Post-Evaluation Feedback Mechanism of Geological Oil Reservoir Engineering

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Abstract. Post evaluation of oilfield productivity construction project is a comprehensive work. Reservoir engineering project, as the hardcore of entire post evaluation, is the basis of oil production and surface engineering project post evaluations. The feedback effect of post evaluation on reservoir engineering project has two points: later adjusting on block evaluated and guidance for reservoir engineering project design. It has important significance to oilfield development adjusting that accomplishing feedbacks well of post evaluation work and information.

Key words: Post evaluation; Reservoir engineering; feedback effect.

1. Introduction
The post-evaluation of the oilfield capacity construction project is a comprehensive work, it conducts comprehensive and systematic analysis and evaluation for data and information related to the preliminary work, construction process, and production operation of the capacity construction project, final benefits and impacts, project sustainability, and other parts of the project cycle. The design plan of reservoir engineering is the basis for oilfield capacity construction, which is the basis for drilling and production engineering and surface engineering design, and it plays a vital role in oilfield capacity construction. As an important part of the post-evaluation of oil and gas capacity, oil reservoir engineering plan evaluation mainly includes geological understanding evaluation, development technology adaptability evaluation, and implementation effect evaluation.

An oil field started conducting detailed post-evaluation of capacity construction since 2010, the capacity post-evaluation work of 10 blocks has been completed at present, the types of capacity blocks are diverse, the detailed post-evaluation work of reservoir engineering can not only provide more reasonable capacity prediction and improvement suggestions for the evaluated block, but also play a guiding role in the preparation of reservoir engineering plans for other blocks of this oil field.

2. Feedback on Evaluated Block
The feedback of the evaluated block is mainly reflected in the improvement and perfection of the evaluated project.
2.1. Contrast the characteristics of geological development altogether and continuously deepen the understanding of oil reservoir
The understanding of oil reservoirs cannot be completed at one time; oilfield development is a continuous development process with continuous practice and development. After the implementation of the development plan, as the development process progresses, the collected data information becomes more and more abundant, new understanding of the geological structure reservoirs and fluid properties is obtained, and the obtained physical parameters of the oil layer are closer to reality. The changes in the structure, reservoir characteristics, oil-bearing properties, physical properties of crude oil and the plan comparison are analyzed via the post-evaluation work, and the new data is timely perfected into the existing data, and the understanding of the reservoir is continuously deepened, so can more accurately understand the structure and characteristics of oil and gas reservoirs, provide reliable reservoir physical parameters and microscopic seepage mechanism, clarify the potential distribution in the later stage of development, and improve the use degree of reserves.

2.2. Forecast development indicators and provide a basis for output plan
As an important index of the oil reservoir engineering plan post-evaluation, the output forecast of the capacity block during production period is one of the main bases for oil field output plan and production operation arrangement, and it is also the basic data for conducting economic benefit evaluation of the production project. After the capacity construction project is put into production, affected by many conditions, the actual annual oil production is different from the plan design index, the development indicators after the evaluation time should be re-predicted based on the actual development status before the evaluation time of the capacity construction project and the comprehensive decline law in the actual production of the project.

When conducting the post-evaluation of the capacity of the ASP flooding capacity project in Block A, the injection time of the two small blocks A1 and A2 was delayed by 10 months and 5 months, respectively, as a result, the effective time of the two blocks was delayed, therefore, it is estimated that the cumulative oil production during the production period is \(214.33 \times 10^4 t\), which is lower than the plan design \(13.57 \times 10^4 t\).

2.3. Make clear block development contradictions and provide basis for formulating comprehensive adjustment plan
The post-evaluation of oil reservoir needs to compare the main development indicators such as new drilling workload, daily oil production capacity of single well, water cut rise rate, decline rate, annual production, and water injection well implementation to evaluate the implementation effect of the project. Moreover, projects that do not meet the design index of the plan should be analyzed in depth, the shortcomings of the plan implementation should be summarized, and reasonable and effective development suggestions should be put forward to provide basis for the later dynamic comprehensive adjustment.

When conducting the post-evaluation of the secondary infilling capacity adjustment in the western transition zone of the oilfield, the evaluation believes that the initial development effect was not ideal, and the single well production capacity did not reach the level of the design. By analyzing block waterflooding, perforation and well completion condition, this paper believes that the main reason for the low initial capacity is the lagging effect of new well water injection and insufficient underground capacity. In order to improve the use condition of the thin and poor oil layers in the block, improve the final recovery rate of the block, and further strengthen the adjustment of the injection-production structure in the transition zone: in optimizing the adjustment of the water injection structure, in allusion to the problem of uneven use among layers, for the well area with low injection-production ratio, relatively poor liquid supply and low formation pressure after new well injection, the water injection volume of new injection wells should be gradually increased, and measures should be taken to increase the water injection volume of some old wells with poor water absorption capacity. Furthermore, the combination of stop and control is implemented for the vulnerable layers to effectively prevent the hidden danger of
casing damage. In the aspect of optimizing and adjusting the liquid production structure, the classified supporting governance such as low production well and low pressure well is implemented, according to the analysis results of remaining oil potential, the well layer is optimized and the oil increase is implemented. The water injection situation in the block has been improved, the use degree of oil reservoir has been increased, and production decline rate and water cut rise has been effectively controlled via comprehensive treatment.

