the EPR of several horizons is shown in the figure. Based on the geological results and according to calculations with the compatibility of drilling conditions due to the presence of four attachment zones, the design of the wells under study is represented by three casing columns, and the bottom part by a countersunk column in the form of a shank.

A special difference between the design proposed by us for scientific testing from the previously used one is an increase in the depth of descent of the second technical column for fixing the upper productive horizons, and the lower horizons with casing columns with a diameter of Ø139.7 mm or special filters in the form of a shank [2, 5, 6, 7].

The essence of this technology lies in the fact that in the operational column (mainly an intermediate column of Ø244.5 mm), for the purpose of descent, two parallel tubing elevators, differing in suspension height - short and long. At the same time, productive horizons are separated by a packer device, which ensures their separate operation and accounting of production by the well for each operational object [3, 8, 10].

At well №200 Northern Goturdepe, in order to DC several productive horizons, the depth of descent of the second technical column was increased by Ø244.5 mm for fixing the upper productive horizons, and the lower horizons by casing columns Ø139.7 mm with cementing in the form of a shank [11].

During the development of well №200 by the DC method, a large inflow of oil was obtained, the results of the studies are shown in Table 3.

Table 3. Data on perforations and indications of studies during the development of well № 200 of the Northern Goturdepe field

Object designation, type of perforator, number of holes	Distance of the test object, (m)	Age, artificial depth, (m)	Development results
I PKO -102 800	4046-4052 4057-4067 4071-4077	Pack IX	I- lift tubing received oil inflow $D_{\underline{connect.\ pipe}}$ =22мм, P_{work} =38 atm. Q_{oil} =157,3 m^3/day.

	4079-4085 4086-4092 4094-4104 4122-4128 4134-4140		
PKO -89 545 Enerjet -43 273	4192-4198 4204-4216 4288-4292	Lower red color NK-1, NK-2	II - lift tubing received oil inflow $D_{\underline{connect.\ pipe}}$ =15mm, $P_{\underline{work}}$ =38 atm. Q_{oil} =127,4 m^3/day

According to the well schemes, the completion in the form of a shank with full cementation in productive zones has the following advantages:

- to use the development of the technology of exploration, cementing, secondary opening and development of the well;

- to ensure the overlap of the zones of reservoir water intake and the tightness of the inclined part of the hole;

- to operate overlapping collectors.

The figure shows the design of well № 200 on the Northern Goturdepe field with a two-lift tubing with downhole equipment for DC.

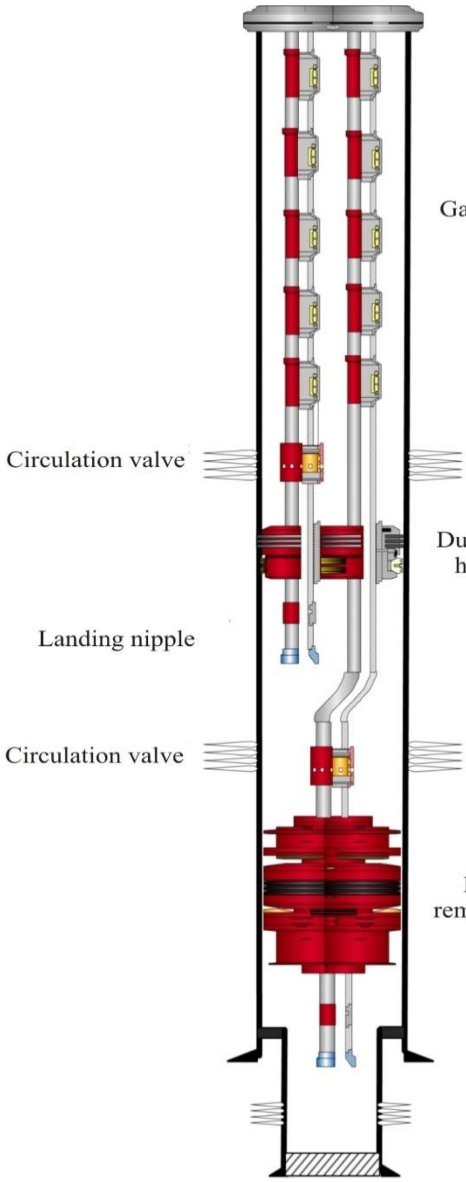

Figure 1. Design of well №200 with a two-lift tubing with downhole equipment for the DC at the North Goturdepe field

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