New Reality of Directional Drilling Services During Production Decline and Coronavirus Pandemic

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Abstract. The year 2020 introduced unexpected critical structural changes into a rather conservative sector of drilling services. In a situation where the confirmed volumes of work are unpredictably transferred, postponed, halted, or renegotiated, the leaders of high-tech service companies providing technical and technological support for oil and gas drilling, had to make a number of strong-willed decisions in order to continue to support the telemetry equipment fleet and retain a team of engineers by staying in the market. Of course, there are those who are not ready for this. In this article, we will look at the technical side of this reboot through a careful optimization of resources used by drilling service companies.

Keywords: Directional drilling · Telesystem · MWD · Measure while drilling · LWD · Pandemic

1 Introduction

Drilling is a technologically continuous process within the framework of the construction of one separate well, well pad or field development, including drilling of exploration and sidetracks. However, the intellectual and technical progress is even more continuous, implying the solution of problems dictated by the need to increase the drilling speed, the increasing complexity of the borehole trajectories, and the acquisition of more and more log data in real time directly in the process of deepening. In turn, solving these problems imposes a framework on directional drilling services, within which each promising player in this market must solve internal problems of increasing the reliability, autonomy, versatility of their equipment, saving costs for its modernization and maintenance, and expanding the fleet. On many issues, the vector of development of telemetry systems is quite unambiguously defined for a decade ahead, and companies often use the fruits of this evolution, successfully buying technological innovations that are offered by foreign and domestic developers. However, what if there was a drastic reduction in resources for this work? If it concerns one company or services that provide any non-unique or not advanced services, the question would not be so interesting, and would be limited to simply leaving the market of these
counterparties, in our case the entire industry was subject to this shock. Even strong players could not survive without making super-operational management decisions aimed at optimizing costs and a new approach to the distribution of financial and human resources. Let us figure out what is happening on the ETTS (engineering, technical and technological services) drilling market, and how companies are solving issues dictated by the new reality.

2 Methodology

Continuous analysis of the directional drilling market situation cannot be overstated. This is one of the most technologically advanced, expensive, innovative, socially significant markets on the planet. The financial well-being of hundreds and thousands of families depends on the success of each player in this market. With each new or first-time applied technology on this market [4], the efficiency of resource costs, the safety of human lives, the birth of new hypotheses, new professionals, new scientists are growing. We can consider this model from a million angles of view, but it is of particular interest in a period of unstable equilibrium, when it needs to self-organize, become self-reliant, independent, give up excesses and devote all efforts to improving efficiency. Each such shake-up gives rise to new opportunities, opens the eyes of conservative engineers to how it was possible before, but now it is already impossible without it. Being at the junction of fields of activity between science and drilling itself, researching this is not only my profession, but I am the sphere of my hobbies.

3 Results

3.1 Technical Equipment Directional Drilling Services

At present, the telemetry equipment market in Russia and in the world is very close in terms of manufacturability. The regional leadership of manufacturers on it is conditional and is dictated primarily by the cost of purchase and maintenance. Of course, there are certain geological features and requirements of subsoil users in terms of the volume of logging data provided for each individual project, but in general, the technical equipment is the same for all manufacturers. A huge amount of research and pilot testing of exotic communication channels of downhole devices with ground decoders has not yet provided a cheap and reliable mass solution for obtaining data from the bottomhole zone. Therefore, the most popular in the market are telesystems with a hydraulic and, especially in the regions of operation of Russian companies, an electromagnetic communication channel. Moreover, the number of common schematic diagrams of downhole devices is also no more than a dozen.

