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:** 02 **Volume:** 118
Published: 28.02.2023 **http://T-Science.org**

Issue Article

Annaguly Rejepovich Deryaev
Scientific Research Institute of Natural Gas of the State Concern „Turkmengas"
Candidate of Technical Sciences, Senior Researcher,
Ashgabat, Turkmenistan
annagulyderyayew@gmail.com

A BRIEF SCIENTIFIC AND PRACTICAL OVERVIEW OF THE DRILLING OF A DIRECTIONAL WELL ON THE WESTERN CHELEKEN FIELD

Abstract: *The article discusses the experience of drilling in Turkmenistan of a directional production and evaluation well in order to restore oil production from an inactive field in the coastal zones of the coastal waters of the Caspian Sea.*

This work can be used and useful for the development of fields in difficult-to-develop shallow waters and to reduce costs during their drilling, as well as to increase the volume of oil produced in order to develop the field in an accelerated manner, without increasing the oil recovery coefficient.

Key words: *azimuth, conservation, displacement, vertical, along the hole, intensity, combined schedule, drilling mode, downhole, wellhead.*

Language: *English*

Citation: Deryaev, A. R. (2023). A brief scientific and practical overview of the drilling of a directional well on the western cheleken field. *ISJ Theoretical & Applied Science, 02 (118),* 189-192.

Soi: http://s-o-i.org/1.1/TAS-02-118-18 ***Doi***: crossref https://dx.doi.org/10.15863/TAS.2023.02.118.18

Scopus ASCC: *2209.*

Introduction

In accordance with the Program for the Development of the oil and gas industry of Turkmenistan, for the period up to 2052, all employees of the oil and gas industry have specific tasks for the successful implementation of large-scale projects of the country's oil and gas sector.

The wise economic policy of the President of Turkmenistan, Serdar Berdimuhammedov, is based on the principles of channeling the vast natural resources and economic power of the country to ensure a happy life for the Turkmen people.

On behalf of the Leader of the Nation, Chairman of the Halk Maslahaty of Turkmenistan Gurbanguly Berdimuhammedov, the development of shallow waters of the coastal part of the Caspian Sea began in 2008.

In order to increase oil and natural gas production, in accordance with the purpose of ensuring a reliable resource base, it is planned to increase efficiency through the introduction of new technologies and methods during the necessary volume of exploration, exploration and deep operational evaluation drilling operations. The experience gained during the construction of a directional exploration well in southwestern Turkmenistan made it possible to conclude that drilling operations can be carried out on the fields located in the shallow waters of the Gulf of the Caspian Sea with the help of directional wells with a deviation of the bottom a long distance from the vertical.

In 1991, the Caspian Sea flooded the Western Cheleken field with a tide. For the purpose of ecology and non-pollution of the marine water area, all existing wells were in conservation. To resume the development of the field, it was necessary to drill new operational and evaluation directional wells and drilling of these wells began in 2022.

The purpose and objective of these works was to resume the development of the field and with a reduction in capital investments for drilling, as well as strictly observe the ecology of marine pollution [1, 2].

Directional production and evaluation well No. 707 on the West Cheleken square was laid with a

design vertical depth of 2620 meters (along the hole of 2764.37 meters) in order to assess the reserve of hydrocarbon raw materials and increase oil production, with the use of advanced technology from foreign companies. In order to implement this project, the geological data of previously drilled wells were analyzed. Drilling of the well was designed to be carried out from the land with a vertical shaft to a depth of 1650 m . From a depth of 1650 meters, drill with an obliquely directed trajectory with an azimuthal angle within 250-260 degrees to the water part of the Caspian Sea. The maximum intensity of the change in the zenith angle according to the design profile is 1.8 degrees by 30 meters. According to the calculation of reaching the design depth, the maximum zenith angle was 39 degrees. With these calculations, the displacement from the vertical to the roof of the productive reservoir according to the design profile was 450.85 m and the total length of the directional section was 1114.37 m. Drilling was carried out on a ZJ70DS type drilling rig manufactured by the People's Republic of China.

