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SELECTION OF DOWNHOLE EQUIPMENT FOR DUAL COMPLETION OF SEVERAL HORIZONS

Abstract. The article describes the choice of downhole equipment and the features of well drilling technology for dual completion of several horizons. The technology of development of productive red-colored strata and testing of several productive horizons, separately the development of a well on two elevators is given. As well as the technology of descent and fastening of the Ø139.7 mm operational shank. This work can be used to select downhole equipment for dual completion of several horizons in multi-layer deposits.

Keywords: Hydraulic packers, zenith angle, azimuth, offset from vertical, circulation valve, gas lift valve, shank.

Let's consider the choice of downhole equipment for four wells drilled at the North Goturdepe multilayer field and developed dual completion method of operation.

Exploration well № 147 of the Northern Goturdepe field

The design depth is 4400 m.

The actual drilled depth is 4400 m.

Actual well design:

Ø426 mm – 596 m;

Ø324 mm – 2701 m;

Ø245 mm – 4140 m.

The well is drilled obliquely-directed with three sections of the profile:

The first section: The vertical interval of the hole (0–3803 m)

In the range from 0–3803 m, drilling operations were carried out vertically.

In the range from 2697–3803 m, the well was drilled with a drill bit Ø295.3 mm and using a rotary layout.

The second section: Zenith angle dial interval (3803–4140 m)

In the range of 3803–4140 m, the service of the company "SchlumbergerLogelcoInc." used a downhole motor Ø209 mm, with a 1.15-degree deviation angle, to drill 295.3 mm of the barrel. At a depth of 4140 m, the zenith angle of the well reached about 45 degrees. In the interval of the zenith angle set, drilling was carried out with drilling roller bits of the "Volgoburmash" type (IADC137) and roller bits of the type (IADC117), diamond bits – PDS293.3 mm of the Smith Bits" company.

Third section: Inclined-directional hole interval (4140–4400 m)

In the range of 4140–4400 m drilling operations were carried out using direct downhole motors Ø172 mm, designed for drilling a hole Ø215.9 mm. In this interval, a diamond chisel was used – PDS Ø215.9 mm. At a depth of 4400 m, the zenith angle reached approximately 45 degrees and the displacement of the borehole from the vertical position was 298 m, the total angle of the magnetic azimuth was 264 degrees towards the sea.

In the range of 3803–4400 m during drilling, in order to measure the zenith, azimuth angle from

the bottom to the wellhead in real time, the MWD system of Schlumberger Logelco Inc. was used in the bottom of the drill string, as well as, in these intervals during drilling, special equipment was used for logging (gamma logging, neutron) it is completed as part of the bottom of the drill columns.

In order to increase the drilling speed, shorten the construction period of the well, as well as minimize the damage to the reservoir properties of productive formations from a depth of 3803 m, a hydrocarbon-based drilling rig with a density of 1.35–1.45 g/cm^3 was used. Service for the preparation and cleaning of hydrocarbon-based drilling fluid "Wersadril" was performed by "M–I SWACO".

Based on the results of geophysical studies at a depth of 4400 meters, productive horizons of the red-colored stratum VIII, IXa, IXb, IXw, IXg, IXd, IXe, NK (lower red-color), NK-1 were uncovered. Based on the results of research at a depth of 4260–4400 m, a cement bridge was installed and a casing Ø245 mm was lowered to a depth of 4140 m on the drilled interval of the hole Ø295.3 mm. [1]. To carry out simultaneous testing and exploration of several productive horizons separately, the development of the well was planned on two elevators. The well was developed with the descent and attachment of special MESHRITE filters of Schlumberger Logelco Inc., from productive intervals of 4238–4248 m. (NK-1), 4193–4150 m. (NK) on the first long elevator (H = 4140 m) and perforation work was performed on the casing Ø244.5 mm in the intervals of 4040–4050 m., 4008–4030 m. (IX) in the second short elevator (4060 m). In order to ensure the tightness of the tested objects in the open hole (4148 m., 4197 m., 4237 m., 4251.5 m.), a swelling packer on drilling fluid with a hydrocarbon base of Schlumberger Logelco Inc. was used." and on a 244.5 mm casing string in the interval (4003 m., 4038 m) two-lift hydraulic packers. And gaslift valves were used to operate the well in a gaslift way.

Exploration well № 37 of the Northern Goturdepe field

The design depth is 5200 m.

The actual drilled depth is 4953 m.

