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Simplified Method of Monitoring Well Drilling Process

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ABSTRACT: In this paper the author proposes to simplify the method of control over the drilling process by digitization of strain-gauge data obtained from the actions of drilling unit mechanisms with the interpretation and operational processing of information, combining similar characteristics of the flushing system andremovalofcontrolinformationthatdoesnotaffectthenormalandstabledrilling process. It has been proved that the proposed control system, equipped with state- of-the-art instruments, allows optimal management of the penetration process and rational development of rock destruction tools.

KEY WORDS: Control parameters; Control pyramid; Optimum drilling mode; Physical and mechanical impact; Well construction; Degree of importance.

I.INTRODUCTION

It is known that the accuracy and operability of technical and instrumentation devices play an important role in the construction of wells as well as in other technological operations. The accuracy and stable operation of their various technical ,technological and climatic conditions are the main factor that allows successful drilling of wells to the design depth. In order to learn how to control the well construction process, we divided all drilling operations into 4classes:oil and gas drilling, solid minerals drilling, water drilling and engineering research drilling. In the construction of wells for oil and gas , control of the drilling process is fundamental and the most complex among the above classes of drilling in terms of quantity and the need to obtain basic information in terms of importance. Well construction is a complex process that includes rock destruction, preparation, cleaning, chemical treatment of flushing fluids, their physical and chemical interaction with the rock during flushing of wells, separation of formations by cementation, situations related to unstable operation of equipment and there are several dozens of other parameters that need to be monitored and regulated in time to ensure optimal management of the drilling process. Among these parameters, only the drilling mud control system has more than 20 parameters. In addition, plugging mud parameters also have more than 5-6 types of control: input material quality control, plugging mud formulation control, dry plugging material quality control, drilling fluid quality control, etc[1].

It is well known that the average speed of oil and gas wells in the world is 1,000 or more meters per month. At such a rate of penetration and in the presence of various mining conditions associated with the characteristics of the geological section and negative phenomena in the processes of drilling rocks, as well as the impact of physical and mechanical effects associated with the destruction of rocks using rock destruction tools(RDD),the presence of resistance to natural interlayered pressure and other phenomena require the modern driller to immediately respond to changes in the above factors and choose the optimal mode for normal operation[2]. Theoretically, the rig operator, his assistants and, in general, the drill operator need to have information on about 50 different types of different parameters at all times. When working continuously, it is virtually impossible to have such a wealth of information and take measures to regulate the optimal drilling regime and information about the technological performance of drilling fluids and plugging composition. If we take into account that such parameters of flushing fluid in the ascending flow, which are related to the density of drilling mud, relative viscosity, water yield, static shear stress, clay crust thickness, etc., are very variable, so there is no need to control them, as they lose their prescription(normative)parameters and are subject to restoration of properties by applying a pre-designed technology for using this composition of drilling fluid. Here it is necessary to control only those parameters which are connected with determination of solid phase and oil concentration in drilling mud and hydrogen sulphide content. The drilling mud delivered to the well is controlled by the staff of the drilling mud

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preparation team and the responsible person must, in order to avoid overloading the operator with excessive information, communicate only basic parameters, such as density, viscosity and amount of fluid falling into the well, to the operator via an electronic network.

The saturation of the drill operator with excessive information sometimes leads to a traveler or an abnormal control of the process on the dashboard, which can lead to emergency situations. It should be noted here that the driller should also have other information related to the technical parameters of well deepening, which should be monitored and analyzed instantly.

II. SIGNIFICANCE OF THE SYSTEM

At present, all control and measurement work on drilling rigs is mainly based on "Uniform Technical Rules for Well Drilling", which do not take into account modern achievements in drilling control. Therefore, these rules require amendments and additions to be made to take into account the level of control and measuring equipment by class. Naturally, the analysis of the information obtained is essential, but it is not always possible to continuously regulate the drilling process to ensure optimal or regulatory performance, precisely by the parameters analysed. There is also a human factor, for example, the reaction of each employee is individual. Therefore, in order to simplify the management of the drilling process, we propose to classify all the information we receive by the level of importance. Below we propose a pyramid for controlling the drilling process. Such a scheme naturally makes it easier for the driller to inform himself when drilling for solid minerals and when drilling for water, as there is no need to have parametric information for this because it is unnecessary to manage the drilling process. Figure 1 shows the drilling process control pyramid. As can be seen in the peak part of the drilling process control pyramid, 7 parameters need to be monitored by the operator or machine operator if the drilling process is running normally.

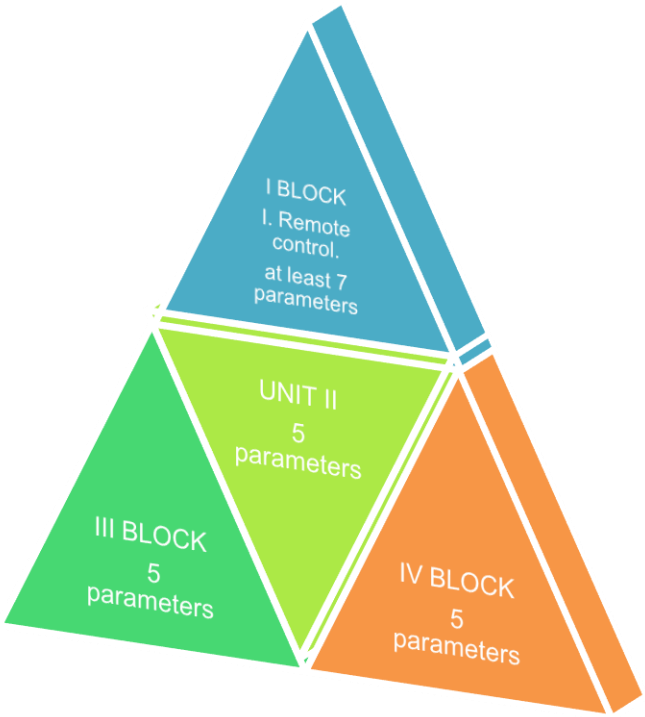

Fig.1. Pyramid of drilling process control

The lower part of the pyramid is divided into 3 control units:2 control units for drilling mud parameters (mainly 5, auxiliary 5), 1 control unit for plugging parameters.