The project for the construction of exploration well No. 707 with a depth of 2620 m (vertical) 2764.37 m (along the hole) at the field in question was developed on the basis of a combined pressure graph in drilled wells and calculations of the hole trajectory. That is, the guide shaft with a diameter of Ø708 mm was lowered to a depth of 7 m (vertically) and secured with rubble concrete. An elongated direction with a diameter of 508 mm was lowered to a depth of 50 m, to overlap weakly cemented sandstones. The conductor Ø=339.7 mm was lowered to a depth of 800, to overlap unstable layers of the horizons of Absheron, akchagil and unstable water layers, as well as possible gas layers of the upper part of the horizon of the red-colored thickness. The technical column Ø=244.5 mm was lowered to a depth of 2100 m vertically and along the hole of 2119 m, for overlapping in water and possibly gas layers of the middle, lower horizons of the red-colored thickness, as well as for the purpose of controlling anti-discharge equipment in case of possible gas and oil occurrences. The operational column Ø = 139.7 mm, descended to a depth of 2620 m vertically and along the hole 2764 m.

Drilling up to 800 m was carried out vertically on an oil-emulsion lignosulfonate drilling mud with a density in the range of 1.40-1.47 g/cm^3 and fastening with a casing string of 339.7 mm was carried out. The parameters of the drilling mud were adhered to within the following limits: conditional viscosity 40-60 in 30 seconds, conditional water yield 10-12, clay crust thickness 2-3 mm, static shear voltage in 1-10 minutes 30-60, alkalinity pH 9-9.5, total mineralization 13-15.

Drilling mud preparation was carried out with seawater. In order to maintain the design parameters of the drilling mud, 20 kg of soda ash was added to the drilling mud for drilling 1 m of cement stone when drilling the cement cup of the conductor. According to the norm, in order to retain the lubricating properties of the drilling mud, oil was added per 1m of 40 kg penetration [3, 4, 5].

Before the conductor was lowered into the well, the drilling mud was treated with concentrated chemical reagents, and the borehole was worked out with rigid layouts of the bottom of the drill strings in order to unhindered descent and attachment of the conductor to successfully achieve the design depth of the drilled well [6, 7].

Drilling for a technical column with a diameter of 244.5 mm vertically from a depth of 800 m to a depth of 1650 m on a Versadril type hydrocarbon-based drilling mud with a density in the range of 1.47-1.68 g/cm^3 and fastening with a 339.7 mm casing string. The parameters of the drilling mud are given in Table 1.

Table 1. Parameters of the drilling mud of well No. 707 on the Western Cheleken field

Drilling mud parameters	**800 m replacement**	**800 m – 2100 m (vertical) 800 m – 2119 m (by hole)**	**2100 m – 2620 m (vertical) 2119 m – 2764 m (by hole)**
Diameter of the borehole, mm	D_c=339,7 mm	D_b=311,0 mm	D_h=215,9 mm
Density, g/cm^3	1,40 – 1,47	1,47 – 1,61 – 1,68	1,74 – 1,81
Conditional viscosity, sec	40 – 60	40 – 60	45 – 80
Statistical shear voltage Q_{10} at 10 sec. Q_{10} at 10 min	 8 – 20 9 – 25	 8 – 20 9 – 25	 10 – 30 10 – 35
Plastic viscosity, η, sPz	20 – 35	20 – 35	30 – 45
Dynamic shear attraction, τ_0, dPa:	15 – 25	15 – 25	20 – 35
Angle of rotation on the device "OFITE", deg: φ^0= 3 rpm φ^0= 6 rpm. φ^0= 300 rpm. φ^0= 600 rpm.	 6 – 10 8 – 12 35 – 60 55 – 95	 6 – 10 8 – 12 35 – 60 55 – 95	 7 – 20 8 – 25 50 – 80 80 – 125
Water output in 30 minutes, in the device "Fann", B, cm^3.	5 – 2	5 – 2	5 – 2
Clay crust, K, mm.	< 0,5	< 0,5	< 0,5
Hydrogen index, pH	9 – 10	9 – 10	9 – 10

Total solid phase, (%)	13	14	33
Total carbon phase , (%)	70	70	54
Total water phase , (%)	17	16	13
Hydrocarbon/water ratio	80/20	80/20	80/20
Electrical stability (Volts)	400 – 1500	400 – 1500	500 – 1500
Calcium content (%, weight)	5 – 8	5 – 8	5 – 8
Chloride content (%, weight)	3 – 6	3 – 6	3 – 6

Further deepening of the well from a depth of 1650 m to a depth of 2100 m vertically 2119 m along the hole was performed obliquely with a set of zenith angle of 27 degrees and azimuth of 250 degrees, while the displacement of the hole from the vertical was 103.69 m.

