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Assessment of Drilling Operation, and Efficiency of Multilateral Wells (Based on the West Absherov Field)

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Abstract

The article provides a detailed justification for the improvement of traditional technologies for drilling wells and development systems in accordance with the development plan of the West Absheron field. It is noted that the most optimal option for modern technologies and approaches to field development is drilling horizontal and multilateral wells in order to effectively develop recoverable oil and gas reserves and stimulate field production. Drilling and exploitation such wells has also been found to be more cost-effective. Thus, the optimal number and type of wells from existing and new platforms have been determined to ensure effective field development.

Keywords: reservoir, horizontal wells, production, drilling, multilateral wells, well completion

Introduction

The Western Absheron field is located in the north-western part of the Absheron archipelago. Industrial oil in the field was first extracted in 1985 during the testing of exploration well No. 35. In 2006, wells 57, 173, 174, 175, and 176 were drilled by the Khazar-6 floating drilling rig and put into conservation because the transmission lines were not ready. The wells were put into operation on 12.01.2011 after the completion of the construction of jacket No. 57 in 2011 and the construction of lines to transport oil to the consumers. Wells drilled from rig No. 120 were put into conservation in 1989. After the overhaul of the jacket, wells 120, 123, 124, 126, 127, and 128 were reconstructed and put into operation on 02.02.2012. At present, 80 wells have been drilled in the field, of which 50 are in operation. The field produces 810 tons of oil per day. The processing rate is up to 1% (Figure 1). The main exploitation objects are QD and QA formation groups. As of 01.01.2021, 495.8 thousand tons of oil were extracted from the QD formation and 254.8 thousand tons from the QA formation. The total residual oil reserves of the GD formation are 6750.2 thousand tons, dissolved gas reserves are 1133.8 million m^3. The total residual oil reserves of the QA formation are 4,858,200 tons, and the dissolved gas reserves are 875.3 million m^3.

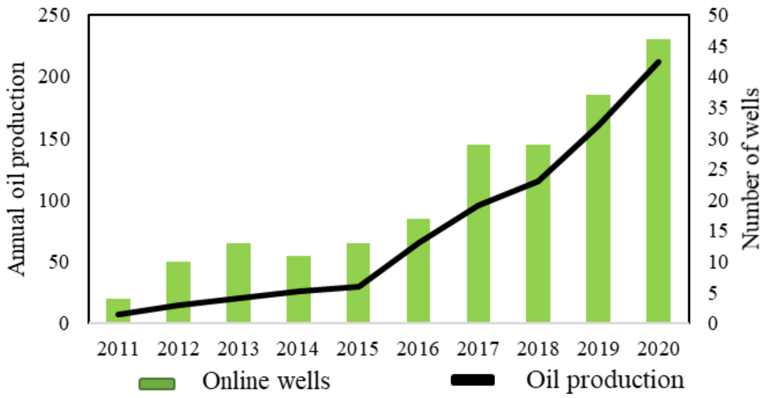

Figure 1 . Number of wells and production dynamics over the field

As can be seen, the resource utilization rate in the field is 6.8% for the QD formation, 5% for the QA formation, and only 6.1% for the field. This shows that, given the future growth of oil reserves, it will take a long time to complete the development of the field at this production rate (Ehlig-Economides et al., 1996; Yusufzade, 1995). From this point of view, there is a need to apply a new development system and technologies to ensure the efficient development of the field (Yusufzade, 1995; Hariri et al., 2012).

To intensify production and increase the efficiency of development from the central block of the field horizontal wells were drilled in 2015 from rigs No. 20, No. 54, and No. 10. A total of 50 wells were drilled from these fixed platforms, including 45 horizontal and 1 multilateral well. At present, 24 wells produce QA formation, 25 wells produce QD formation, and 1 multilateral well produce both QA + QD formation. The length of the horizontal filter on the wellbore is 80-100 m. The average daily oil production of these wells is 16.2 tons/day. This stage can be marked as the beginning of the period of innovation in the development of the field. Thus, compared to 2015, production in the field has increased 7.3 times over 5 years (Figure 1).

