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Issue Article

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# REQUIREMENTS FOR STRUCTURES, THE QUALITY OF DRILLING OPERATIONS AND CONTROL OVER THE TECHNOLOGICAL REGIME OF WELLS AND BOREHOLE EQUIPMENT

***Abstract***: *the article discusses the requirements for structures, drilling technology, the method of opening the reservoir and the development of wells on the example of the Altyguyi gas condensate field. The choice and justification of the well design in accordance with the intervals of compatibility of the well section according to mining and geological drilling conditions based on the forecast curves of reservoir pressures and rock rupture pressures (combined pressure graph), as well as methods of primary and secondary opening of productive formations and their development are considered in detail.*

*To monitor the operation of wells, control and measuring equipment and devices for taking wellhead samples of extracted products are installed. The binding of wells should ensure the conduct of a complex of studies: individual measurement of the flow rate of liquid and gas, water content, (echometry, dynamometry, descent of deep instruments, etc.).*

*During the operation of wells, their research is carried out in order to monitor the technical condition of the production column, the operation of equipment, to check the compliance of the parameters of the wells with the established technological regime, to obtain information necessary to optimize these modes.*

*These proposals are necessary for high-quality wiring of wells and their operation.*

***Key words***: *combined schedule, hydro-gas dynamics, inflow profile, gutter system, anti-discharge equipment, bottom-hole zone, backwater overflow, conductor, quaternary deposits, hydraulic fracturing, tack.*

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## Introduction

The drilling depth of production wells on the Altyguyi field along the $NK_9$ horizon, depending on the location of wells in the structure, varies on average in the intervals of the consolidated part of 3750 m, in the krill parts it is 4000 m.

Drilling of wells is planned by the rotary method. All project wells are vertical.

The selection and justification of the well design is 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 pressures and rock rupture pressures (combined pressure graph). And also taking into account the requirements of the "Safety Rules in the oil and gas industry", "Regulations for calculating intermediate columns when drilling wells in the areas of Western Turkmenistan" and geological and technical information, based on proposals to improve technical and economic indicators for previously drilled wells in the field of Altyguyi [1, 2].

The design of production wells with a depth of 3750 m on the productive horizon of NK-9 in the consolidated part has the following form:

- shaft direction of pipes Ø720mm and 10m in length to prevent the erosion of the wellhead and the binding of the wellhead with a trough system for the circulation of drilling mud;

- elongated direction of pipes Ø 530mm and 30m long to overlap the upper unstable part of the section and install anti-blowout equipment, for effective well management during further deepening under the conductor and possible gas occurrences at shallow depths;

- a conductor made of pipes Ø426mm and 400m long for overlapping unstable sandy-clay quaternary deposits and effective well management in case of possible fluid phenomena, using anti-blowout equipment during drilling for an intermediate column;

- the first intermediate column of pipes Ø324mm and 1600m long to reduce the interval of the open borehole when drilling for a technical column, to prevent hydraulic fracturing with an increase in the density of drilling mud.

- the second technical column made of pipes Ø324mm and 3460m long for overlapping formations with high reservoir pressures and in order to increase the density of drilling mud to 2.0 – 2.15 g /cm$^3$, as well as to reduce the risk of seizure of drilling tools and control of anti-blowout equipment in case of possible complications and during drilling for the production column. The casing shoe with adjustment descends to the lower part of the NK-6 horizon;

- an operational column of pipes with a diameter of Ø140 Mm descends to a design depth of 3750 m in order to operate the productive horizon.

The cement is lifted behind all the columns to the wellhead. The combined pressure graph is shown in the figure 1.