The deepening of the well under the production column with a diameter of 139.7 mm from a depth of 2100 m vertically 2119 m along the hole to a depth of 2620 m vertically 2764 m along the hole was performed obliquely with a finite set of zenith angle of 39 degrees and azimuth of 260 degrees. At the same time, the displacement of the hole from the vertical was 491.2 m. Drilling of the interval was carried out with a hydrocarbon–based drilling fluid of the Versadril type with a density in the range of 1.67 - 1.81 g/cm^3. The parameters of the drilling mud are given in Table 1.

The Versadril system is one of the best systems for drilling clays, where the stability of the hole is the main criterion. In addition, this system operates at high temperatures up to 180-190 °C and has more improved rheological properties. The “Versadril” system has a very low water output [8].

In all intervals drilling was carried out with the rotary method in the following modes:

- in the interal from 0 m to 50 m under the elongated direction: axial load 4 – 6 t.ef., rotor rotation 30 – 40 rpm, drilling mud consumption 58 l/sec;
- in the interal from 50 m – up to 800 m under the conductor: axial load 10 – 16 t.ef., rotor rotation 60 – 100 rpm, drilling mud consumption 42 l/sec;
- in the interal from 800 m to 1650 m, the vertical part of the technical column: axial load 10 – 14 t.ef., rotor rotation 60 – 100 rpm, drilling mud consumption 41 l/sec;
- in the interal from 1650 m – up to 2119 m in the section of the zenith angle set for the technical column: axial load 5 – 10 t.ef., rotor rotation 120 – 130 rpm, drilling mud consumption 41 l/sec;
- in the interal from 2119 m – up to 2764 m for the production column: axial load 5 – 10 t.ef., rotor rotation 120 – 130 rpm, drilling mud consumption 28 l/sec;

Profile data of the borehole No. 707 on the Western Cheleken area are shown in Table 2.

Table 2.

Title	Depth (m)	Zenith angle (degree)	Azimuth (degree)	Vertical depth (m)	Offset (m)
Wellhead	0,00	0,0	0,0	0,0	0,0
Ø339,7 mm	800	0,0	250,0	800	0,0
Angle set interval	1650	0,0	250,0	1650	0,0
Interval stabilization	2100	27,0	250,0	2083,53	103,69
244.5 mm	2118,49	27,0	250,0	2100,0	112,05
Angle set interval	2150,0	27,0	250,0	2128,08	126,30
Interval stabilization	2388,64	39,0	260,0	2328,0	255,63
Entrance to the roof of the formation	2700,04	39,0	260,0	2570,0	450,86
Final depth	2764,37	39,0	260,0	2620,0	491,19

The actual drilling of the well with amendments was brought up to 2764.37 m (along the hole).

In the process of drilling this well, geological and technological studies (GTI) were regularly carried out. They control drilling parameters, assess the overall situation, select reservoirs in cross-section and determine their saturation state, as well as prevent accidents [9, 10].

The station consists of three main modules:

− technological (real-time drilling monitoring);

− gas logging module (recording the total volume of gas content and analysis of the composition of gas impurities);

− geological module (operational analysis of core, sludge, drilling fluids and reservoir fluids) [11].

When drilling a well, the maximum displacement of the bottom was 491.19 m with a magnetic azimuth of 260°, the maximum zenith angle at a depth of 2764.37 m was equal to 39.0°. As a result of the development of the third facility, an inflow was received with a maximum total flow rate of 30 tons /day.

Directional production and evaluation well No. 707 on the Western Cheleken area has successfully fulfilled its goal, confirming the oil and gas potential of this section of the field without additional costs for

materials and time for the construction of an offshore platform [12]. A directional exploration well was drilled with a significant offset from the bottom, creating an opportunity for further acceleration of work on the field site in the Caspian Sea and hard-to-reach places.

Conclusion

1. By drilling an obliquely directed well, the goal has been achieved and the resumption of development of the mothballed field has begun.

2. This drilling method has cost-effectively reduced the cost of installing an expensive offshore platform.

3. Safe well management prevents the danger of pollution of the marine area.

4. This method is acceptable to apply in hard-to-reach areas that exist on the earth's surface with old infrastructure, as well as in marine areas.