Actual well design:

Ø426 mm – 594 m;

Ø324 mm – 2781 m;

Ø245 mm – 4761 m.

Ø178 mm. "shank" – 4691–4906 m. (215 m).

Drilling after the descent and fastening of the technical column Ø244.5 mm was carried out with a drill bit Ø215.9 mm using a rotary layout and drilling fluid with a density of 1.80 g/cm^3. At a depth of 4953 meters, drilling reached the design horizon and 12 productive horizons of the lower red color were opened. According to the research of logging data, a cement bridge was installed in the range of 4906–4953 m and a 177.8 mm shank was lowered to test objects in open sections to a depth of 4906 m. With an entrance of 70 m of the upper end of the shank Ø177.8 mm into the inside of the Ø244.5 mm technical column, the Weatherford shank suspension system was used to suspend and ensure the tightness of the upper end of the shank. The use of this system when the operational shank Ø177.8mm was lowered led to an increase in the reliability of the quality of cementing work and the tightness of the upper end. As a result of the conducted geophysical studies, the opening of NK-7, NK-8, NK-9, NK-10 we NK-11 productive red-colored horizons has been clarified. To carry out simultaneous testing and exploration of several productive horizons separately, the development of the well was planned on two elevators. On the Ø177.8 mm operational shank in the intervals of 4706–4710 m, 4721–4724 m, 4726––4728 m (NK-9), 4780–4786 m (NK-10), 4818––4826 m, 4847–4750 m, 4856–4860 m (NK-11) on the first long elevator (H = 4815 m) and Ø244.5 mm technical the column has been perforated in the intervals of 4448–4454 m. (NK-7), 4612–4618 m, 4626–4629 m. (NK-8) in the second-long elevator (4510 m.), it was determined to develop the well.

For the smooth descent of the two-lift line-up, the casing shaft was cleaned inside the well with a scraper and a reiber. After the preparation of the descending downhole equipment, the descent of the two-lift line-up was carried out in the following order (bottom – top):

The funnel of the long elevator (end) is 4815 m.

Ø177.8 mm shank Packer type Thundercat – 4810 m.

Circulation valve – 4792 m.

Ø177.8 mm shank Packer type Thundercat – 4775 m.

Circulation valve – 4739 m

Circulation valve – 4681 m.

The packer of the company "Schlumberger Logelco Inc." type QMAX – 4670 m.

The circulation valve in the long elevator is 4563 m.

The funnel of the short elevator (end) is 4510 m.

Hydraulic packer for parallel double lift type Hydrow II – 4505 m.

Circulation valve – 4459 m.

Hydraulic packer for parallel double elevator type Hydrow II – 4397m.

Circulation valve – 4342 m.

In the lowered two-lift layout, a QMAX type packer (4670 m) was used by Schlumberger Logelco Inc., and all other equipment was used by Weatherford. And for the operation of the well by the gas lift method, the gas lift valves of the Weatherford company were used.

Production well № 156 of the Northern Goturdepe field

The design depth is 4300 m.

The actual drilled depth is 4302 m.

Actual well design:

Ø426 mm – 398 m;

Ø324 mm – 1999 m;

Ø245 mm – 4156 m.

Drilling operations were completed when a depth of 4302 meters was reached with a hole diameter of Ø215.9 mm and the use of drilling fluid with a density of 1.50g/cm^3.

At a depth of 4302 meters, drilling reached the design horizon and the productive horizons of red color IX, NK-1, NK-2 were opened.

In order to prevent indicators of damage to the reservoir properties of productive layers in the hole of Ø215 mm during the cementing process, special filters were planned to be lowered into the open hole. Based on this, in the range of 4147–4298.5 m in the productive horizons NK-1, NK-2 of the lower red color, descent and fastening with 13 special MESHRITE type filters (the length of one filter is 11.65 m) of the company "SchlumbergerLogelco-Inc." were made. For the direct descent of special filters to the design depth, a flushing tubing Ø73 × × 5.5P105 NUE with a stinger on drill pipes was simultaneously lowered inside the filter. The entrance of the upper end of the filter shank into the inside of the Ø244.5 mm technical column for hanging and ensuring the tightness of the upper end of the shank, an ULTRAPAK type packer from Weatherford was used. When planting an ULTRAPAK packer to the required depth, the flushing tubing Ø73 × 5.5P105 NUE with a stinger and drill pipes were lifted.

