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Powered Rotary Steerable System Technology

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Abstract: As the demand of hydrocarbons are growing high a challenge to recover from complex and inaccessible areas must be drilled and evaluated. Maximizing the production by proper reservoir management and through proper well bore placement, It requires sophisticated tools & techniques to maximize recovery and profit.
It is possible with Powered rotary steerable systems (RSS) to improve drilling rate , reduce damage, and lessen non-productive time (NPT), leads to even cut is exploration costs if we apply this with the proper drilling environment. A motor connected with wire and a hollow rotor and a flexible shaft makes a link between rotary steerable systems (RSS) and logging while drilling (LWD) downhole tools by means of Telemetry Motor Technology (TMT)
Telemetry powered Rotary Steerable System increases Rate of Penetration and reduces Stick slip vibration and Non Production Time (NPT). With the integration of advanced drilling technologies, such as TMT powered RSS and real-time downhole measurements with effective planning in offshore and onshore , it is possible to reap tangible benefits from drilling optimization. With improved performance as a result of increased torque capacity and bit speed, and reduction of the stick-slip mechanism, this new motor-driven rotary steerable technology has delivered superior performance and improved ROP in challenging thin formations.
Keywords: Recover, Sophisticated tools, Non Productive time, Flexible shaft, Stick Slip Vibration, Tangible benefits, Thin Formations.

I. INTRODUCTION

The combination of proper drilling systems with proper technology allows an efficient drilling process which cuts Non Production Time, stimulate safety and improves production. A proper BHA with a good merging of downhole tools provide a better drilling efficiency and an effective ROP. A suitable BHA design and a proper drilling system emphasis a better well planning & construction.
The rotation of a complete drill string may cause a serious damage in some formation which will end up in stuck up. In order to avoid that we used PDM mud motor system is used to turn just the drill bit without rotating the whole drill string which reduces the drill string wear especially in directional drilling. But now with Rotary steerable drilling is, as its name suggests, technology that enables full three-dimensional directional drilling control to be performed while drilling with continuous drill string rotation from surface.[1] No “slide” drilling is necessary. This capability requires a special BHA component above the bit to direct the well path in the desired direction, maintaining the orientation of the drilling trajectory independent of the rotation of the BHA and drill pipe above it. This component is the rotary steering device.

II. APPLICATIONS

Rotary Steerable system powered by Telemetry connection has more advantages which includes reduced vibration in drill string, higher rate of penetration and minimize casing wear as the rotary power is delivered directly to the bit. Drilling optimization and formation evaluation or logging sensors can be impregnated in the face of the wired motor because of the wired connection and the modular design providing great versatility to the Bottom hole assembly configuration. Telemetry powered Rotary Steerable system gives a path for incorporating variety of sensors used for various applications, including geosteering, performance drilling, and reduced stick-out in casing while drilling applications. A serious downside of torsional vibration to normal Rotary Steerable system can be ruled out by Telemetry powered Rotary Steerable system as the powered section divides the drill string from Rotary Steerable system, which increases not only the reliability on Rotary Steerable system but also for all of the electronic sensors in the string including optimization and formation evaluation sensors[2]
Telemetry powered Rotary Steerable system can resolve the problem of limited load to turn the drill string. In case of ERD and complex drilling profiles , this gives an ease of reduced stress on the rig, wear on drill string and top drive by mitigating the surface torque and extending the range capabilities.

A. Benefits

Telemetry powered Rotary Steerable System can has lot of benefits which includes, More Energy will be transmitted directly to the bit so the efficiency of crushing the formations and Rate of Penetration will be increased and also it will reduce the problems related to stuck pipe and torsional vibrations. The disengaging mechanism of the Rotary Steerable System lower the degree of vibrations to Logging While Drilling tools so that we get accurate results as well as improved life of the tool and other BHA components. With proper well planning, with the use of Rotary Steerable System we can place well path in the pay zone to get an optimum production from it.

B. Telemetry Powered Rotary Steerable System

Normally Rotary Steerable System uses MWD tools to provide communication between surfaces to the subsurface, it is crucial in directional drilling as the directional driller has to get the complete information about the subsurface condition and directional control (well path) for efficient drilling. The MWD tools information from the subsurface will help the directional driller to make sure that the well is drilled according to the well plan created by the engineers. For efficient drilling we also have to know about the formation being drilled, so an LWD tool will be placed in the Rotary Steerable System to send the information about the formation being drilled to the directional driller in the surface.[3] Normally sensors will be connected to Rotary Steerable System, Wiring the Rotary Steerable System motor allows transmission of power and high speed communications between the Rotary Steerable System and the MWD.