Materials and methods

The beginning of the second innovative phase of the field development is the multilateral well No. 19 drilled in February 2021 which has been noted for its high production rate. Thus, after it was determined that the formation pressure at QD and QA formations was equal to 1160.3 psi, multilateral well No. 19 was drilled in the central block of the field with two laterals and designed for joint development of QA and QD formations (Figure 2). The main well was drilled to a depth of 786 m with a deviation of 321,265° azimuth to the QA formation, the lateral well was drilled from 608 m depth with 240° azimuth, and deviation of 249 m to the QD formation to a depth of 722 m. The completion filter on the QA formation was set at 772-662 m (110 m), and the filter on the QD formation was set at 692-630 m (62 m) depth.

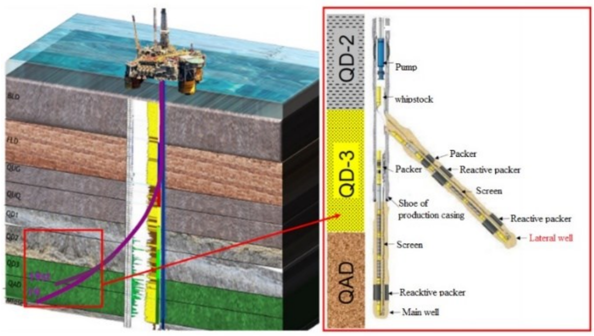

Figure 2 . Schematics of well No19

The production rates for the first well in the field are described in the graph below (Figure 3). As can be seen from the graph, the well operates with a stable oil production of 28-29 tons/day. However, it should be noted that according to the results of production analysis of surrounding wells (wells 8, 17, 22, 64, 144, 146), the average daily oil production of wells from the QD formation is 15 tons/day, the average daily oil production from wells from the QA formation equal to 12 tons/day. Multilateral well No. 19 produced an additional 1,200 tons of oil during its operation compared to the surrounding wells. Taking into account the actual production figures of the well, the production forecast until 2040 was calculated in the three-dimensional model of the field and compared with other completion options (Figure 4).

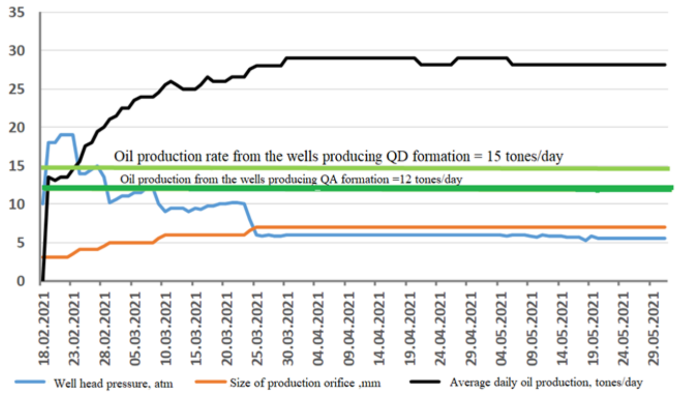

Figure 3. Development parameters of multilateral well 19.

With the current method of completion, the total oil production of the well by 2040 is 114,000 tons, the total oil production is 86,000 tons if both wells are operated from the QD formation, and the total oil production is 84,000 tons if the well is completed from the QA formation and returned to the QD formation, in the case of completion of two horizons (QA + QD) with one lateral, the total oil production is projected at 100 thousand tons. At the same time, the capital costs of the well do not differ significantly from other options, and the income from the well is projected to be 1.5-3 times higher than other options, which indicates that diversified wells to be drilled in the field in the future will have higher economic efficiency (Neskoromnykh, 2012; Salas et al., 1996).