Layout of the shank filter (top-down):

Packer type "ULTRAPAK" – 4126–4129 m;

Casing pipes Ø139.7 mm.– 4129–4147 m;

Special MESHRITE type filters (13 pieces) – 4147–4298.5 m;

Flushing shoe with two check valves and casing pipe Ø139.7 mm.– 4298.5–4302 m.

After lowering the filter shank to the design depth at an interval of 4000–4012 m. (IX), perforation work was carried out. For the smooth descent of the two-lift line-up into the well, the casing barrel was cleaned with a scraper and a reiber. The long first elevator was planted on the ULTRAPAK type (4127 m) packer shank filter located at the upper end of the Weatherford company, special filters were installed in the interval (4147––4298.5 m) of the productive horizons of the lower red color NK-1, NK-2 and with the descent of the second short elevator to a depth of 3973 m, the de-

velopment was carried out productive horizon IX (4000–4012 m).

In order to ensure the tightness of the tested objects, packers of the Hydrow II type (3968 m) and packers manufactured by Weatherford for single-lift ULTRAPAK tubing were used.And for the operation of the well by the gas lift method, the gas lift valves of the Weatherford company were used.

Production well № 200 of the Northern Goturdepe field

The design depth is 4900 m.

The actual depth drilled is 4662m.

Actual well design:

Ø426 mm – 592 m;

Ø324 mm – 1999 m;

Ø245 mm – 4189 m.

Ø139.7 mm. "shank" – 4170–4332 m. (162 m).

This is the fourth well completed by drilling in the shallow waters of the Caspian Sea. Prior to the start of drilling operations, a special site for the installation of drilling rigs was prepared by the builders of the Turkmenneft concern, having made a road inside the water [2].

Drilling operations were stopped due to the opening of the project horizon (NK-8) at a depth of 4662 meters with a drilling fluid density of 1.50–1.52g/cm^3.

Based on the results of geophysical studies, productive horizons of the red-colored strata IX, NK-1, NK-2 were discovered. According to the research of logging data, a cement bridge was installed in the range of 4332–4490 m and for testing and exploring several productive horizons, the development of the well separately on two elevators, the descent of the operational shank Ø139.7 mm was carried out. The descent and fastening of the Ø139.7 mm operational shank was carried out by special equipment of the Weatherford company. With an entrance of 19 m. (4170 m) of the upper end of the shank Ø139.7 mm into the inside of the Ø244.5 mm technical column, the Weatherford shank suspension system was used to suspend and ensure the tightness of the upper end of the shank. The use of this system when the operational shank Ø139.7 mm was lowered led to an increase in the reliability of the quality of cementing work and the tightness of the upper end. On the Ø139.7 mm operational shank, having carried out perforation work in the intervals of 4192–4198 m, 4204–4216 m, 4288–4292 m. (NK-1, NK-2) productive horizons of red-colored thickness on the first long elevator (H = 4175 m) and Ø 244.5 mm technical column having carried out perforation work in the intervals of 4046–4052 m, 4057–4067 m, 4071––4077 m, 4079–4085 m, 4086–4092 m, 4094––4104 m, 4122–4128 m, 4134–4140 m, (IX) productive horizons of the red-colored thickness in the second long elevator (4040 m.), it was determined to develop the well.

After the perforation work, for the smooth descent of the two-lift line-up inside the well, the casing shaft was cleaned with an Ø218 mm rib. After the preparation of the descending downhole equipment, the descent of the two-lift line-up was carried out in the following order (bottom – top):

Long Elevator funnel (end)– 4175 m;

Hydraulic packer of type "WH-6" for single–lift tubing – 4166 m.;

Circulation valve (in long elevator) – 4147 m.;

Funnel of short elevator (end) – 4040 m.;

Hydraulic packer for double elevator (type Hydrow II) – 4030 m.;

Circulation valve (in a short elevator) – 4014 m.

In order to ensure the tightness of the tested objects, hydraulic packers manufactured by Weatherford were used on two-lift tubing of the Hydrow II type (4030 m) and for single-lift "WH-6". And for the operation of the well with the gas lift method, the Weatherford gas lift valves were used.

The productive horizons of the lower red color NK-1, NK-2 on a long elevator were mastered by the Ø10 mm nozzle in the fountain way, and the productive horizons of the pack IX were mastered by the Ø22 mm nozzle in the gas lift way and a large inflow of oil was obtained [3].

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