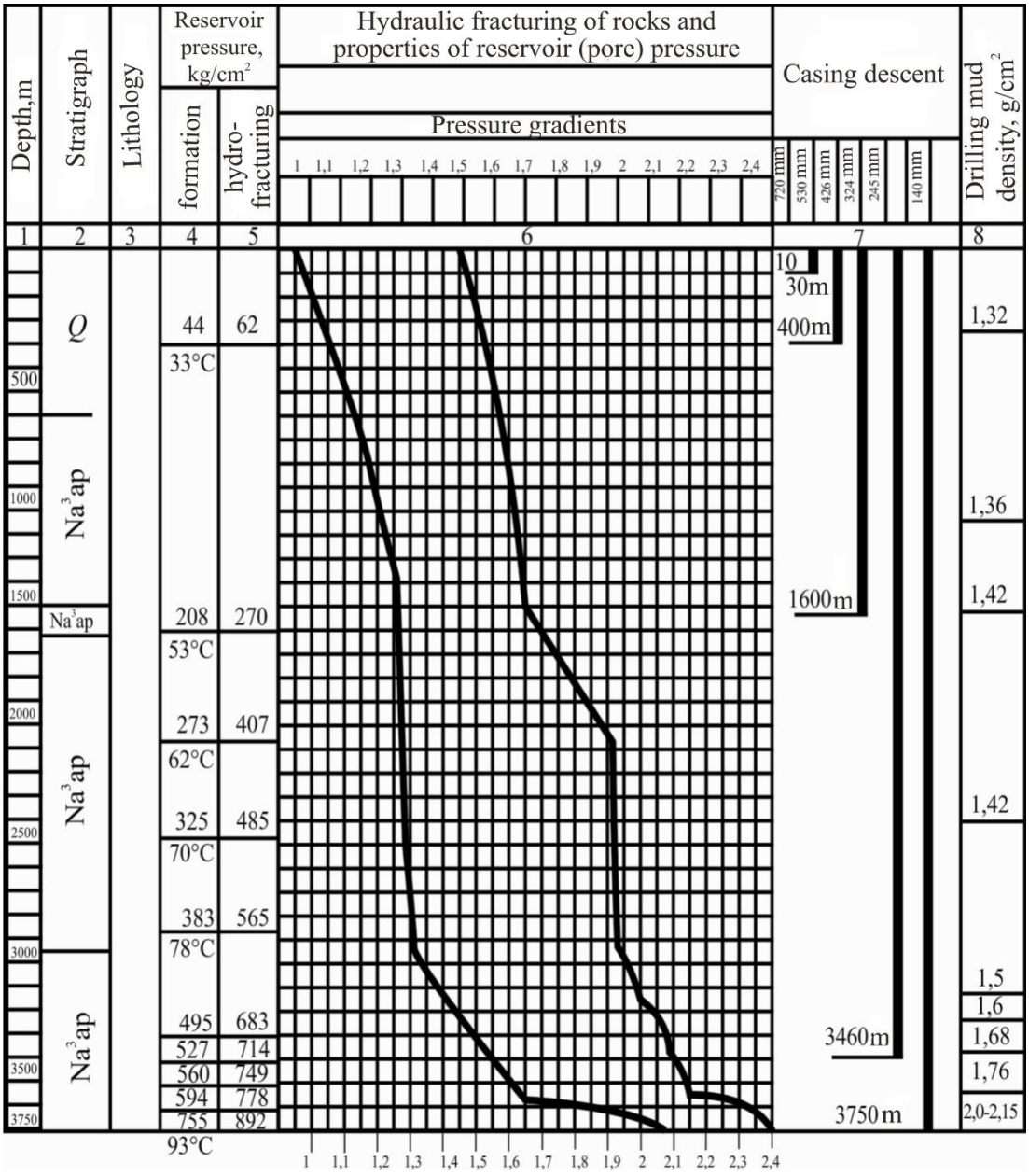


**Figure 1. Combined pressure schedule at the Altyguyi field**

The design of production wells with a depth of 4000 m on the productive horizon of NK-9 in the krill part has the following form:

- the shaft direction of the pipes Ø 720mm descends to a depth of 10m to prevent the erosion of the wellhead and the binding of the wellhead with a trough system for the circulation of drilling mud;

- the elongated direction of the pipes Ø 530 mm descends to a depth of 30 m to overlap the upper unstable part of the section, consisting of loose, sandy-clay deposits, protecting the wellhead from erosion, as well as overlapping the zone of possible gas saturation at shallow depths;

- a conductor of Ø426mm pipes descends to a depth of 600 m into the water pressure horizons to cover the upper unstable part of the section of quaternary deposits, isolate the borehole from hydrostatically connected with the surface of water, secondary gas contamination of rocks due to drainage. As well as installation of anti-blowout equipment for effective well management in case of possible oil and gas occurrences during drilling for the first intermediate column;

- the first intermediate column of pipes Ø 324mm descends to a depth of 2000m to cover quaternary deposits, the Absheron and Akchagyl tiers, parts of the upper section of the red-colored strata, in which hole collapses and absorption of drilling fluid are possible during the well wiring, and also ensures successful well wiring to the depth of the descent of the second intermediate column and effective well management in case of possible gas and oil occurrences with the help of anti-discharge equipment;

- the second intermediate column of pipes Ø245mm descends to a depth of 3750m, ensures successful wiring of the well to the depth of the descent of the production column, as well as effective well management during manifestations, when opening high-pressure gas condensate horizons NK-7 and NK-8 with the help of anti-blowout equipment.