3. Feedback on Subsequent Oil Reservoir Engineering Plan Design

Feedbacks on the preparation of oil reservoir engineering plan of the same type of blocks are mainly reflected in the optimization of plan design ideas, layered well pattern deployment and development index design.

3.1. Optimize the plan design and improve the design rationality

The adaptability evaluation of development technology is to evaluate the rationality of the development technology from well pattern deployment, selection of layer division development methods, and determination of mining speed and production level in accordance with the situation after the implementation of the plan. The analysis of the development layer division, well pattern, well spacing, rationality and adaptability of development methods in the evaluated block can provide basis for the preparation of oil reservoir engineering plan for other blocks to be adjusted.

It can be seen from the conclusion of the ASP flooding capacity in Block A that the spacing of the ASP flooding should be 150m or less. The main basis are as follows: first, the well spacing is small and the oil layer control is high, which is conducive to improve the recovery; second, the production practice shows that as the well spacing reduces, the oil layer use extent is significantly improved; third, Reducing the well spacing is conducive to the reasonable adjustment of the injection rate of ASP flooding. This conclusion can be used as an important basis for the well spacing design of the ASP flooding pattern in the oilfield block.

In addition, according to the post-evaluation results of the capacity, the development index of the oil reservoir engineering plan design can be reasonably adjusted. For example, the capacity utilization is one of the important indicators for the preparation of oil reservoir engineering plan, and it is a direct reflection of whether the capacity block meets the requirements of the plan design. At present, there are differences in the calculation methods of newly-built capacity designed for various capacity blocks in the oilfield. In 2007, the calculation formula of the newly-built capacity of a reservoir plan was: average daily oil production per well in the first year of production × number of production wells × 300 (days)/1000. In May 2012, according to the latest requirements, the calculation formula of the newly-built capacity is designed as: the average daily oil production of a single well in the next year of production × the number of production wells × 300 (days)/1000. Due to the difference in initial capacity calculations, in 2001, the calculated capacity utilization after three-infill of capacity adjustment in a block is lower. Therefore, in order to more objectively and accurately evaluate the block newly-built capacity and capacity utilization, the unified water flooding infill and adjustment calculation method of newly-built capacity is determined, namely the average daily oil production of single well in the next year, the time is 300 days.

3.2. Summarize technological innovative achievements and provide technical support for scheme design

Technological innovation is the inexhaustible driving force to support the sustainable development of oilfield in the ultra-high water cut period, it is necessary to summarize the technological innovation of oil reservoir engineering plan in time in the capacity post-evaluation work, and provide guidance for the design of oil reservoir engineering plan in other blocks.

Taking the secondary infill and capacity adjustment block in the western transition zone of the oilfield as an example, the technological innovative points of this oil reservoir engineering plan can be summarized as the following: first, optimizing plan deployment to ensure personalized design:
considering the development condition of the oil reservoir and the deployment condition of original well pattern deployment: Strip II and III adopt 150m×150m five-point method area well pattern, and original well pattern of oil production wells in Strip II is injected to form 145m×145m four-point method area well pattern; second, in order to explore the potential of are without wells in the infill adjustment area in the northern part of Strip IV, provide a detailed basis for the future expansion of wells, a total of 12 profile wells are designed in the area without wells from north to south; third, 7 oil and water wells of area without well area near the edge in newly designed oil and water well of Strip IV are determined as risk wells, and the drilling sequence from the inside to the outside is implanted, and the wells that are close to the inside of the strip with less risk are first drilled, and then decide whether to drill sequentially in accordance with the situation of the sand body. The development condition of oil layers in the eastern transition zone of the oilfield is similar to that of the western transition zone, and the well pattern deployment way is the same, the technological innovative achievements of the secondary infill adjustment in the western transition zone provide strong technological support for the determination of the eastern secondary infill adjustment way.

4. Conclusion and Suggestion

The feedback mechanism of the dynamic adjustment of the evaluated block and the plan design of the block to be adjusted can be formed via objective post-evaluation of the geological oil reservoir engineering plan system, it not only provides guidance for the deepening of geological understanding, capacity plan and later dynamic adjustments of the evaluated block, but also provides plan design ideas for adjustment plans of other blocks, optimizes the plan index design, and improves the rationality of plan design.

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