Impact Factor:					
	ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
	ISI (Dubai, UAE) = 1.582	РИНЦ (Russia) = 3.939	PIF (India) = 1.940
	GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
	JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

SOI: 1.1/TAS DOI: 10.15863/TAS

International Scientific Journal

Theoretical & Applied Science

p-ISSN: 2308-4944 (print) **e-ISSN:** 2409-0085 (online)

Year: 2023 **Issue:** 11 **Volume:** 127

Published: 03.11.2023 **http://T-Science.org**

Issue Article

Annaguly Rejepovich Deryaev
Scientific Research Institute of Natural Gas of the State Concern „Turkmengas”
Doctor of Technical Sciences, Principal researcher,
Corresponding Member of International Academy of Theoretical and Applied Sciences,
Ashgabat, Turkmenistan
annagulyderyayew@gmail.com

THE TECHNOLOGY OF DRILLING DEEP AND DIRECTIONAL WELLS WITH ELECTRIC DRILLS IN THE AREAS OF THE WESTERN PART OF TURKMENISTAN

Abstract*: The article discusses the technology of drilling deep vertical and directional wells with electric drills on the Goturdepe area. The analysis of geological and technical conditions of hole drilling, changes depending on the depth of reservoir temperatures and pressures, as well as the choice of well design and parameters of the operating mode of electric drills at depth intervals in order to successfully complete the projected wells with complex mining and geological conditions for drilling.*

To analyze the choice of technology for drilling deep vertical and directional wells with electric drills on the Goturdepe area, materials of previously operated wells, geological and operational characteristics of fields and the guidance document "Technology of drilling oil and gas wells", as well as safety rules in the oil and gas industry were used. This paper provides a detailed analysis of the complexity of drilling deep vertical and directional oil and gas wells and their specific causes, as well as recommendations for choosing the design of wells and parameters of the operating mode of electric drills for depth intervals.

Such work can be used to perform the assigned tasks when drilling oil and gas wells by electric drilling in fields with complex mining and geological characteristics.

Key words*: electric drill, telemetry system, curvature mechanism, formation, thickness, incision, strength, abrasiveness, power.*

Language*: English*

Citation: Deryaev, A. R. (2023). The technology of drilling deep and directional wells with electric drills in the areas of the western part of Turkmenistan. *ISJ Theoretical & Applied Science, 11 (127)*, 18-22.

Soi: http://s-o-i.org/1.1/TAS-11-127-6 ***Doi***: crossref https://dx.doi.org/10.15863/TAS.2023.11.127.6

Scopus ASCC*: 2209.*

Introduction

The technology is designed for drilling deep and directional wells with electric drills E290, E240, E215, E190 (E185), 164 bits in diameter, respectively, 490; 394; 295,3; 269,9; 144,5; 215,9; 190,5 mm with the use of gearboxes-inserts, curvature mechanisms, telemetry systems and layouts of the bottom hole assembly (BHA) with stabilizers, centralizers and calibrators.

The technology includes drilling of exploration, production and directional wells in compliance with the requirements, techniques and operations for their hole drilling and consists of the following main processes [1, 2]:

- drilling for a conductor;
- drilling for two intermediate columns;
-drilling for the production column, including the opening of productive horizons in the Koturdepinsky formation of the lower section of the red-colored strata;
-opening and sinking of the drained horizons of the Absheron-Akchagyl and Upper red-colored deposits.

Geological and technical conditions of the hole drilling.

a) Lithological and stratigraphic characteristics of the section being opened.

b) In the lower part of the Absheron tier there are two packs of high-grade colloidal soda clays “black clays” spread with siltstone lintel, with a total capacity of 150 to 250 m. Their Schreiner hardness does not exceed 100-300 MPa.

c) Up to the depth of the “black clays”, 75% of the section is composed of rocks whose strength exceeds 500 MPa according to Schreiner, and 25% have a strength of 800 MPa. The part of the section lying below the “black clays” is composed of rocks with a Schreiner hardness of 200-1500 MPa [3, 4].

d) The strength and abrasiveness of rocks correspond to the use of chisels of types M, MS, S at loads per unit length of the diameter of the bits from 2 to 10 kN / cm.

Changes in reservoir pressures and temperatures with depth:

a) Up to the roof of the “black clays” reservoir pressures are normal. Formation pressure gradients do not exceed 0.0115 MPa/m;

b) in the interval of occurrence of “black clays”, the gradients of pore pressures, according to geophysics, do not exceed 0.0115 – 0.014 MPa/m. At this stage of drilling operations, drilling fluids with a density of 1.45 – 1.50 g/cm^3 are used for opening and sinking these intervals [5, 6]. The stability of the borehole is not provided with a lower density of drilling mud.;

c) the pressure of reservoir fluids in sediments lying below the “black clays” is abnormally high, the gradients of reservoir pressures vary from 0.0120 - 0.0130 MPa/m to 0.2 – 0.23 MPa/m in the sole of the red–colored thickness in the roof of the underlying red-colored thickness of sediments [7, 8];

d) the main productive objects in the area (in the supracolor and upper red-colored deposits) are drained. Low gradients of reservoir pressures in them (0.006 MPa/m) cause complexity of the design and technological process [9, 10];

e) reservoir temperatures in wells up to 5000 m deep reach 110 C.