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solution - 5. If one of the parameters at the bottom of the blocks is disturbed due to the negligence of processing in eersor other technical reasons, the number of volume controlled parameters will increase dramatically and may reach 16 (Figure 2).

If measures are not taken in a timely manner to eliminate malfunctions in the auxiliary equipment, which serves to bring it to regulatory level or if operators are negligent about the unscheduled regulation of the lower 3 control unit, the number of parameters that must be regulated reaches 22. This huge number of parametersis the maximum risk and will lead to an emergency situation.

Based on the above considerations, the control pyramid should be kept at peak at all times, i.e. the minimum number of control parameters and instrumentation should work according to the importance of the information they receive.

In order to minimise the control parameters to be regulated on the drilling process control panel, the control of the downstream 3 units must be clearly organised.

The staff working with the automatic control devices to bring the drilling fluid parameters to the normative values on these blocks and the operational laboratory staff must ensure stable work to maintain the prescription values of drilling fluid and other normative values of the controlled parameters[3].

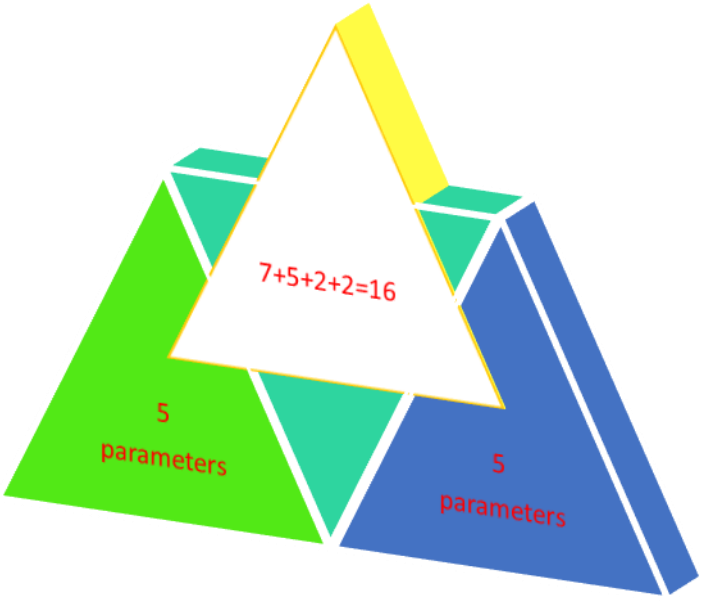

Fig.2.Type of control pyramid with broken mode

The table shows the classification of controlled parameters of drilling operations, where it is proposed to determine their performance by automating the study of mud fed into the well and in the ascending flow of mud under laboratory conditions to quickly determine individual controlled parameters.

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III. EXPERIMENTAL RESULTS

Classification of controlled drilling parameters by level of importance

№		Blocks	Control parameters by level of importance	Methods of determination		To the control panel
1	**1**	I unit	Drill shaft turnovers			The operator (driller) monitors and regulates. All indicators are displayed on the default screen
2	**2**		Axial load			
3	**3**		Supply of washing fluid			
4	**4**		Monitoring of the condition of PRI (chisels, bits, drill bits, etc.)			
5	**5**		Density of drilling fluid			
6	**6**		Drilling Speed			
7	**7**		Conditional viscosity control			
8	1	II unit	Control of rheological indicators of properties	Automatic.		It monitors, controls and brings the dissolution team up to standard levels. If necessary, transmits it to the operator ordispatcher. These indicators are shown on the screen(display)
9	2		Drainage control			
10	3		Control of static shear stress in clay crust			
11	4		Control of solid impurities concentration		In the drilling mud laboratory	
12	5		Control of stability and sedimentation indicators			
13	1	III unit	Gas concentration determination console			
14	2		Control of solid phase and oil concentration in drilling mud			
15	3		Control of colloidal particle concentrations in drilling mud			
16	4		Control definition of hydrogen indicator			
17	5		Lubricating ability control			
18	1	IV unit	Determination of the stability of hydrophobic emulsions	Automatic		
19	2		Determination of specific electrical resistance			
20	3		Drilling mud filtrate analysis			
21	4		Assessment of inhibitory properties of drilling fluids		In the drilling mud laboratory	
22	5		Determination of foam stability			
23	1	V unit	Assessment of hydrogen sulphide content in drilling mud			
24	2		Determination of the amount of surfactants in solution			
25	3		Determination of corrosion properties			
26	4		Crust compressibility			
27	5		Thermal properties			
28	1	VI unit	Input quality control of plugging materials	specialist	During swabbing operations in	
29	2		Control when selecting a swab solution recipe			
30	3		Quality control of dry plugging materials			
31	4		Quality control of gelling fluid on a drilling rig			

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VI. CONCLUSION AND FUTURE WORK

Naturally, it is not possible to organize drilling in ideal conditions. However, in order to keep the process constantly on track, we offer some parameters to be monitored and regulated automatically or robotised.

Thus, the consolidation of technical and technological parameters with a simplified control method will facilitate work and avoid complications and accidents of various kinds, and speed up the process of well construction to the design depth with minimal time and money spent.

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