Running a 178/140 mm combined casing string with the possibility of rotation in the challenging geological settings of Western Siberia

ENG

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The article discusses the current problem of complications observed during the RIH of casing and combined strings at the fields of Western Siberia, including borehole wall instability, differential sticking, and losses of circulation. These factors may lead to failure to reach the design depths for casing strings, resulting in longer drilling time and higher costs. To address the above issues, the authors propose a solution involving the use of a combined casing string with the possibility of controlled rotation during RIH operations.

KEYWORDS: well construction, complications during casing and combined string RIH operations, improving the reliability of casing string RIH operations in challenging geological settings, technology of casing string RIH with rotation, minimizing the risk of the casing string jamming, casing torque rings, evaluating the efficiency of using a 178/140 mm combined casing string with the possibility of controlled rotation during RIH operations, casing running tool (CRT)

The complications observed when running casing and combined strings at the fields of Western Siberia are still among the key problems affecting the efficiency of well construction. Borehole wall instability, differential sticking, and loss of circulation result in casing strings' failure to reach the design depths, simultaneously leading to longer time and higher costs of drilling operations.

One of the promising directions for improving the reliability of casing RIH operations is the use of technologies for casing string RIH with rotation. Rotation reduces the contact forces between the casing string and the borehole walls, thus minimizing the risk of sticking and ensuring better control over the process in intervals with challenging geological settings. The purpose of this study is to substantiate and evaluate the efficiency of using a 178/140 mm combined casing string with the possibility of controlled rotation during RIH operations.

As part of the preparatory work for the technology implementation, a series of preliminary engineering calculations were performed in order to find the maximum permissible torque and drag values. The calculation results were used as initial data for the terms of references for the design and manufacture of the equipment elements that would ensure the operability of the equipment when the combined string is rotated in the course of RIH operations.

All the equipment used in the project had passed bench tests, as well as quality control and validation procedures, which eventually confirmed its operability and suitability for use in rotation mode.

To increase the maximum permissible torque, torque rings for a BTC 178 and 140 mm casing string were placed in the box-and-pin connections. This helped achieve a significant gain in the permissible torque during operations without alterations to the standard threaded connection design. To enable rotation of the combined string in the course of the RIH operation, as well as rotation with circulation, a special equipment assembly – a casing running tool (CRT) – was mounted in the top drive of the drilling rig. Overall, a series of engineering calculations, the subsequent upgrade of the casing hardware elements, the use of the CRT and torque rings for BTC casing strings ultimately resulted in the stable operation of all components during rotation, in which a maximum torque of 50 kN*m was achieved.

To run field trials of the proposed engineering solution, the customer selected a well characterized by pronounced borehole wall instability in the Alym formation interval and numerous cases of drag during drilling and preparatory operations before the casing RIH.

During the RIH of the combined production string, a drag of up to 5 tonnes was recorded at a depth of 1,480 m. In the course of flowback and reaching the stable production at Q = 8 l/s, the mud loss occurred with an intensity of 30 m3/h. To address the loss of circulation, a pack of bridging agent with mixed granular size with a concentration of 250 kg/m3 was injected. After pumping the pack, no deviations in the the completion equipment functioning were recorded. After the borehole was strengthened, the RIH operation was continued.

At a depth of 1,553 m, the string was rotated as designed with the following actual parameters recorded: flow rate Q = 5 l/s, pressure P = 10 atm, rotation speed N = 20 rpm, torque M = 10 kN*m (**Fig. 1**).

On the back of continuous drags, the combined string was run in the intervals of 1,553–2,246 m and 2,786–3,149 m with mandatory circulation and rotation after each casing pipe connection, which helped relieve contact loads, reduce the likelihood of jamming, and achieve more stable RIH dynamics **(Fig. 2).** The total time of the combined string RIH with rotation and circulation was 38 hours (the total mouth-to-design depth RIH time was 91 hours). The string made it to the design depth solely due to the use of the rotation technology. All subsequent operations – equipment activation, cementing, and millout – were performed as designed without deviations.

The results of the pilot trials confirmed that the use of upgraded completion system elements in combination with torque rings and the technology of rotary casing string RIH considerably improves the reliability and technical performance of casing string RIH operations in complicated geological settings.