The main problem in the wired motor design include compensating the irregular motion of the rotor in the power section, passing the transmission section and the bearing pack and recoup for different rotational speeds between the rotor and upper housing.

As of the lobe configuration the rotor in the power section creates an eccentric and axial motion, the fewer the lobes, the higher degree of eccentric motion, the shorter the lobe the higher the degree of irregular motion. When passing a conductor from the top of the rotor to the top of the motor housing, this eccentric and axial motion must be compensated for. A mechanical compensator is used to compensate the movement in the axial and radial directions, also it will prove a bidirectional continuous conductor for power and communication transmission. As the rotor is decoupled from the upper housing rotation must be compensated by using a slip ring which allows different rotation and, provides a conductor for stable power transmission and for high frequency, high speed Communications.

The Telemetry motor design employs a titanium flex to transmit rotation from the power section to the drive shaft. This design allows incorporation of a solid conductor through a bore in the centre and provides high torque capability to drive higher loading below the wired motor. The Telemetry motor has flexibility to use virtually any conventional power section provided the torque and rev/min specification is within the tool limits and application requirements. Higher torque capability will allow for smoother rotation of the Rotary Steerable System and drill at a higher ROP. The preferred power section type's uniform wall thickness expands with temperature. Thinner rubber thickness that expands at a constant rate means that the rotor and stator can be fit precisely for high temperature application. This allows application of the Telemetry technology at temperatures up to 175°C.

C. Wired Motor— RSS BHA Design

The location of a motor in an Rotary Steerable System assembly requires consideration of the impact on the Measurement While Drilling, Rotary Steerable System, and Bottom hole assembly performance, which allows flexibility in the location of the motor in the Bottom hole assembly. The motor can be located between the Rotary Steerable System and Measurement While Drilling or within the modular Measurement While Drilling components. The optimum placement of the power section is normally directly on top of the Rotary Steerable System and below the Measurement While Drilling. This location allows torque to be passed directly to the Rotary Steerable System, allows grater bit speed without over-rotating the drill string .Measurement While Drilling, minimizes the amount of stress below the power section, and decouples vibration to the Measurement While Drilling and upper string. The Bottom hole assembly can also be designed with drilling Optimization sensors or Logging while drilling sensors located below the motor.[4] Placement of the drilling optimization sensor below the motor and above the Rotary Steerable System can be used to measure torque, weight on bit (WOB), and bending on bit, for example, directly above the Rotary Steerable System for drilling optimization. Logging while drilling sensors can be placed directly above the Rotary Steerable System and below the motor to obtain measurements closer to the bit.

The wired motor can also be configured with a bent housing for conventional motor applications, allowing power and communication to the bottom of the motor and placement of sensors directly on top of the bit. Typical applications include ranging sensors for intersection wells and Logging while drilling sensors for near bit formation evaluation.

1) *Slip Ring in RSS:* Slip Rings will be fixed in between the drill string and MWD tool. Slip rings will be used to provide a perfect connection for transmitting electrical or electronical data's given by operator at surface. Electrical connection is made between the housing and the slip ring assembly via a connector block that is fastened to a plurality of stator rings in the slip ring assembly.[5] The connector block extends radially outward from the stator rings and physically engages an opening in the housing thereby rotationally coupling the stator rings to the housing.

D. Bore Hole Quality

With RSS it is possible to maintain proper hole quality as it is fitted with Measurement while drilling tool so surveying can be done during drilling for maintaining direction and hole quality. As the drillstring rotates with the bit hole clening will be proper and so hole quality will be maintained.[6] A well from Vietnam has been shown here as an example, In this two wells have been drilled one is with mud motor and the other is with RSS. The datas of these well has been plotted as a graph Fig 3, From the graph it is inferred that, It took around 10 hrs to drill 213 ft but with RSS they have drilled 608 ft in 10 hrs. Non Production time with RSS has been decreased a lot as it is not needed to change its mode with Rotary Steerable System.

