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Issue Article

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ECONOMIC EFFICIENCY OF THE CONSTRUCTION OF A MULTI-BRANCH WELL USING THE BIRCH LEAF TECHNOLOGY AS AN ALTERNATIVE TO FISHBONE

Abstract: *Today the priority task for the oil and gas industry is to increase the oil and gas recovery of reservoirs. As an alternative to reservoir development, instead of hydraulic fracturing technology, it is proposed to apply a new technology for the construction of multi-branch horizontally inclined wells - «Birch Leaf». The paper considers the possibility of using and calculates the economic effect of the introduction of a new technology of intensification of inflow for Uzbekistan.*

Key words: *Economic effect, «Birch Leaf», «Fishbone», multi-branch well, horizontally branched wells.*

Language: *English*

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Introduction

The relevance of the growth in hydrocarbon production is also evidenced by the decree of the President of the Republic of Uzbekistan No. 4388 dated July 9, 2019 – «On measures to provide the economy and the population with stable energy resources, financial rehabilitation and improvement of the management system of the oil and gas industry» [1]. The key point of the resolution is the issues of improving the operational efficiency of oil and gas companies and the possibility of introducing advanced technologies into the oil and gas industry. Also, realizing the importance and necessity of developing the oil and gas industry, on May 24, 2022, the President made a speech on expanding oil and gas production, reducing costs by increasing operational efficiency, and also considered the possibility of introducing advanced technologies into the oil and gas industry. According to experts, most of the reserves have recently moved into the category of hard-to-recover.

To develop reservoirs with hard-to-recover reserves and increase their efficiency, it is necessary to use modern methods to intensify the flow of fluid into the well. This usually includes the construction of high-tech wells with multistage hydraulic fracturing (fracking) and the use of new methods to displace oil residues that cannot be extracted by traditional methods.

According to experts, most of the reserves in recent decades have been transferred to the category of «hard to recover», which leads to a reduction in the number of oil and gas wells with "simple" geological characteristics that could give a high indicator of hydrocarbon production when drilling vertical or inclined wells. The current situation calls for the introduction of modern and effective methods to increase or at least restore the initial production volume.

One of the modern methods of intensification of reservoir fluid inflow is the Birch Leaf technology. This technology is a control technology for mechanical drilling of radial channels in a horizontal well. Thus, a multi-branch well is obtained, from the horizontal trunk of which numerous branches branch off, which also have their own branches. The trajectory of branches from horizontal trunks in this technology resembles the shape of a birch leaf, which is reflected in the name of the technology.

The design of the Birch Leaf technology is assembled on the surface of the well before work begins. The equipment is compact in size and presents

no difficulties during assembly. This is one of the advantages of this technology, unlike hydraulic fracturing technology, which requires the use of large-sized machinery and a significant number of working personnel. When using this method, less process fluid is required than when using hydraulic fracturing, which reduces the need for its disposal and the risks of entering groundwater. [10]

The Birch Leaf technology was created in contrast to Fishbone. Rosneft PJSC unique project for the construction of the Birch Leaf well took first place at the All-Russian competition «New Idea 2020». The project was implemented by specialists of Taas-Yuryakh Neftegazodobycha and Tyumen Petroleum Research Center. The Birch Leaf well is named so for its similarity to a tree leaf. This world's first 15-bore multi-branch horizontal well, each of which branches off into 2 more shafts, was drilled at the Srednebotuobinskoye field [5, p. 55]. A drilled well using this technology makes it possible to effectively cover all kinds of gas and oil traps, thereby contributing to the effective development of this field [7, p. 12]. It is important to note the fact that the initial flow rate of the well amounted to 401.5 tons of oil per day, which is significantly higher compared to other technologies for the construction of multi-hole wells providing high flow rate. [10]

It is also worth noting that thanks to the technology, an increase in annual gas and condensate production is projected by 4.01 and 1.82 times according to the Birch Leaf technology, respectively, and by Fishbone - by 3 and 1.62 times relative to a "simple" horizontal well.