The findings obtained suggest that there is a significant potential for the application of this technology in similar geological conditions. Focus areas for further research should include:

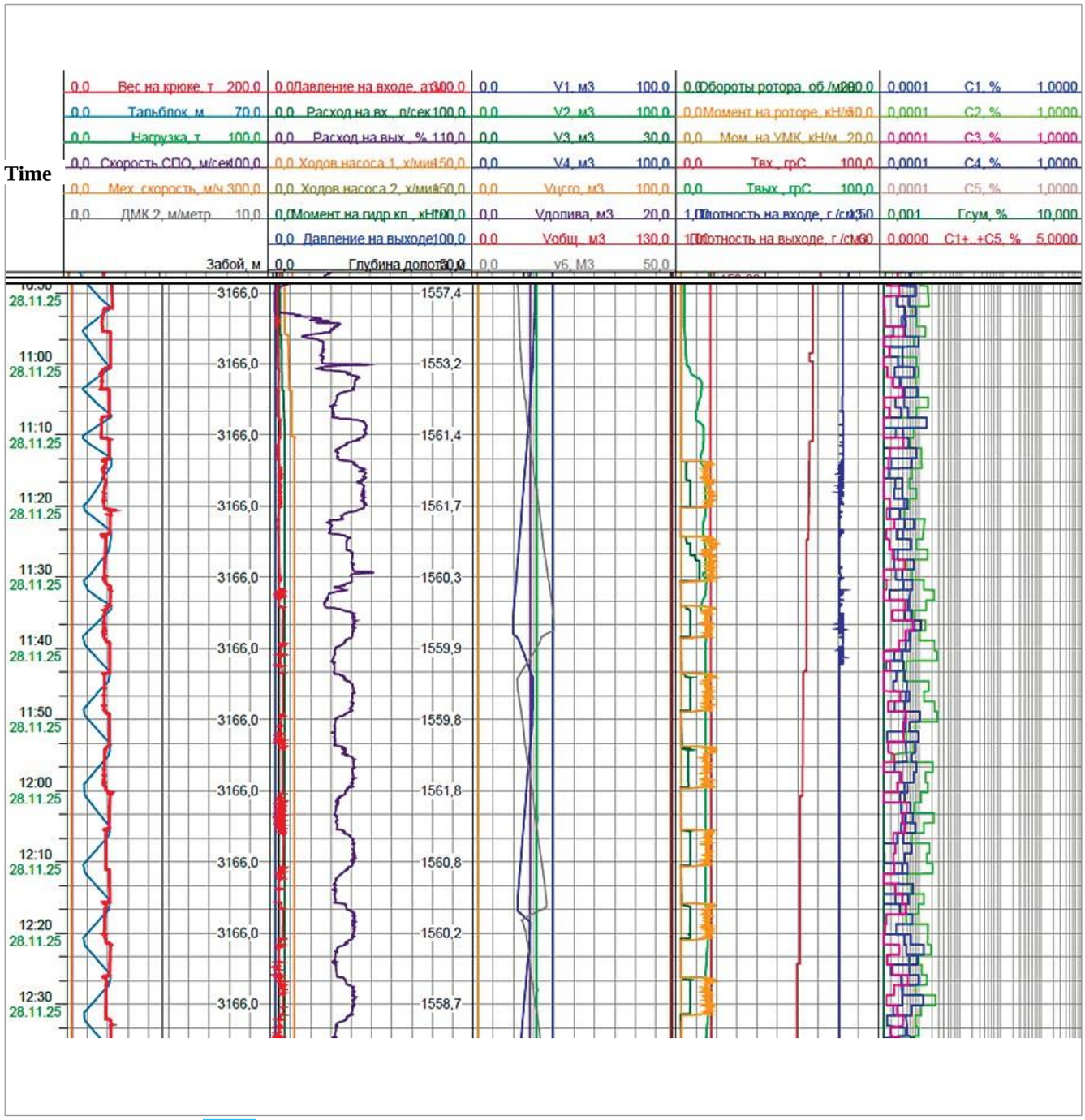

Fig. 1. 178/140 mm combined casing string rotation diagram for a depth of 1,550 m

- formalization of dependencies between torque and the borehole parameters;
- elaboration of optimal rotation modes for various types of complications;
- enrichment of the database to apply the technology at other fields.