Telesystems with a hydraulic communication channel [1], which have gone through the path of long experiments on a positive or negative impulse, stopped their evolution at the ubiquitous choice of the former, so we will not even consider the latter. This will allow them to be divided only according to the principle of operation of a hydraulic pulser: with a rotating and so-called “poppet” flow shut-off mechanism.
Rotary - rotating pulser, according to experience, is more reliable in terms of the quality of data transmission in the conditions of imperfect drilling mud, but has a more complex design of the working section, which requires qualified service work with a shorter overhaul interval, low versatility in the context of application in the BHA (bottom hole assembly) of different standard sizes (that is, the use of the same pulser is possible at any standard size, but only after visiting the service, to replace the “cup” - the stator and rotor plates), and, most critical for operation, higher power consumption [9]. A large number of companies are experimenting with the installation of turbo generators into the downhole complex, which generate energy by rotating a screw or vane flow of drilling fluid, but their resource does not exceed 300 h before the next service and introduces another mechanical element into the BHA (bottom hole assembly) [3] that is subject to erosion, clogging, mechanical failure, therefore, it does not completely solve the issue of reliability and uncompromising autonomy of the downhole telemetry complex. Rotary pulsers are, as a rule, top-mounted, allowing them to be connected with any number of collar and non-collar logging tools. The advantage of “poppet” pulsers with a progressive stroke is autonomy due to the principle of its operation: redistribution of the flushing fluid flow by closing the valve inside the pulser. This makes it possible not to waste energy on direct action on the working elements that create a positive pressure impulse in the discharge line, the pulser will close under the action of the power spring when the flow of drilling fluid presses on the upper part of the rod, and will open when the passageway inside the pulser is closed, lifting the rod by force accelerating flow at the point of narrowing of the flow area between the pulser tip and the mounting sleeve. An additional advantage of this design, as a rule, is the versatility when using the same telesystem string in non-magnetic drill collar of different standard sizes with different inner diameters [11]. To drill the next section, it is enough to simply use a locating sub of the required diameter with a suitable locating sleeve, and change the commutating centralizers on the string itself to damp vibrations and tightly fix the devices inside the drilling tool. Moreover, such pulsers are easy to maintain and adapt to any flow rate of flushing fluid by selecting the flow area between the tip and the diaphragm of the mounting sleeve [6]. Such telesystems, as a rule, have a non-collar design, and the installation process in the non-magnetic drill collar consists in lowering the string with force to fix its bottom in the installation sleeve of the circulating sub. This is also a disadvantage of the design: the string is fixed in the working position with the help of spacer half-rings, implying its retrievability in the event of a loss of BHA mobility (sticking, tool breakage), which in turn carries the danger of the instruments “surfacing” during aggressive descent, especially in the absence of check valve below the set sub, limiting the run speed, increasing the run time. Poppet pulsers usually have a bottom position, which complicates their use in BHA with a wide range of logging tools, especially those using collar design.

The knowledge and reliability of these designs provides them with wide popularity among “alternative” manufacturers of telemetry systems. The scenario for their implementation is always the same: the manufacturer commutes its inclinometers, gamma modules, resistivity meters and other necessary devices with the original pulser of the famous brand, conducts a series of tests, and then begins to produce its own with varying degrees of localization, using original, copied and elements of its own
production. As a rule, the reliability of such solutions is lower than the original one, a strict binding to the manufacturer’s service complicates their use by third-party companies, but their cost can become a key factor in order to give them preference when expanding the fleet. In turn, this state of affairs allows “alternative” manufacturers to use their developments in their affiliated directional drilling services, significantly reducing their costs of purchasing and maintaining their fleet. The negative factor of this approach is the low level of RandD (research and development work), and, consequently, work with equipment of “past” generations of relatively current developments of manufacturers, whose devices have been localized for the needs of an “alternative” developer.

Telemetry systems with an electromagnetic communication channel [7] are traditionally the largest number of Russian manufacturers. As has been said many times in our works, this is an underestimated type of downhole telesystems in the world. Of course, it has a number of disadvantages depending on the geological section, vertical drilling and well waste, but it is incomparably cheaper to buy and maintain. Such telemetry systems always have a very reliable generator on board, which makes it possible to achieve autonomy of 300 h or more.

3.2 Work with Telesystem Park Under Restricted Possibilities Delivery of Spare Parts and Large-Unit Elements from Abroad

The uncontested popularity of foreign TV systems and the lack of production of hard alloy and non-magnetic elements in Russia played a cruel joke on companies whose fleet is not diversified by alternative devices or suppliers of localized spare parts (spare parts, tools and accessories). No, of course, the market did not get up, but the foreign exchange rate and a certain deficit caused by the difficulty of delivering to Russian sellers have significantly increased the cost of owning a fleet for organizations operating this equipment. Moreover, the specificity of these services is such that savings on materials can lead to drilling failures, which in turn carries fines and reputational risks. The last factor is especially important now, when some companies have “free” equipment, planned for the contracted volumes, which have been postponed indefinitely. These organizations can afford to dump in the market, just not to lose their engineering staff, technicians, ensure leasing payments and not send half of the technical fleet to idle. Because long-term forecasts are now more uncertain than ever, losing a customer can be fatal for any organization.

The paradox of the moment also lies in the fact that companies that have not adapted to the new realities end up selling their TV systems and spare parts at affordable prices, which creates fierce competition with official suppliers, further complicating the situation with the purchase of new equipment. Suppliers of refurbished devices, companies engaged in connecting elements of telemetry systems from different manufacturers, and, of course, domestic developers of telemetry systems have become in demand again [8]. For example, a well-known Tyumen manufacturer of drilling equipment completely covers the high demand for neutron types of logging and geosteering. He, in cooperation with a well-known Moscow integrator of drilling components and software for ground-based decoding complexes, provides their commutation with «APS» telemetry systems widespread in Russia. This scenario is
beneficial to everyone, except, perhaps, «APS Technology» itself, but they cannot compete either in price or in terms of delivery.