1) *Figures:*

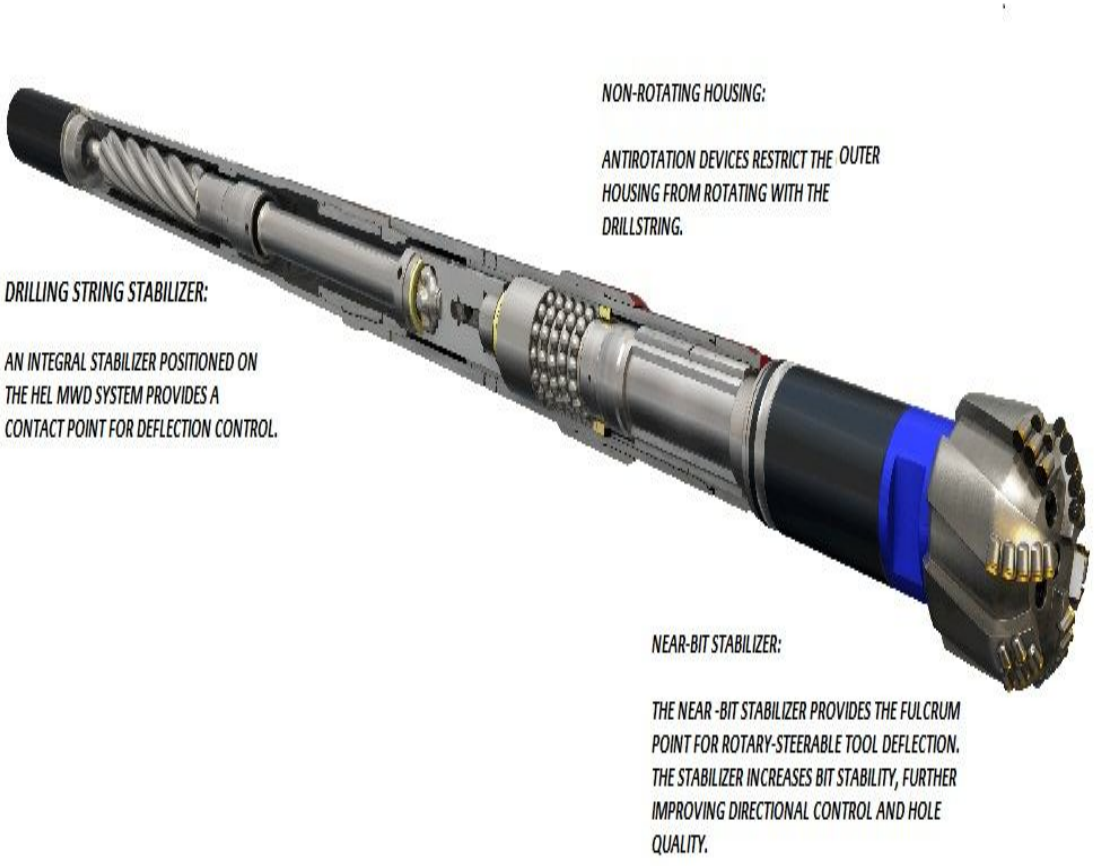

Fig : 1 .Parts of Rotary Steerable Sytem

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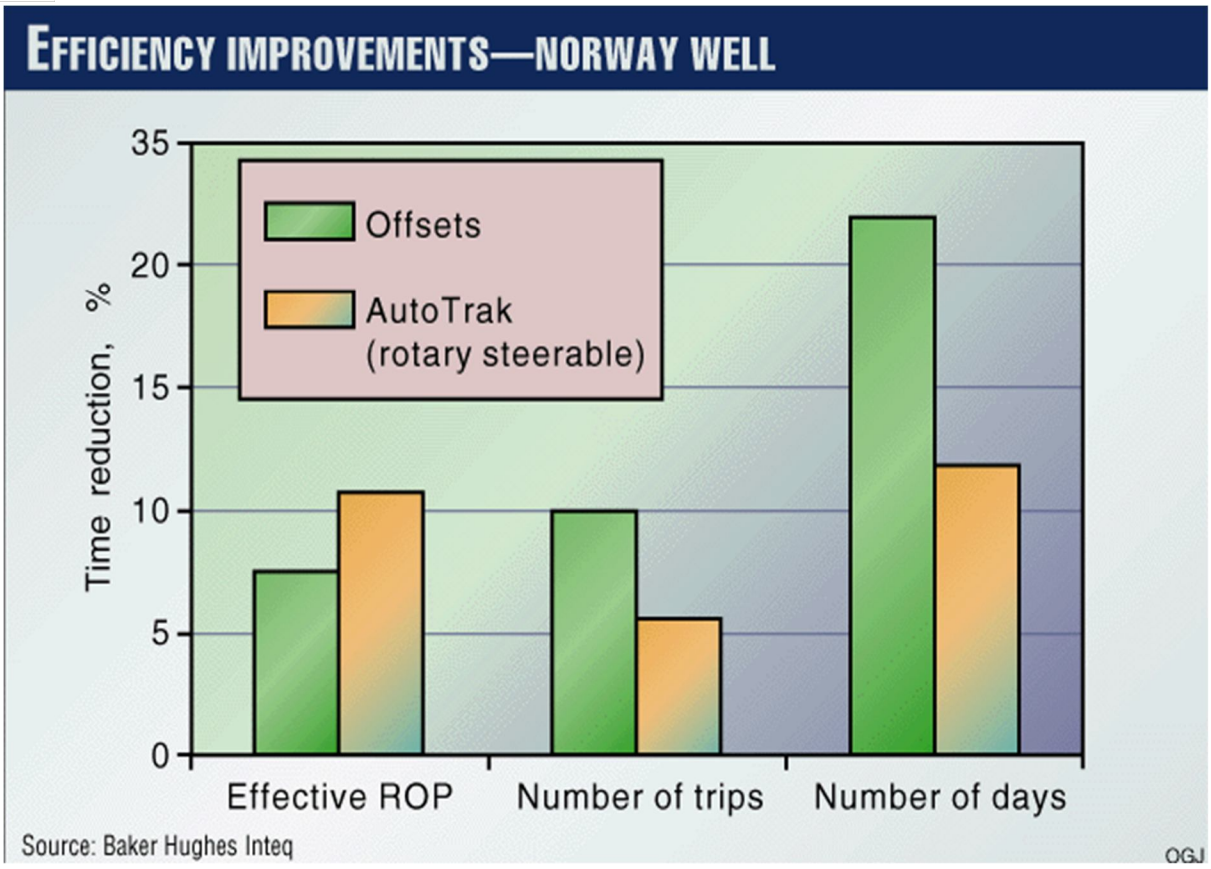

