problem is not regulated by any legal documents. In addition, the commercial gas turbine and gas turbine power plants do not burn dry stripped gas - mainly consisting of methane, and the gases of the second and third stage separation which, unlike methane, post combustion yield significant emissions of harmful substances in atmosphere. According to many officials, experts and specialists, dealing with waste - processing APG power unit is the same serious waste, as well as the use of smoky torches, destroying valuable for the gas and petrochemical industry.

Russia has announced it will stop the practice of *gas flaring* as stated by the deputy prime minister Sergei Ivanov on Wednesday September 19, 2007. This step was, at least in part, a response to a recent report by the National Oceanic and Atmospheric Administration (NOAA) that concluded Russia's previous numbers may have been underestimated. The report, which used night time light pollution satellite imagery to estimate flaring, put the estimate for Russia at 50 billion cubic meters while the official numbers are 15 or 20 billion cubic meters. The number for Nigeria is 23 billion cubic meters.

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RESEARCH ON PELLET IMPACT DRILLING: HISTORY, TECHNIQUES AND RESULTS

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Drilling in in hard and tough rocks is associated with low values of mechanical speed and bit pressure. Pellet impact drilling method is aimed at destruction of rocks due to continuous circulation of metal pellets provided by an ejector pellet impact tool string (EPITS) in a bottom-hole area. This prospective technique can result in a considerable gain of penetration rate within the range of hard and tough rocks; reduction of costs of a well construction by cutting down round-trip time. One more advantage of this method is that its implementation will not require considerable re-equipment of the drilling rig since pellet impact method easily adapts to the existing well drilling technology.

For the first time the method of rock destruction by pellet impact was offered in 1955 by a group of scientists from American company «Carter Oil». A jet pump was chosen by them as a device which can cause acceleration and recirculation of pellets. Despite the possibility of destroying rocks, the method was criticized by own pioneers. In fact, negative conclusions have been brought about owing to a procedure errors and a number of shortcomings of "gravity-aspirator" tool string (Fig. 1.) [1]. Nevertheless, this method continued to arise interest of some researchers. Since 1963 the EPITS was used for well deviation studies in the Southern Kazakhstan Geological Survey directed by A.B. Uvakov. Thereafter, the tool string has been improved numerous times. If Uvakov's EPITS could make up to 20 m/h in tough and very tough rocks, the "PIM-216" tool string (Fig. 2) designed by S. A. Zaurbekov in 1995 already showed excess of mechanical speed by 20% and bit pressure by 43% over the serial tools during its industrial testing [4, 5].

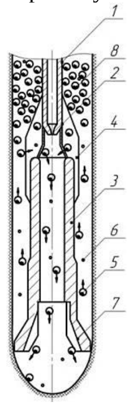

Fig. 1. Gravity-aspirator drill bit [1]
1 – drill string; 2 – primary nozzle;
3 – secondary nozzle; 4 – bars; 5 – rock-breaking pellets; 6 – cuttings; 7 – feet; 8 – pellet cloud.

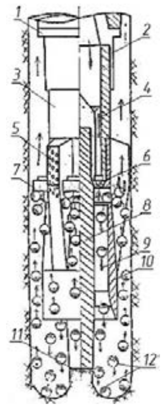

Fig. 2. "PIM-216" tool string with the nozzle and circular mixing chamber [5]
1 – calibrating device; 2 – sub;
3 – connector end;
4 – fluid delivery channel;
5 – calibrating and centralizing bars;
6 – circular nozzle; 7 – arrestor;
8 – drill bit holder;
9 – circular mixing chamber;
10 – drill bit body;
11 – hard alloy teeth; 12 – pellets.

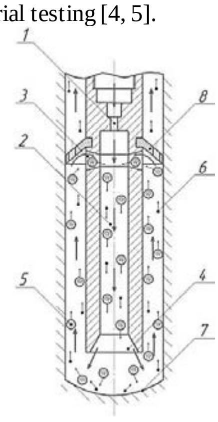

Fig. 3. Ejector pellet impact tool string [2]
1 – nozzle; 2 – mixing chamber; 3 – operating windows;
4 – diffuser; 5 – pellets; 6 – drilling cuttings;
7 – rock; 8 – arrestor.

