# AN INNOVATIVE APPROACH TO DRILL A EXTENDED REACH WELL USING HIGH TORQUE CONNECTION

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***Abstract : Horizontal wells having a lateral extent of greater than 6000ft are generating more industry problems when compared with shorter lateral wells of 2000-5000ft. While drilling these longer lateral wells, it requires numerous connections that exposed to maximum torques, bending and rotational loads which results in making the connections ineffective, that in turn results in poor sealability and mismatched string location. This paper describes how the upgraded design of high-torque connections has been employed to withstand maximum load before being installed in the wellbore. [1, 5]***

***Keywords - Torque, Lateral wells, Drill string, Loads, Connections.***

## Introduction

Directional drilling was started in 1920's and its continuous evolution lead to Extended Reach drilling from 1970's and is still improving with the upcoming technologies.

A horizontal drilling is said to be Extended Reach drilling when the horizontal departure and true vertical depth is in the ratio of greater than 2:1.

ERD = HD / TVD = 2/1 = 2

The main objective of ERD is

(i) To reach a maximum horizontal area from one surface drilling location.
(ii) To increase the productivity and drainage capability of a reservoir.

The major challenges associated with ERD are

(i) Hole cleaning
(ii) Managing Bottomhole pressure
(iii) Managing the loads on Drill string

### Hole cleaning

The removal of drill cuttings from the wellbore is a major constraint in ERD due to the following reason:

(i) Mud properties
(ii) Rate of penetration of Drill bit
(iii) Flow rate of mud
(iv) Pipe rotation speed
(v) Trip in and Trip out speed

### Managing Bottom hole Pressure

In an ERD well, the flow regimes in a subsurface varies drastically over the depth which results in the pressure deviations inside the well.

### Managing the loads on Drill string

A drill string is an assembly of drill pipe, drill collar and drill bit and it is hollow, so that the drilling fluid can be pumped down and circulated back to the surface through annulus. It also transmit the torque through the kelly. The loads acting on a drill string are

(i) Compressional load
(ii) Buckling load
(iii) Torsional force
(iv) Drag friction force

Out of these maintaining the drag friction force is a major challenge because of the drill string weight varies in the deviated sections and long horizontal laterals. It makes the casing policy complicated. To overcome this drag friction force effect, it is better to employ a casing string and production liner directly for bottom hole completions.

A success of a project is based on analysis of torque and drag for a drill string. High torque is required for a well, when the lateral departure is high. It improves the bonding of cement with the formation because of the rotation of string.

The drill string connection and the tubular joints needs to be withstand the high torque level and to maintain its mechanical and sealability performance. [6]

### Connection Methods

To mitigate the growing challenges of ERD, an innovative method was designed. The connection employs a threaded and coupled pattern that provides maximum tensile efficiency along with maximum torque capacity. The excellent torque capacity is achieved by a selflocking dovetail thread design. The seal design is a single metal to metal seal with radius to cone contact surfaces and it gives stable seal contact during all loading sequences and robust make and break performance. [3]

**Finite Element Analysis**

It is a numerical method which is used to check the performance of the product line and size of each connector. [2] The FEM helped in the evaluation and elaboration of connector designs with respect to

- ❖ Make and Break Performance
- ❖ Sealability Performance
- ❖ Elevated Temperature Performance
- ❖ Bending Performance
- ❖ Fatigue Performance

**Make and Break Performance**

It is the fundamental aspect of connection performance because the connection needs to be withstand field running conditions at extreme high torque.

Based on the American Petroleum Institute (API) Recommended Practice (RP) 5C5 for casing applications, the make and break performance was formalized productively to all sizes of connector. All make and break instances were executed at maximum torque with stability (MTS) to validate the high torque performance of the connection.

Maximum torsional value was also considered along with MTS and was illustrative of the maximum torque that could be applied to the string while maintaining structural performance.

**Sealability Performance**

The connection was validated to API RP 5C5 connection Application level IV.

**Elevated Temperature Performance**

The high torque connection was validated for temperatures upto 180°C using yellow rated thread compound with combined load test sequences.

**Bending Performance**

When drilling along the shale region, bending is a critical aspect of the connection performance and was validated particularly. In numerous cases, the maximum bending of 40% (upto 42°/100 ft) was applied to the connection during elevated-temperature tests.

**Fatigue Performance**

The fatigue performance of the new connection was characterized by using six specimens. Stresses were applied to each of the specimen in the form of bending, with a minimum pressure of 100 psi applied from inside of the sample to detect the leaks thereby confirming the samples are in good condition. Three different bending levels were tested and the connection performed well.

**Rig Test**

To confirm the robustness and performance during installation at the wellbore, a rig-running simulation was executed on 10 joints of the pipe, which were produced on the production lines.

The following conditions were tested:

- ❖ Fast makeup speed
- ❖ Misalignment
- ❖ Triple stand
- ❖ High torque

No anomalies were encountered, the connection performed very well during the trial.

**Operation Report**

When the number of deviated wells increases, the operating company needs to validate the high-torque connections and quality of the pipes that can be able to withstand high-load conditions during the operational frequencies throughout the well cycle.

**Conclusion**

Even though the production casing string of 4 ½” - 5 ½” is the most commonly used size range but in this study a 7” casing along with liners in order to reduce fracture pressure.

In this study, a build rate of 10°/100 ft is used for installing the production casing of 7” which allows 25 to 30 joints of casing string can be installed in a hour. For which the oil based mud is used to facilitate the process in a speedy manner. [4]

It is shown from this paper that for a successful completion of longer extended reach lateral wells this high torque connection casing is highly recommended.

**References**

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