To the drained horizons of the Absheron-Akchagyl and Upper red–colored deposits, the temperature gradient is 0.031 - 0.021 S/m.

Well construction

Technical projects should provide for the following typical well designs:

a) for drilling exploration wells in the eastern section of the Goturdepe area: a conductor with a diameter of 426 mm, 1 intermediate column with a diameter of 324 mm, an intermediate column with a diameter of 245 mm, an operational column with a diameter of 140 x 168 mm -5200 m; - for drilling production wells in the eastern section of the Goturdepe area: a conductor with a diameter of 426 mm - 100 m - 600 m, 1 intermediate column with a diameter of 324 mm - 1500 m - 2500 m, II intermediate column with a diameter of 245 mm - 3500 m - 3900 m, an operational column with a diameter of 168 mm - 4250 m - 4400 m, direction with a diameter of 324 mm - 30 m, conductor with a diameter of 245 mm - 600 - 800 m, operational column 140 mm - 2700 m .wells with a depth of 2700 m in the eastern part of the area and 1700 m in the western part are drilled both vertically and obliquely directed [11, 12, 13].

b) For drilling production wells in the western section of the Goturdepe area: conductor with a diameter of 324 mm – 600-800m, intermediate column with a diameter of 245 mm - 2200-3200 m, production column with a diameter of 140 mm - 3200-3800 m, direction with a diameter of 426 mm - 30 m, conductor with a diameter of 299 mm - 60 m, "shank" with a diameter of 219 mm - 500- -1500 m, an operational column with a diameter of 140 mm -1700 m [14, 15].

Electric drill testing mode

To ensure the implementation of the established work program, it is necessary to install such a power supply mode for the electric drill motor, which would ensure its operation in the nominal mode, if there are no restrictions related to the strength of the gearbox insert. These restrictions are carried out by reducing the value of the supply voltage. It is also allowed to slightly reduce the voltage against the nominal voltage and in the case when an electric drill with a gear-insert provides a preset mode of operation of the bit at this reduced voltage, see Table 1.

The choice of voltage at the terminals of the secondary winding of the TMTE-560/6 transformer for powering the electric drills used, depending on the drilling depth, should be made in accordance with the table in which the no-load currents of the electric drill corresponding to these voltages and depths are also given [16, 17].

Table 1. Parameters of operation of electric drills by depth intervals

Drilling interval, m	Type of electric drill	Voltage on the transformer, V	Idle current, A	Inrush current, A
0		1700	80	277
1000	3290 – 12r (i =3,15)	1700	78	260
2000		1800	90	260
2800		2000	98	268
0		1500	78	312
1000	3240 – 8r (i =3)	1550	80	303
2000		1700	90	309
3000		1850	100	302
4000			98	274
below		2000	110	280
600		1350	65	279
1500	3215 – 8r (i = 3)	1500	76	283
100		1350	65	279
1000		1500	76	283
2000	3190 – 8r (i =2,92)	1750	95	274
3000		1850	103	264
4000		1950	112	257
1300		1200	61	180
1700	3164 – 8r (i =2,92)	1200	61	180

Layout of the bottom hole assembly (BHA)

a) The layout of the BHA includes: a bit, a super-drill centralizer, a calibrator, an electric drill with an insert, a centralizer, a device for controlling the trajectory of wells, a telemetry system of the STE, a device for monitoring the insulation of the electric drill system-a current supply of the UKI type (UKIO), weighted drill collar (DC), drill pipes, a check valve, a leading pipe, pantographs, swivel. In all elements of the layout from the electric drill to the current collector, cable sections of the current supply of the electric drill are mounted. Wells with a depth of 1,700 m in the eastern part of the area and 4,100 in the western part are drilled both vertically and obliquely [18].

b) the role of centralizers when drilling with electric drills with a diameter of 215 mm, 240 mm and 290 mm is performed by 3 blades welded to the body of the electric drill. The blade has a length of 300 m and a width of 60 mm. The first three blades are welded to the body of the electric drill in its lower part (on the spindle), and the second - in the upper part at a distance of 10 m from the first "centralizer". The third centralizer is installed at a distance of 10-12 m from the device for monitoring the insulation;

c) the diameters of the blade centralizers are designed to be 3-5 m smaller than the diameter of the bit used for drilling and are equal to 485, 390, 292 mm for bits with a diameter of 490; 393.7; 295.3 mm, respectively;

d) for electric drills with diameters of 164, 190 mm (185 mm) (when drilling with bits with diameters of 190.5 and 215.9 mm), the centralizers are not welded. When drilling wells with these electric drills 1, the centralizer (calibrator) is installed on the shaft of the electric drill under the gearbox insert at a distance of 1.5-2.0 m from the bit. A smaller distance is accepted for the electric drill E-164, a larger one - for the electric drill E190-8r.