Since 2012 the researches in this area have been conducted at the Department of Well Drilling of Tomsk Polytechnic University. These investigations proved that construction of ejector tool string, with the nozzle and the tubular mixing chamber arranged consequently in line is optimal (Fig. 3). This device functions as follows: the operating fluid supplied to the tool is accelerated in the nozzle (1) and runs at the high speed to the mixing chamber (2). A suction zone forms in the area outside the nozzle. Operating fluid from annular space is sucked through the operating windows (3) due to effect of ejection along with pellets (5) and drilling cuttings (6). Then two-phase fluid goes through the mixing chamber, diffuser (4) and breaks the rock (7). Then the pellets rise in the annular space until they are stopped by the arrestor (8) and then the cycle is repeated.

To carry out experiments, a laboratory bench was constructed (Fig. 4). Being modified in 2015, it includes SKB-4 drilling rig (4) (nominal feed 80 L/min; nominal pump suction feed 5,6 MPa) as a basic unit. The jet pump (1) (feed 120 L/min; max pressure 4 MPa) supplies the operating fluid through the discharge manifold (3) to the pellet impact tool string which is maintained and shifted by the drilling rig. The manometer (2) measures the pressure difference in discharge manifold after the jet pump. The fluid with drilling cuttings, being transported from the bottom hole, raises through the drilling barrel (6), which imitates a hole and helps to make the process of pellet circulation visible. After passing the barrel, the fluid and cuttings are removed through the drain pipe (7) to the drilling sump (10), where the fluid is sucked by the jet pump through the inlet manifold(8).

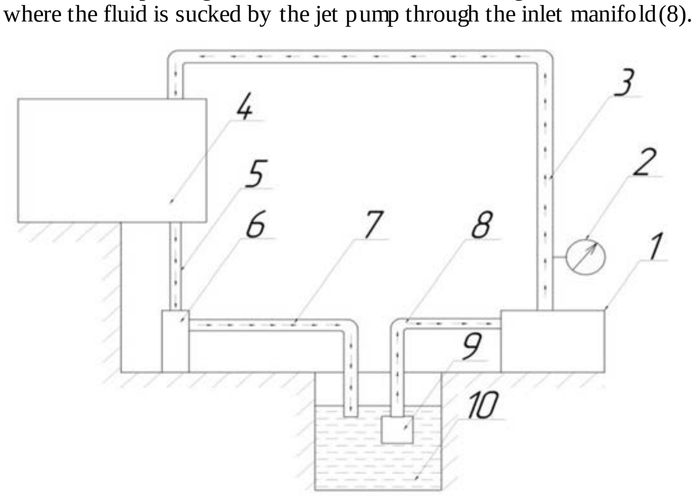

Fig. 4. Scheme of the laboratory bench for investigation of pellet impact drilling technological processes:
1 – jet pump; 2 – manometer; 3 – discharge manifold; 4 – SKB-4 drilling rig; 5 – drilling pipe;
6 – drilling barrel; 7 – drain pipe;
8 – inlet manifold; 9 –filter; 10 – drilling sump.

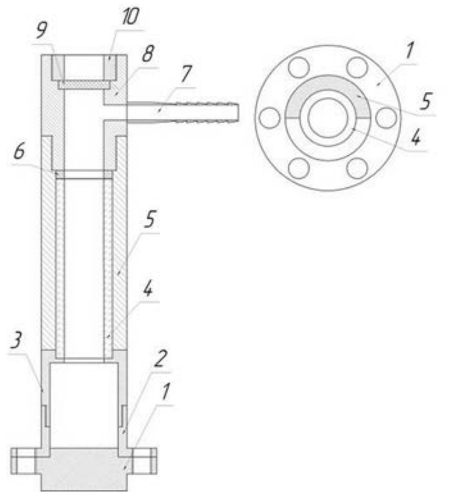

Fig. 5. Drilling barrel:
1 – backer plate; 2 – flange;
3 – bottom cylinder; 4 – Plexiglas tube;
5 – middle cylinder; 6 – bottom rubber gasket;
7 – tap; 8 – top cylinder;
9 – top rubber gasket; 10 – packing nut.