The absence of official profile events, exhibitions, conferences has created a kind of information vacuum in the industry, but, obviously, in this situation, the issue of survival is more relevant. It is also interesting to look at the market of domestically produced electromagnetic telesystems. The well-known Samara manufacturer of Bitas telesystems has fully loaded production from the beginning of the year. This was largely facilitated by the significant modernization of the generators feeding the downhole equipment and the method of their fastening and switching to the electromagnetic separator. This made it possible to increase the overhaul interval from 300 to 450 h and significantly reduce the risk of flushing the mounting flange and the upper cross of the probe.

That is, the demand for electromagnetic kits has increased, and confirms the thesis about the underestimation of these telesystems and the services that can be provided with their use. Particularly interesting is the direction of development of logging tools integrated into this equipment [10, 12]. Its potential is undoubtedly great, since this telemetry system is not tied to the use of batteries, and is capable of operating under conditions of high autonomy even with the largest energy consumers at the bottom. In addition, given the low comparative cost, it will clearly find its consumer in the domestic and, perhaps, foreign market.

3.3 Peculiarities of Work of Field Parties During Pandemic, in Conditions of Reducing Costs

The first wave of self-isolation revealed the same bottlenecks in the provision of engineering personnel for all enterprises in the oil and gas industry. The main reason for this was the rotational work method at remote construction sites. The standard schedule “30 days on duty, 30 days at home” has been significantly modified due to foci of spread of infection, since people from different regions work at the facilities and from time to time move between jobs, creating many contacts, exacerbating the problem. In the second wave of self-isolation, observers were set up in every major city for staff flying into the region. This forced measure, of course, is effective and justified, but it leads to a loss of flexibility in transferring people from one object to another and increases the wage fund, since the employee on the shift must receive a salary, but he cannot work during the observation. This gives rise to a scenario of work with a reduced composition of field parties. This is personal daily fatigue, general fatigue from a long stay on duty - a huge burden on engineers, not always fairly compensated by employers. Moreover, the risk of errors and equipment failures due to the human factor increases.

The situation with the rules for organizing observatory is also not ideal. Each region and even the customer independently sets the duration and conditions of stay of employees in them, which often leads to excesses in the field. As elsewhere, there is an other side of the coin, which forces companies to modernize their approach to work. Operation centers are being set up that remotely monitor drilling processes. This leads to a change in the information infrastructure, modernization of the software of the ground telemetry complex, and the development of systems for automatic data analysis.
All this will be in demand and after the removal of restrictions on the delivery and removal of personnel from work sites, it will bear fruit in the automation of script processes and help to more effectively manage the resources of companies.

4 Discussion

In this article, I want to raise a large layer of problems at the junction of technological progress, the economic situation in Russia and in the world, the energy market, research and integration of technical devices into existing procedures, a thrifty attitude to any resources, and, most importantly, safety and health drilling facility personnel. Based on this small text, we can continue to explore ways of transferring data from the bottom, and, perhaps, we will be able to abandon the word “exotic”, describing new efficient data transfer channels. We can continue to search for the optimal technical and financial integration of telemetry components, creating new effective industrial designs [5]. We can develop measures to counteract the growth of morbidity in teams working autonomously at remote sites and much more. Of course, in each of the above areas there is a certain amount of scientific materials, articles and textbooks. However, I see the value precisely in how complex self-sufficient systems interact, each of which is in the zone of its interests, but, nevertheless, forced to use, manage, invent, produce something really new.

5 Conclusion

Any owners of business processes strive for a stable balance and stability of their course, however, the highly competitive market of high-tech services sets the rules of survival, in which the main condition is constant movement forward. The redistribution of emphasis on the telemetry equipment market can also be viewed in a positive light: domestic developments are being reassessed and evolving to meet the usual requirements of telemetry users. They successfully deal with the initial flaws and features of their designs, and remain the most financially available to purchase and own.

Combinations of well-known commercial solutions give a serious advantage to companies providing engineering, technical and technological support for drilling, allowing them to get only the best from each telemetry system [2], saving on spare parts, increasing their autonomy and stability of their work at the bottom. Continuous development, automation, modernization and expansion of the list of services provided with minimal investment, cost optimization and other solutions that require rethinking in times of crisis are essential for the industry to reach a new level. Despite the critical situation for many companies, this stress will definitely bear fruit, because technological progress cannot be stopped.
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