CONCLUSION

The use of a 178/140 mm combined casing string with the possibility of rotation during RIH operations is an efficient engineering solution for wells characterized by borehole wall instability and a high risk of sticking. The results of the conducted trials confirm the viability of further practical implementation and scale-up of this technology in fields with similar conditions.

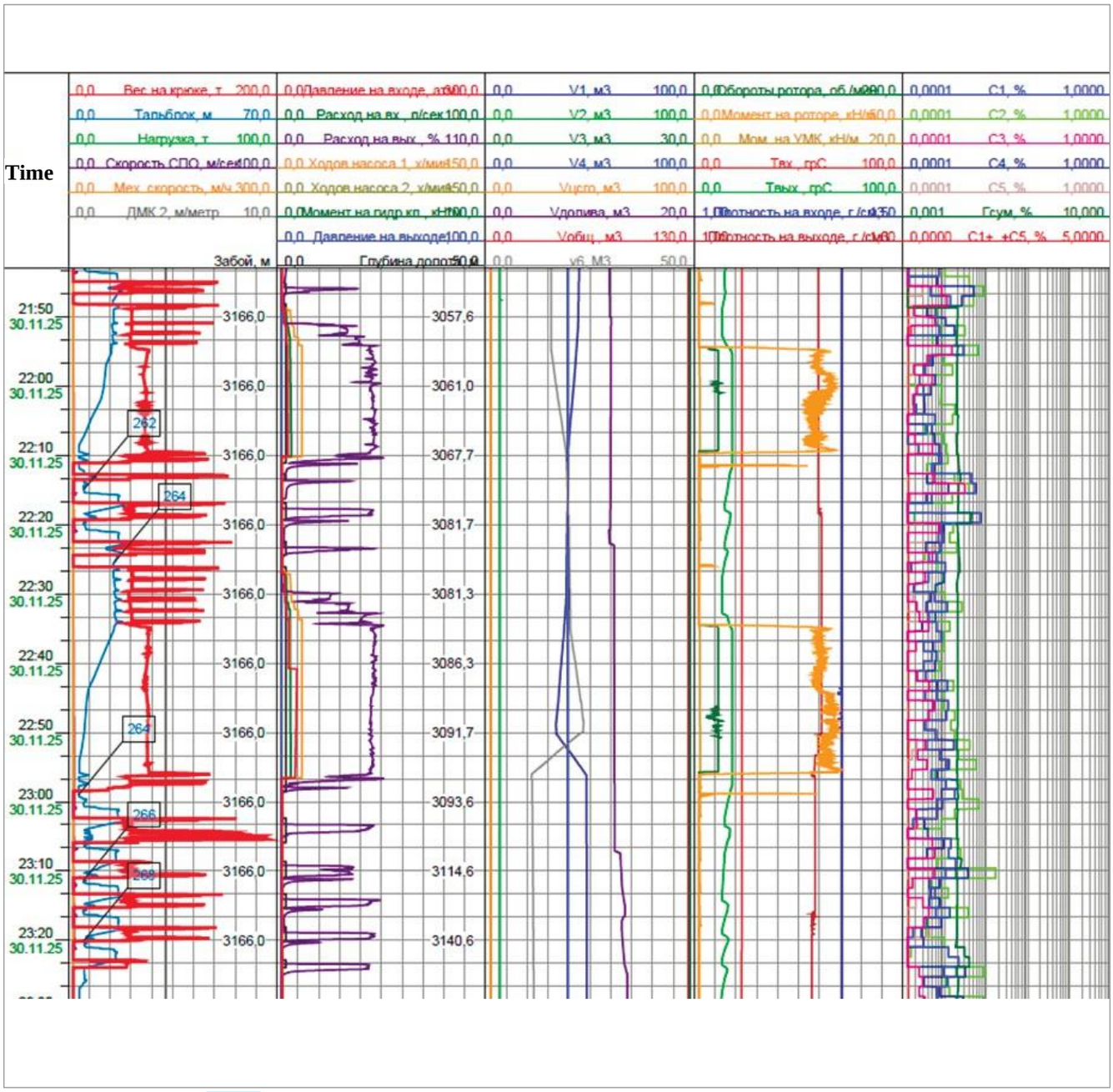

Fig. 2. 178/140 mm combined casing string rotation diagram for a depth of 3,090 m

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