The special drilling barrel (Fig. 5), which was mentioned above, was designed to make the experiments visible through the Plexiglas tube (4). The rock specimen is placed in the bottom cylinder (3) and fixed by the backer plate (1) and the flange (2). The rubber gaskets (6, 9) suppress the mechanical vibrations and pressurize the barrel effectively. The operating fluid with the cuttings is sucked through the drain pipe, which is connected to the tap (7).

Based on theoretical and experimental investigations, the following results have been obtained:

– the possibility of increasing pellet impact drilling efficiency in tough rocks by accurate technological process coordination and adequate construction of tool string elements has been proved;
– for the first time high-speed photography (3600 shots per second) has been carried out to explore rapid processes and to develop a physical model of drilling;
– functional correlation between drilling mode efficiency and the pellet diameter, the height of operating windows, the mass of pellet portion, the nozzle diameter, the distance between the nozzle outlet and the top slice of operating windows, the distance between tool string and hole bottom, the length of the mixing chamber, the cone angle of arrestor, mud flow rate, the opening angle of a diffuser have been assessed.

Pellet impact drilling method being considered prospective, the following theoretical and experimental researches are further required:

– research on methods to maintain optimal distance between pellet impact tool string and bottom hole;
– development of runout decrease methods;
– design of detector to determine hydrodynamic parameters of two-phase flow;
– design of catching-charging device which can replace worn out pellets, run in and pull out pellets to reduce round-trip time [2].

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DRILLING PROGRAM DIRECTIONAL WELL 191 POTYMSKO-INGINSKI L.A

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Krasnoleninskoye oil and gas field is located in the Russian Federation in the western part of the Khanty-Mansi Autonomous District of the Tyumen region. Production centers are located in Nyagan. Krasnoleninsk group of fields contains several fields: Stone, Talinskoye, Em-Egovskoe, North Stone, Palyanovskoye, Inginskoe, East Inginskoe, Pottymsko-Inginskoe, Elizarovskaya swan. Oil-bearing Krasnoleninskoye field is associated with deposits of Jurassic age. The initial group of stocks is estimated 1.2 billion tons, the largest being Talinskoye [1].

The primary objective of well 191 is to produce oil at commercial rates from UK2 reservoirs. Drilling is performed by the drilling company PNG. Support is provided by drilling company Baker Hughes. This project was developed by the well drilling company Baker Hughes employees. Basic data on the well are shown in Table 1.

Table 1

Well details

Well data	
Field	Krasnoleninskoe
Pad	19
Well number	191
Well purpose	Production well
Type	Horizontal well
SURVEYING DATA	
Coordination System	Pulkovo 1942
MSL, m	41.6
North reference Wellhead coordinates	Grid North 12371783.77m E, 6829042.68m N
GEOLOGICAL DATA	
Directional borehole TD	MD, m 4505
	TVD, m 2381.0
	TVD SS, m 230
TARGET CHARACTERISTICS	
Target reservoir name	UK 2
Target size, m	T1 – 50 m

In the process of project development the lithology of the area was considered. Lithological characteristics of the area are different. There are the following types: at the beginning of the section – sand, loamy sands, clays, green clays with thin siltstone lenses, calcareous. The productive horizon is represented by Bazhenovskaya suite and consists of Brownish black argillites, black bituminous argillites with interbeds of siltstone. The section of Paleozoic age completes basement which consist of micaceous quartz shales, chlorite quarts shales, clay sericite shales, basalt, amphibolites. [2]

During the project development 191 drilling models was built. The following submission of construction of the well (Fig. 1), the plan (Fig. 2), and the cross-section (Fig. 3) are shown [3].

As previously mentioned, in the course of drilling, the following types of telesystem AutoTrak and OnTrak are used. Below some information about these kinds of telesystems is presented. AutoTrak is based on the success of the most technologically advanced Rotary Closed Loop System (RCLS), the AutoTrak G3 is the latest stage of MWD/LWD development in a rugged modular design. This third generation system opens new opportunities in all aspects of directional drilling, including both geosteering and extended reach applications. Changes in well trajectory or other downhole programming are efficiently communicated from surface without interruption to the drilling process [2].