e) the following BHA are recommended [19, 20]:

- a bit Ø 190.5 mm + an electric drill Ø 164 mm with a centralizer on a spindle Ø 189 mm + a centralizer Ø 189 mm + a device for monitoring the insulation + a DC Ø 146 mm - 10-12 mm + a centralizer Ø 189 mm + a DC Ø 146 mm (by calculation) + drill pipes Ø 127 mm.

- a bit Ø 215.9 mm + an electric drill a bit Ø 190 mm (185 mm) with a centralizer a bit Ø 214.3 mm on a spindle at a distance of 1.5-2.0 m from the bit + a centralizer a bit Ø 214.3 + a device for monitoring the insulation + DC Ø 146 mm - 10-12 m + a centralizer Ø 214.3 mm + DC Ø 146 mm (by calculation) + drill pipes Ø 127 mm.

f) when drilling wells with electric drills, drill pipes inside the ends steel drill pipes with a diameter

of 114, 127, 140 mm with cable sections of the type: KST-1; KST-1-T; KST-11 are used.

g) as a weighted bottom, a DC with a diameter of 146-254 mm of design length with cable sections KST P or KST – 1 is provided [21, 22].

h) in order to control the insulation resistance of the "Electric Drill-current supply" system, an insulation monitoring device of the UKI type (UKIO) must be included in the drill string layout.

f) the set of curvature and stabilization of the angle of the directional section of the borehole is carried out using the telemetry systems STE-164 and STE-215:

- when drilling a section of a set of curvature, a BHA is used - a bit + an electric drill with mechanism of curvature (MC) + STE + DC Ø 146 (178 mm) - by calculation and drill pipes [23, 24];

-if an additional set of zenith angle is required, the centralizer is installed above the chisel, and when the zenith angle is reduced, the centralizers are installed above the electric drill;

i) the recommended parameters of the hole profile of directional wells on the Goturdepe area are given in Table 2.

Table 2. Recommended parameters of the borehole profile of directional wells on the Goturdepe area

Parameters of the borehole profile	The western section of the square	The eastern section of the square
The length of the vertical section, m	900	1000
Curvature set interval, m	900 – 975	1000 – 1070
Zenith angle of curvature, deg	26	11
Radius of curvature in the interval of zenith angle set, m	380 – 400	380 – 400
Horizontal deviation of the borehole	400	335

References:

1. Deryaev, A.R. (2022). Zadachi issledovaniya dlya metoda odnovremennoj razdel'noj ekspluatacii mnogoplastovyh mestorozhdenij. *Innovacionnye nauchnye issledovaniya* №2-2(16) Ufa: Nauchno-izdatel'skij centr “Vestnik nauki”. pp. 43–51.
2. Zajcev, S.I., Kanyuga, A.P., Pronina, M.I., et al. (1978). Metodika opredeleniya fil'tracionnyh parametrov plasta po nachal'nomu uchastku KVD. *Neftyanaya i gazovaya promyshlennost'*. № 2. Kiev, pp.33-36.
3. Deryaev, A.R. (2022). *Sovremennoe sostoyanie izuchennosti bureniya napravlennyh i mnogozabojnyh skvazhin s razdel'noj ekspluataciej odnovremenno neskol'kih gorizontov (zarubezhnyj opyt).* Sbornik statej mezhdunarodnogo nauchno-issledovatel'skogo konkursa “Akademicheskaya nauka na sluzhbe obshchestvu”. Petrozavodsk: Nauchnoe izdanie: MCNP “Novaya nauka”. pp.170-178.
4. (1976). *Metodika podbora diametrov nasadok gidromonitornyh dolot s uchetom glubiny skvazhiny i parametrov nazemnogo oborudovaniya*. M.: VNIIBT.
5. Kendin, S.N. (1994). *Sposob izolyacii pogloshchayushchih plastov*. Patent Rossijskoj Federacii, klass E21V 33/13 № 2014433.
6. Kameneckij, S.G., Kuz'min, V.M., & Stepanov, V.P. (1987). *Nefte promyslovye issledovaniya plastov*. (p.224). M.: Nedra.
7. Leonov, E.G., & Isaev, V.I. (1987). *Gidroaeromekhanika v burenii*, (p.304) – M.: Nedra.
8. Deryaev, A.R. (2022). Rekomendacii po kompleksnomu vnedreniyu s razdel'noj ekspluataciej odnovremenno neskol'kih gorizontov na gazovyh mestorozhdeniyah Turkmenistana, *Problemy nauki* №1(69) – M: Izdatel'stvo “Problemy nauki”. pp.16-21.
9. Deryaev, A.R. (2022). Tekhnologicheskie i tekhnicheskie problemy, svyazannye s provodkoj gorizontal'nyh skvazhin elektroburom i puti ih resheniya. *UNIVERSUM; Tekhnicheskie nauki* №1 (94) chast' 3 – M: Izdatel'stvo “MCNO”. pp.46-49.
10. Kokaev, V.N., Izmajlov, L.B., & Kononova, L.B. (1980). *Vliyanie zheloboobrazovaniya na vybor konstrukcii glubokih skvazhin.* (pp.2-4). M.: VNIIOENG, seriya “Burenie”, vyp.7.
11. Deryaev, A.R., & Orazklychev, K. (2015) *Sposob odnovremenno-razdel'noj dobychi nefti i gaza iz mnogoplastovoj zalezhi odnoj skvazhinoj*. Patent № 644 ot 08.06.2015. (nomer zayavki 15/101320).