The object of the research is the Yuzhnaya Tandyrcha gas condensate field (GCF), located in the Bukhara-Khiva oil and gas region of the Republic of Uzbekistan on the territory of the Guzar district of the Kashkadarya region. It was discovered in 1982 during geological exploration, which revealed the industrial gas content of carbonate Upper Jurassic deposits confined to the horizons XV-HP, XV-P and XV-PR. The field has its own geological features: low permeability of the reservoir, different piezo conductivity in layers and gas-water contact, which causes a high risk of waterlogging. The cracks are mostly filled with calcite or dolomite, and open cracks are rare. The leaching process leads to the formation of large cavities. These factors limit the possibilities for the application of standard measures to intensify the production of natural gas and condensate. [9]

Currently, hydrocarbon production is carried out using hydraulic fracturing, however, this method of development has the following disadvantages, which determines the choice of an alternative method for intensifying the flow of fluids into the well:

- Significant costs due to the need for a large number of equipment and maintenance personnel.
- The process of hydraulic fracturing takes from several days to several weeks (in the case of multi-stage hydraulic fracturing).
- The main disadvantage of hydraulic fracturing is the lack of the possibility of accurate crack formation in the required plane. This is due to the unpredictability of the direction of action of the total stress vector in the rock. This vector is conventionally decomposed into a vertical and two horizontal components. It cannot be said unequivocally that today there are no such techniques that would not be able to determine the maximum possible direction of the vectors. However, they are quite expensive and require statistical evidence within the studied areas. Based on the above, it can be concluded that, using hydraulic fracturing, there is a risk of encountering well flooding and gas occurrence. This is a consequence of the uncontrolled passage of cracks through the corresponding formation.
- Environmental hazard – due to the presence of chemical additives in the hydraulic fracturing fluid, soil contamination occurs. [3]

The construction of multi-hole horizontal wells makes it possible to solve the problem of low reservoir productivity based on existing wells. Wells are considered to be multi-boreholes, from which branching trunks are drilled to solve various technical and geological problems. Any multi-hole well is directional, because drilling a new branch requires deflecting the trunk from the original direction. Horizontally branched wells are a type of multi–hole wells, because they are carried out in similar ways, but in the final drilling interval, the zenith angle is adjusted to 90°.

The use of horizontal technology allows to solve the following tasks:

- The number of wells in the field is decreasing, which is especially important when developing deposits on the shelf. Onshore infrastructure construction is also declining;
- Production volumes are increasing, oil recovery is increasing;
- Wells are flooded much more slowly;
- Effective work with formations with low permeability, with lenticular deposits, with large vertical fracturing;
- Simple and reliable pressure maintenance inside the reservoir. [3]

All calculations were carried out using the horizontal gas condensate well 84 of GKF Yuzhnaya Tandyrcha. The well was commissioned in 2017. The design depth of the well vertically is 2,317 m and along the trunk is 2,763 m. The vertical depth of the roof of the productive gas reservoir is 2,234 m. The length of the horizontal section is 300 m. The borehole is not secured with casing pipes. Collector type – pore-fractured. [4]

The initial gas production of the well in question in the first year of operation amounted to 15,494.3

thousand m^3/year, and 227.1 tons/year for gas condensate. In 2023, gas production was 54,978.3 thousand m3/year, and gas condensate production was 5,497.8 tons/year. In the future, the projected production will decrease year after year by an average of 8.4% for gas and 12% for condensate.

Table 1 presents a comparative analysis of the technical and economic indicators of the use of Birch Leaf and Fishbone technologies for 2024-2032. capital investments in technology in the economic model of the project paid off due to an increase in volumes of natural gas and condensate, which amounted to 896,526.8 thousand m3 and 6,090.3 tons, respectively, according to Fishbone.

According to the data of the Uzbek Republican Commodity Exchange JSC, the price of gas is 340 thousand soums/thousand m^3 with VAT and condensate is 4500 thousand soums/ton. In order to return investments, from 2025 to 2028, it is planned to escalate the sale price of natural gas in the amount of 10%, from 2029 to 2030 - 15%. From 2031 to 2032, the price escalation will be 20%. Thus, at the end of 2032, the sale price of natural gas will amount to 948.0 thousand soums per thousand cubic meters. The condensate price was calculated in the same way. [2]

Table 1. Technical and economic indicators for the use of Birch Leaf and Fishbone technologies for 2024-2032

Name of indicators	Unit of measurement	Birch leaf	Fishbone	Difference
Natural gas growth	thousand m^3	1 006 749,63	896 526,80	12,3%
Condensate growth	tons	6 554,69	6 090,3	7,6%
Gas sales price	thousand soums/thousand m^3	In 2024 – 340 In 2032 – 948		
The selling price of condensate	thousand soums/tons	In 2024 – 4500 In 2032 – 12 547,07		
Revenue from the sale of growth	million sums	567 386,26	485 004,1	17,0%
Investment costs	million sums	109 704,48	74 230,00	47,8%
Operating costs	million sums	154 015,90	90 795,00	69,6%
Tax liabilities	million sums	152 421,94	154 035,00	-1,05%
Cash flow	million sums	127 104,76	165 944,10	-23,4%
Discounted cash flow (10%)	million sums	59 399,56	25 159,40	136,1%
The payback period of the project	years	4,00	3,00	
IRR		31%	35,8%	

Source: made by the author based on MS Excel data

Investments in the amount of 74,230.0 million soums are represented by the total cost of Fishbone technology and logical operations related to the transportation of technology. Investments are being invested simultaneously in full in 2024. In 2024, investments at Birch Leaf include equipment, a program and a well, the rest of the amount is distributed over the years.