The shoe Ø245 mm of the second intermediate column is installed in a clay bundle, and the installation depth of the shoe is adjusted according to the logging data;

-an operational column of pipes with a diameter of Ø140 mm descends to a design depth of 4000 m, provides the necessary conditions for testing productive layers and carrying out repair and insulation work. The final depth of the descent of the production column is adjusted according to GDS (gas-dynamic studies) data.

The cement is lifted behind all the columns to the wellhead.

Drilling of wells for the conductor is planned to be carried out on an oil-emulsion humate-lignosulfonate drilling mud, for intermediate and operational columns - on a polymer, cement-inhibited drilling solution ALKAR-3 according to the recipe of the institute "Nebitgazylmytaslama" [3].

In the process of drilling production wells, core sampling, as a rule, is not designed. The selection of individual core samples can be planned in order to study their filtration properties and develop measures for their effective (pollution-free) opening.

Separate studies of formations during drilling and by other methods can be planned and performed in order to clarify reservoir pressures, hydraulic fracturing pressures and properties of reservoir (pore) pressure [3, 4].

It is planned to use water-based clay solutions weighted with barite and treated with chromlignosulfonate reagents and inhibited with cement for well wiring.

For the construction of wells, drilling rigs of the normal BU-5000 series are required on a diesel drive - Uralmash-ZD and diesel-electric -ZJ 70 DS.

Drilling rigs, in addition to the equipment included in the kit, must also be equipped with complete anti-blowout installations and additional equipment for the preparation, cleaning and storage of weighted drilling fluids in desert conditions.

When drilling, rigid layouts of the bottom of the drill strings are used according to the regulations developed by the drilling technology laboratory of the institute "Nebitgazylmytaslama". Recommended layouts prevent the curvature of the borehole. Their use does not require additional templating and drilling of the borehole before the descent of the casing strings.

For drilling boreholes, it is recommended to use high-performance 3- roller-bit of the MS-TSGAU, MS-TSGVU and S-TSGVU series. The adjustment of the operating parameters is carried out in accordance with the technical project or geological and technical order (GTO).

In the course of drilling, complex geophysical studies of wells are planned.

The research package includes: standard logging, cavernometer, profiler, side logging, gamma logging, neutron logging, acoustic logging, thermometry, inclinometer. Logging operations are carried out on a scale of 1:500 for all holes.

In order to achieve the greatest technological effect, the filtration and rheological properties of the solution are adjusted. To open a productive object, the drilling mud is subjected to special treatment in order to reduce its water output and give the filtrate properties that prevent contamination of the formation.

Protection of the formation from contamination during secondary opening is achieved by perforating the column under conditions of a given depression on the formation with the help of PKO-86 perforators (on drilling mud) or "Paurget", "Enerzhet" (on water), followed by smooth (in order to avoid destruction of the hole zone) launching the object into operation according to the technology of the institute

"Nebitgazylmytaslama" [6].

In order to study the nature of changes in the oil and gas value of formations and for the most complete recovery of reserves in the process of developing oil and gas deposits, it is necessary to carry out complex hydro-gas dynamic, field-geophysical and laboratory studies.

Control over the development of oil and gas deposits, the condition and operation of wells and downhole equipment should include the following minimum of research on existing producing wells:

- systematic and periodic control measurements and determinations of reservoir, bottom-hole and wellhead pressures. Bottom-hole pressure should be measured in the form of one-time studies for all new producing wells and after they are out of repair, as well as systematically in existing wells at least twice a year. Determination of reservoir pressure should be carried out in the form of one-time studies on all wells that have opened productive formations (including in the legal area), after their exit from drilling or repair work and systematically in operating producing wells at least once a half-year; studies by the method of established sampling should be carried out as one-time for all new wells, as well as for existing wells before and after repairs, geological and technical measures (GTM) related to changes in the state of the bottom-hole zone, and systematically for existing producing wells at least once every two years;

- studies of wells by the pressure recovery method are carried out in the form of one-time studies on all new producing wells, as well as wells that have come out of repair and systematically on existing producing wells at least once every two years.

In addition, the dynamics of changes in current and accumulated oil, water and gas production is monitored for the deposit as a whole, for individual layers, sections, and individual wells [7]. For wells opening multi-layer objects, pressure recovery studies should be carried out simultaneously with studies of the inflow profile by the geophysical service:

- the study of inflow profiles should be carried out as one-time studies on all new producing wells and after GTM associated with the impact on the bottom-hole zone, and systematically on existing wells equipped for the production of depth measurements at least once a year.