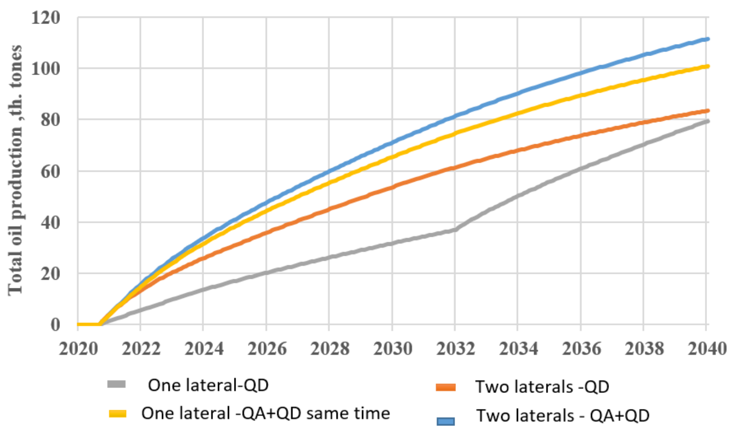

Figure 4. Comparison of the production forecast in the multilateral well 19

Taking into account the above, it is proposed to drill this type of multilateral wells from existing and future foundations to ensure the efficient development of the Western Absheron field (Figure 5).

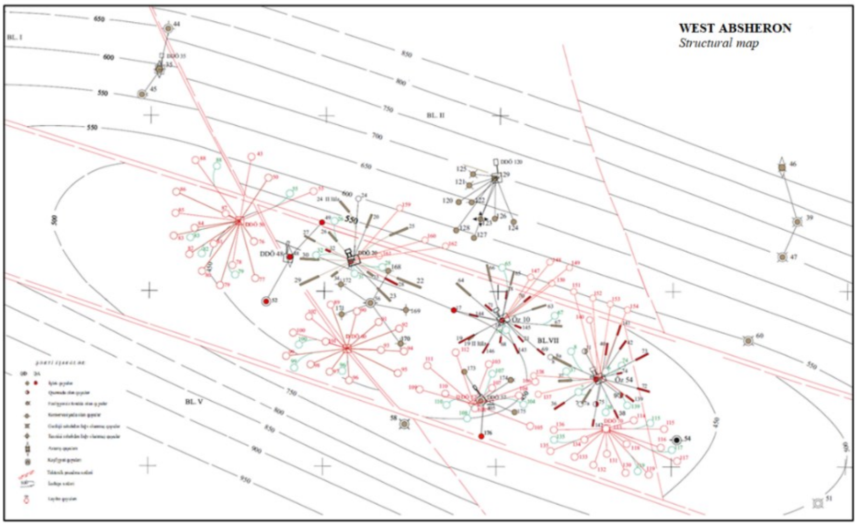

Figure 5. Perspective drilling map of the Western Absheron field.

To ensure full-scale development of the field, a new development scenario has been developed based on a three-dimensional model and based on the development results of well No. 19. In addition to the existing foundations, it was considered to build and put into operation 3 new foundations (50, 60, 70) in the field and to drill a total of 31 horizontal and 12 multilateral wells from these foundations. It is proposed to expand rig No. 57 by drilling an additional 6 horizontal and 4 multilateral wells, and an additional lateral well from 15 existing horizontal and 14 drilled wells. This development strategy is considered the most optimal option for current technologies and modern development systems (Golenkin et al., 2017; Salas et al., 1996; Eliseev et al., 2016).

Results and discussions

From the results of the comparative analysis, it was determined that the drilling of multilateral wells is more efficient to ensure the efficient development of the Western Absheron field. The production performance of multilateral well No. 19 drilled in the field is twice higher than the production performance of other wells. This will increase the intensity of production and increase the efficiency of development. In this regard, it is proposed to drill this type of multilateral wells from existing and future offshore platforms in the field. At the same time, it is recommended to consider the possibility of drilling a lateral well in existing operational wells where geological and technological aspects allow to do so. Drilling laterals reduce the number of casing strings lowered in upper sections thus noticeably the expenses for well constructions and field development reduce.

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