While calculating the economic efficiency from the use of the Birch Leaf technology, the period from 2024 to 2036 was considered, which is associated with the industrial development of the field under study.

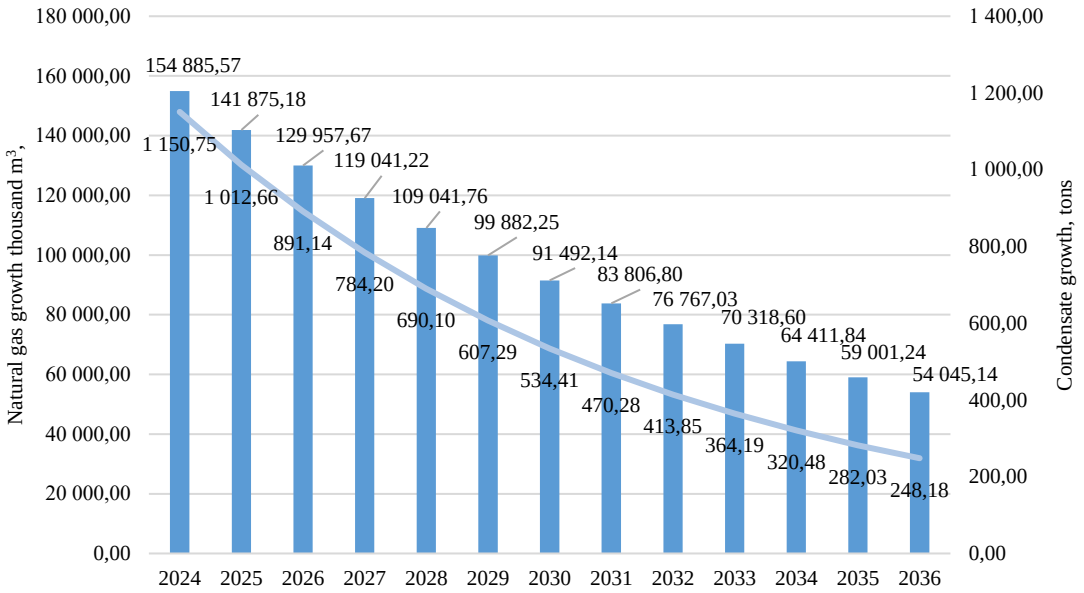

Figure 1. The volume of natural gas and condensate production from 2024 to 2036, taking into account the introduction of the Birch Leaf technology

Source: made by the author based on MS Excel data

Figure 1 shows the dynamics of natural gas and gas condensate growth. There is a falling production of 8.4% for gas and 12% for gas condensate annually. The volume of hydrocarbon growth for 2024 is calculated based on the volumes as of January 1, 2023. As a result, the increase in gas in 2024 will amount to 154,885.57 thousand m^3, and in condensate – 1,150.7 tons.

Table 2. Technical and economic indicators in the application of Birch Leaf technologies for 2024-2036

Name of indicators	Unit of measurement	Meaning
Natural gas growth	thousand m^3	1 254 526,45
Condensate growth	tons	7 769,57
Revenue from the sale of growth	million sums	962 048,80

Source: made by the author based on MS Excel data

Table 2 shows the volume of growth over 13 years for gas (1,254,526.45 thousand m^3) and condensate (7,769.57 tons), as well as revenue from sales of an increase of 962,048.8 million soums.

Table 3. Structure of operating costs from 2024 to 2036

Name of indicators	Units of measurement	Meaning	Specific gravity
Operating costs	**million sums**	**255 884,67**	**100%**
Gas production costs	million sums	235 229,24	91,9%
Condensate production costs	million sums	10 921,64	4,3%
Polymer drilling mud costs	million sums	7 728,80	3,0%
Electricity costs	million sums	2 004,99	0,8%

Source: made by the author based on MS Excel data

The operating costs will amount to 255 884.67 million soums. The structure of operating costs is presented in Table 3. The standard costs for the production of one thousand cubic meters of gas amount to 77.6 thousand soums, which increases annually in direct proportion to the selling price. The total cost of gas production is 235,229.24 million. The standard variable cost of condensate growth is 683.2 thousand soums/ton, which also increases as the selling price. Gas production costs account for a large share (91.9%).