- These studies can be carried out either in combination with studies using the method of steady-state sampling and pressure recovery, or independently:

- monitoring of the position of the WOC, GOC and GWC measurements of oil and gas saturation should be carried out using a set of geophysical methods for observation wells, wells of the reference network at least once a half-year, as well as for producing wells in the GTM process;

- determination of the sources and intervals of watering, opened by perforation, is carried out both in the process of studying the inflow profiles, and independently when watering the production of wells;

- determination of the temperature along the trunk of a working well is carried out selectively for individual wells at least once a year;

- determination of reservoir and bottom-hole temperature is carried out in the process of measuring bottom-hole and reservoir pressure at least once a half-year;

- inspection of the condition of production columns should be carried out according to the fund of producing wells in the process of repair, GTM and suspected defect formation. The study reveals the damage to the columns, the condition of the cement ring and the location of the column flows;

- revision of gas lift valves and determination of the place of gas input into the lift is recommended to be carried out after the descent of the elevator and in case of a sharp decrease in the flow rate of the well;

- deep oil sampling and their subsequent analysis should be carried out on specially selected reference wells, the total number of which should be at least 5% of the total fund of producing wells;

- it is recommended to take wellhead samples of oil, gas and condensate to determine physicochemical properties in surface conditions once a year through the wells of the reference network.

The analysis of geological and field materials shows that there are a number of wells in the operational fund with hydrodynamic imperfections in the degree and nature of the opening of the productive reservoir. When drawing up a project for the development of gas condensate deposits of the field in order to increase the productivity of wells, it is recommended to determine the objects of completion and shooting of the productive horizon in the gas environment with enhanced charges [8, 9].

To increase the productivity of low-flow wells, it is recommended to conduct clay acid treatments of the bottom-hole zone of the formation and hydraulic fracturing.

Based on the obtained positive results of using the method of simultaneous operation of wells, the Altyguyi deposit in the pipe and annular space is also recommended to continue its implementation in low-flow wells.

During the operation of wells, their research is carried out in order to monitor the technical condition of the production column, the operation of equipment, to check the compliance of the parameters of the wells with the established technological regime, to obtain information necessary to optimize these modes.

a) the technical condition of the well and the installed equipment is checked (tightness of the cement stone, casing and tubing, condition of the bottom-hole formation zone, contamination of the borehole, pump supply, operation of valves installed at depth and other devices);

b) the compliance of the operating parameters of

the installed equipment with the production capabilities of wells and the specified technological regime is checked;

c) the reliability and operability of the equipment units is evaluated, the inter-repair period of the equipment and the well is determined;

d) information is obtained that is necessary for planning various types of repair and restoration and other work in wells, as well as for establishing the technological effectiveness of these works.

The types, volume, and frequency of studies and measurements in order to monitor the operation of equipment for all methods of well operation are established by oil and gas production departments together with research organizations and geophysical enterprises in accordance with the recommendations of project documents and approved by the management of the association [10].

Research on monitoring the operation of producing wells should be carried out in full compliance with the safety rules in the oil and gas industry, in compliance with the requirements of subsurface and environmental protection.

The documents regulating the scope, methods and technology of research are the existing mandatory complexes, instructions and other guidance documents on technological, hydrodynamic and laboratory studies, observations and operations.

Materials for monitoring the operation of equipment are systematically analyzed and used by the engineering service of oil and gas producing enterprises to ensure the established technological modes of operation of the well.

All primary research materials are subject to mandatory storage throughout the entire period of well operation (except for echograms and dynamograms, the shelf life of which is set at least three years).

The comprehensive implementation of the above measures will allow maintaining gas production at the Altyguyi field at the project level [11].

For the idle and inactive fund of oil wells and for the fund of wells under development after drilling, it is recommended to carry out works on their restoration, development and commissioning: well returns to the above and below horizons, water isolation works based on a complex of geophysical studies of wells (GSW), inspection of production columns, extraction of emergency tubing and packers. All work on the wells should be carried out taking into account the GSW materials carried out during the repair process. During repairs, it is necessary to apply new technologies ("Slickline" technology, flexible tubing, etc.) [12].

The timing of repair work will be determined by many factors, both geological (the development of the operated facility, the absence of nearby wells at the return facility, the results of testing it at this site, etc.) and technical (the condition of the well, the availability of the necessary equipment, etc.), therefore, it is not possible to predict them for specific wells in the future. The possibility and expediency of the work, and the timing of their execution will be determined during the operation of the field specifically for each well.

Recently, a large amount of work has been carried out at the Altyguyi field on the geochemical determination of the composition of oil, gas and condensate, as well as hydrodynamic studies. The results obtained made it possible to determine the reserves of condensate and free gas, as well as their calculated parameters.

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