References:

1. Deryaev, A.R. (2022). *Tekhnologiya bureniya naklonno-napravlennoj skvazhiny s razdel'noj ekspluataciej odnovremenno neskol'kih gorizontov na mestorozhdenii Severnyj Goturdepe.* Materialy 83-j Mezhdunarodnoj nauchno-prakticheskoj konferencii “Aktual'nye voprosy nauki”. (pp.30-35). Moscow: OOO Izdatel'stvo Sputnik +.
2. Deryaev, A.R. (2022). *Opredelenie nabora plastov dlya odnovremennogo, razdel'nogo i sovmestnogo ispol'zovaniya naklonnoj skvazhiny na mnogoplastovom mestorozhdenii Severnyj Goturdepe.* Materialy 83-j Mezhdunarodnoj nauchno-prakticheskoj konferencii “Aktual'nye voprosy nauki”. (pp.26-29). Moscow: OOO Izdatel'stvo Sputnik +.
3. Deryaev, A.R. (2022). *Burenie naklonno-napravlennyh skvazhin s burovym rastvorom na uglevodorodnoj osnove «Versadril».* Sbornik statej po itogam Mezhdunarodnoj nauchno-prakticheskoj konferencii “Razvitie nauki i tekhniki: mekhanizm vybora i realizacii prioritetov”. (pp.95-100). Sterlitamak: Nauchnoe izdanie: “Agentstvo mezhdunarodnyh issledovanij”.
4. Deryaev, A.R. (2022). *Rekomendacii po bor'be s pogloshcheniem pri burenii naklonno-napravlennyh skvazhin*. Sbornik statej Mezhdunarodnoj nauchno-prakticheskoj konferencii “Instrumenty i mekhanizmy sovremennogo innovacionnogo razvitiya”. (pp.62-65). Ufa: Izdatel'stvo OOO “Omega sajns”.
5. Deryaev, A.R. (2022). *Burenie naklonno-napravlennyh skvazhin s burovym rastvorom na uglevodorodnoj osnove.* Sbornik statej po itogam Mezhdunarodnoj nauchno-prakticheskoj konferencii “Razvitie nauki i tekhniki: mekhanizm vybora i realizacii prioritetov”. (pp.95-100). Sterlitamak: Nauchnoe izdanie: “Agentstvo mezhdunarodnyh issledovanij”.
6. Deryaev, A.R. (2022). *Komponovka niza buril'noj kolonny dlya bureniya napravlennoj skvazhiny pri odnovremenno-razdel'noj ekspluatacii*. Sbornik statej VII Mezhdunarodnoj nauchno-prakticheskoj konferencii “Aktual'nye voprosy, dostizheniya i innovacii”. (pp.61-67). Penza: Nauchnoe izdanie: MCNS «Nauka i prosveshchenie».
7. Deryaev, A.R. (2012). *Burenie naklonno-napravlennyh skvazhin na mestorozhdeniyah Zapadnogo Turkmenistana.* Nebitgazylmytaslama institutynyň makalalar ýygyndysynyň 2-nji (29) goýberilişi, (pp.267-276). A: Türkmen döwlet neşirýat gullugy.
8. Deryaev, A.R. (2022). *Kreplenie naklonno-napravlennyh skvazhin dlya osvoeniya sposobom odnovremenno razdel'noj ekspluatacii. «Innovacii v nauke, obshchestve, obrazovanii» monografiya*. (pp.53-77). Penza: Nauchnoe izdanie: MCNS «Nauka i prosveshchenie».
9. Deryayev, A.R. (2022). Basic requirments and features of well drilling technology for dual completion of several horizons. *European Journal of Technical and Natural Sciences*, №5 - Vienna: Publishing: “Premier publishing”, pp.21-23.
10. Deryayev, A.R. (2022). Development of a hydrocarbon buffer fluid system and field testing. *International Journal of Current Research* vol.14, issue 08 - India - Deli: Publishing: “International Journal of Current Research”, pp.22109-22112.
11. Deryayev, A.R. (2022). Determination of physical properties of oil and gas for field development by dual completion. *Danish Scientific journal*, №64 -Copenhagen V Denmark: Publishing: “Danish Scientific journal”, pp.48-50.
12. Deryayev, A.R. (2022). Determination of the properties of reservoir fluids and gases for the development of multi-layer deposits by dual completion. *German International Journal of Modern Science*, №42 -Satteldorf. (pp.28-31). Germany: Publishing: “Artmedia 24”.