Table 4. Tax deductions to the budget of the Republic of Uzbekistan for the period 2024-2036

Name	The tax rate	Value (million soums)	Specific gravity
Income tax	15%	47 170,52	15,6%
VAT	12%	103 076,66	34,2%
Property tax	1,5%	7 021,39	2,3%
Subsoil tax	15%	144 307,32	47,9%
Total taxes		**301 575,89**	**100%**

Source: made by the author based on MS Excel data

Tax deductions, which include property tax, income tax, VAT and subsoil tax, were calculated in accordance with the current legislation of the Republic of Uzbekistan in the field of taxation during the technical and economic calculations for the project. Based on the design data, as well as taking into account the specific cost of gas and condensate production at the actual level of 2023, in the variant taking into account the acquisition of technology at the expense of Uzbekneftegaz JSC's own funds, the following results were obtained, presented in Table 4.

The amount of taxes paid from 2023 to 2036 for the implementation of the project will amount to 301,575.89 million soums. At the same time, the largest share in the structure of tax deductions to the budget of the Republic of Uzbekistan for the project for the entire forecast period is the payment of subsoil tax (47.9%), followed by VAT (34.2%). The smallest share is taken by the property tax in the amount of 2.3%.

The gross financial result obtained from the difference in sales revenue, VAT, operating expenses and depreciation for the entire forecast period is 476,792.76 million [6]. In 2025, it decreased by 9% due to the inclusion of depreciation (10,524.56 million), then there is an average increase of 8%. The cash flow generated by the difference between net profit and capital investments is negative in 2024, then positive. Over the entire period of the project, the cash flow indicator will amount to 278,293.53 million soums. The average value of the increase is 13%. Discounted cash flow with the introduction of the technology at a discount rate of 10% will amount to 872 956.64 million soums. The payback period of the project will be 5 years with an internal rate of return of 29%. [8]

Analyzing the data obtained, it can be concluded that the proposed technology is more cost-effective compared to Fishbone and, accordingly, there is a need for its implementation.

Scientific supervisor: PhD in economics, associate professor Otto Olga Edgarovna

References:

1. (2024). *Resolution of the President of the Republic of Uzbekistan No. PP-4388 09.07.2019. "On measures for the stable provision of the economy and the population with energy resources, financial rehabilitation and improvement of the management system of the oil and gas industry."* [Electronic resource], Retrieved 13.02.2024 from https://lex.uz/docs/4410281
2. (2024). *Uzbek Republican Commodity Exchange JSC.* [Electronic resource] Retrieved 15.02.2024 from https://uzex.uz
3. (2024). *Drilling of multi-hole horizontally branched wells. SNK.* [Electronic resource] Retrieved 04.04.2024 from http://snkoil.com/press-tsentr/polezno-pochitat/burenie-mnogozaboynykh-gorizontalno-razvetvlennykh-skvazhin

4. (2016). *Group work project for the retrofitting of the Yuzhnaya Tandyrcha gas condensate field.* JSC "O'ZLITINEFTGAZ", (p.135). Tashkent.
5. Bliznyukov, V.Yu., Bliznyukov, Yu.N., Bliznyukov, V.Yu., & Duzhik, S.A. (1991). *Improving the designs of deep wells*. (p.84). Moscow: VNIIOENG. (Review. inform. Ser. "Construction of oil and gas wells on land and at sea").
6. Basovsky, L.E., & Basovskaya, E.N. (2022). *Economic assessment of investments: A textbook*, (p.241). Moscow: INFRA-M.
7. Akulov, N.I., & Valeev, R.R. (2016). Features of the geological structure of the Srednebotuobinsk oil and gas condensate field. Iz*v. Irkutsk State University. Series: Earth Sciences*, 2016, vol. 18, pp. 3-13.
8. Vilensky, P.L., Livshits, V.N., & Smolyak, S.A. (2015). *Evaluation of the effectiveness of investment projects. Theory and practice: Textbook* - 2nd ed., reprint. and additional. (p.888). Moscow: Case.
9. Minnivaleev, T.N., & Khonimkulov, B.A. (2024). *Technology of construction of the birch leaf well as an alternative to the "fish bone" technology.* Innovative aspects of the development of science and technology. [Electronic resource] Retrieved 15.02.2024 from https://cyberleninka.ru/article/n/tehnologiya-stroitelstva-skvazhiny-berezovyy-list-kak-alternativa-tehnologii-fish-bone/viewer
10. (2024). *The Birch Leaf project took the first place at the All-Russian competition "New Idea". Rogtec.* [Electronic resource], Retrieved 13.02.2024 from https://www.rogtecmagazine.com/proekt-berezovyj-list-zanjal-pervoe/?lang=ru