Fig : 2. Comparison between RSS and Offset drilling (Conventional drilling)

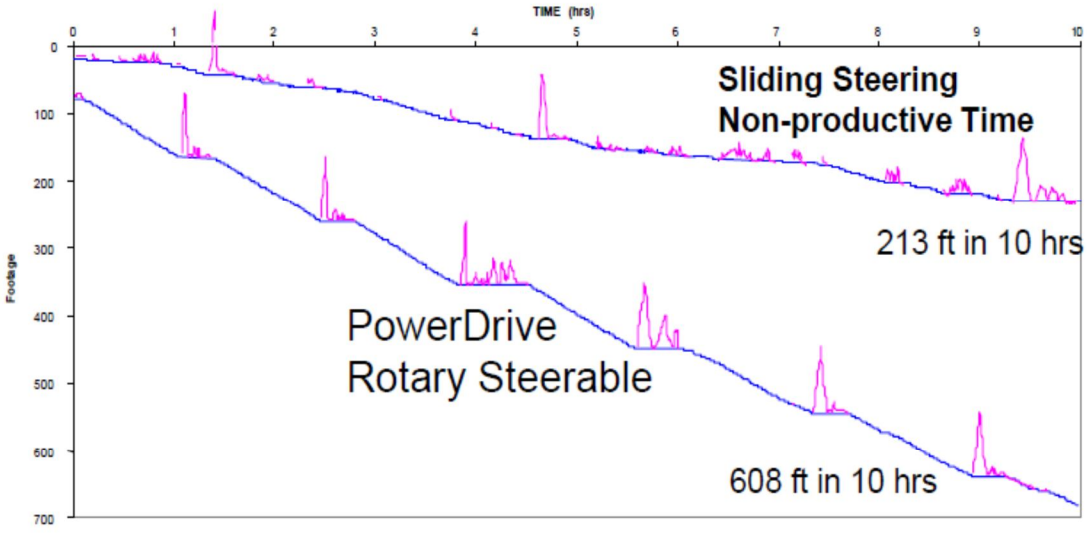

Fig. 3- Comparison between rotary steerable and steerable motor runs in the same well.