12. Deryaev, A.R., & Orazklychev, K. (2015) *Sposob odnovremenno-razdel'noj i sovmestnoj ekspluatacii neskol'kih produktivnyh gorizontov odnoj skvazhinoj i ustrojstvo dlya ego osushchestvleniya*. Patent № 643 ot 08.06.2015. (nomer zayavki 14/101317).
13. Deryaev, A.R. (2022). Osobennosti bureniya naklonno-napravlennyh skvazhin i tekhnologiya ih odnovremennoj razdel'noj ekspluatacii. *"Fundamental'naya i prikladnaya nauka: sostoyanie i tendencii razvitiya".* Monografiya. (pp.76-96). Petrozavodsk: Nauchnoe izdanie: MCNP "Novaya nauka".
14. Deryaev, A.R. (2022). Ohrana nedr i okruzhayushchej sredy pri razrabotke gazovyh mestorozhdenij metodom odnovremennoj razdel'noj ekspluatacii. *Nauchnyj zhurnal Metod Z* №2(4) – Sankt-Peterburg: Izdatel'stvo: GNII «Nacrazvitie», pp.12-14.
15. Makovej, N. (1986). *Gidravlika bureniya*. Perevod s rumynskogo. (p.536) M.: Nedra, 16.
16. Deryaev, A.R. (2022). *Rekomendacii po burovomu rastvoru dlya bureniya sekcii 295,3 mm otkrytogo stvola naklonno-napravlennoj skvazhiny*. Sbornik statej II Mezhdunarodnoj nauchno-prakticheskoj konferencii "Nauka, obshchestvo, tekhnologii: problemy i perspektivy vzaimodejstviya v sovremennom mire". (pp.7-11). Petrozavodsk: Nauchnoe izdanie: MCNP "Novaya nauka".
17. Mirzadzhanzade, A.H., & Entov, V.M. (1985). *Gidrodinamika v burenii*. Moskva: Nedra.
18. Mishchevich, V.I., & Sidorov, N.A. (1973). *"Spravochnik inzhenera po bureniyu",* (p.376), M.: Nedra.
19. Malevanskij, V.D. (1963). Vybor dliny promezhutochnyh kolonn na mestorozhdeniyah s bol'shim etazhom gazonosnosti. *Neftyanaya gazovaya promyshlennost'*. Seid-Rza M.K. №1, pp. 31–32.
20. Kendin, S.N., & Hamraev, K.D. (1999). *Sposob stroitel'stva skvazhin*. Patent Turkmenistana klass E21V 33/12, № 262.
21. Deryaev, A.R. (2022). Provedenie promyslovyh ispytanij kompleksnoj ingibirovannoj dobavki KAIR-T na neftegazovyh ploshchadyah Turkmenistana. *Problemy sovremennoj nauki i obrazovaniya* №1(170) – M: Izdatel'stvo "Problemy nauki", pp.11-17.
22. Mudrov, V.I., & Kushko, V.L. (1983). Metody obrabotki izmerenij. (p.304), M.: *Radio i Svyaz'*.
23. Orlov, A.V., & Bliznyukov, V.Yu. (1987) *Opredelenie glubiny spuska obsadnyh kolonn pri proektirovanii konstrukcii skvazhin graficheskim sposobom*. M.: VNIIOENG, seriya "Burenie", vyp.11, pp. 23-25.
24. Deryaev, A.R. (2022). *Analiz sovremennogo sostoyaniya metoda odnovremennoj razdel'noj ekspluatacii skvazhin*. Sbornik statej III nauchno-prakticheskoj konferencii "Science and technology research:". (pp.22-29). Petrozavodsk: Nauchnoe izdanie: MCNP "Novaya nauka",