III. CONCLUSIONS

The TMT powered RSS furnished a superior performance and improved ROP in challenging medium and in hard formations by increasing torque capacity and bit speed and reduction of the stick-slip. The housing of downhole sensors ahead of the power section provides a high speed and power communications between the RSS and the MWD, The decoupling of BHA from the drill string reduces the vibrations and NPT The matched uniform wall thickness power section powering a point the bit RSS improves performance significantly in hard formations and HP/HT applications.

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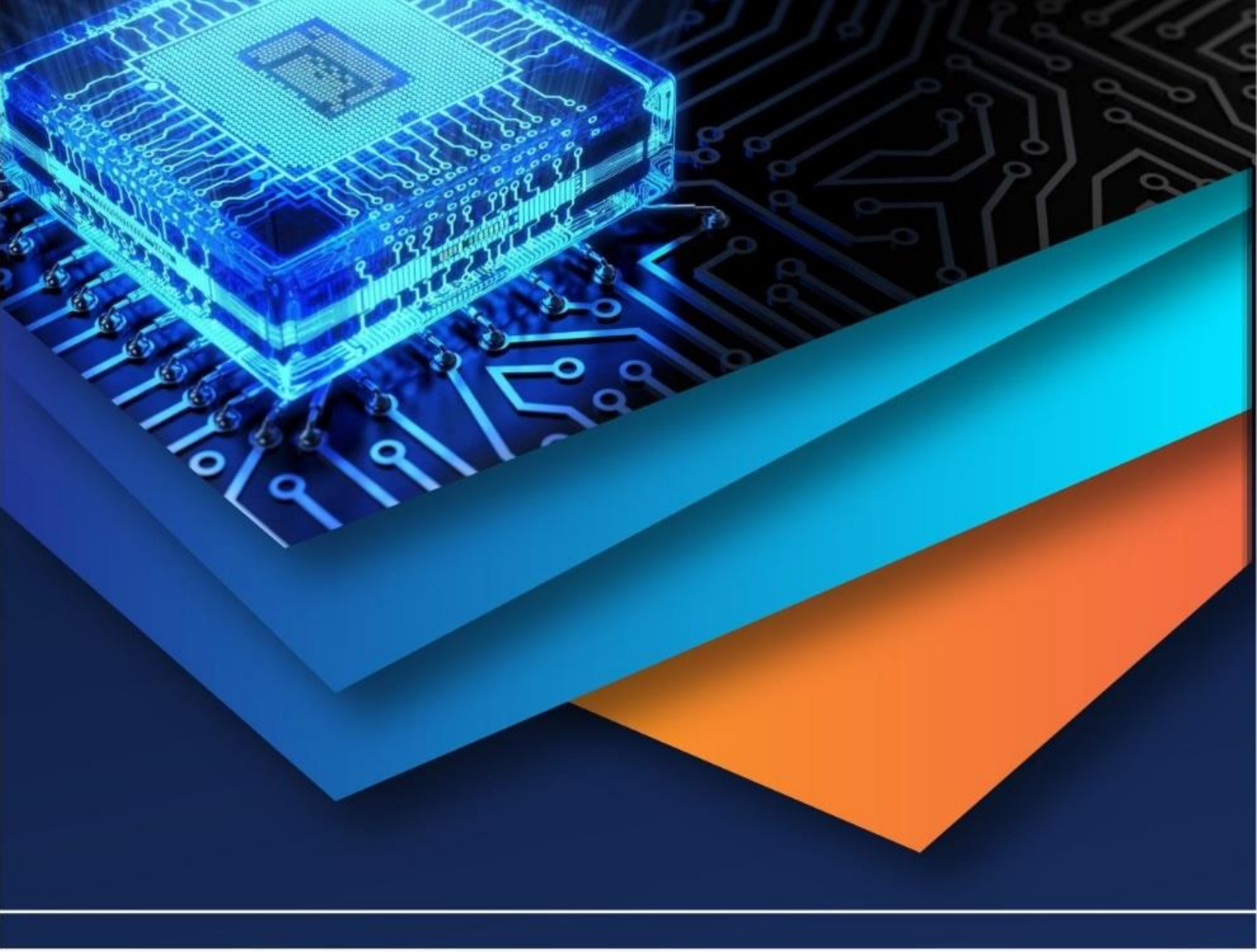

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