“Horizontal Drilling Technology”

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Vertical and Horizontal Drilling:

Definition of horizontal and vertical wells, Information required to drill vertical (such as location in coordinates, casing points, and Target as TVD), while the information required to drill horizontal wells are more (they include the same information of vertical drilling plus direction of the well and the inclination as well as length of horizontal section). Bottomhole Assembly (BHA) in case of vertical and horizontal wells.

The designing steps of BHA in case of vertical drilling, which includes the calculation of DC length based of WOB. The WOB is taken from the recommended operating parameters of bit manufacturer. Also, in this lecture, the main function of drill pipe will be highlighted, thus the drill pipe is not subjected to compression to avoid fatigue.

Types of BHA in vertical drilling including stabilizers. Explaining the terms and figures distributed related to BHA.

Planning Horizontal Wells:

Advantages and Reasons of horizontal wells (at least 10 points will be mentioned and explained)

Well profile on horizontal wells, which include KOP, Build up section, End of build and Tangent section. Detailed definitions and explaining those items will be presented. Functions of Tangent section.

The importance and definitions of Azimuth and inclination and how to express the direction in degrees. The combination of both items is presented as DLS.

The differences between True vertical depth (TVD) and measured depth (MD) are explained including examples of cases in which MD and TVD are important.

Types of horizontal wells based on radius (Figure available), BUR of each type and length of horizontal sections. Differences between all of the types are provided.

Types of horizontal wells based on shapes (Build and hold –Slant-, S-shape, Continuous build, horizontal wells (J-Well) and other shapes.

Horizontal Drilling Procedures:

Kick off tools and procedures of each method: - Jetting, - Whipestock and Mud motor. In this lecture the Jetting and Whipestock will be explained and the term
**Sidetracking**, which is converting old vertical wells into horizontal wells, will be highlighted.

Mud motor as a common used Kick Off tool. The parts of PDM will be mentioned and explained such as Rotor, Stator, Lobe, Bearing, Fixed and flexible Bent housing, Bent-sub, Stage, dump sub.

Other expresses and terms related to horizontal drilling will be explained such as Toolface setting, high side and low side as well as the terms Sliding and time drilling.

Also, related to the mud motors, the relationship between Lobes and RPM as well as Torque will be presented with the help of *Sperry Sun* charts of different mud motors. *(Description and differences between Mud motor and Drill-Turbine will be presented)*

**Calculation Methods:**

Calculation of required values such as dogleg severity, TVD, Closure (vertical section), N/S and E/W and other values using standard methods.

Presenting other calculation methods such as average angle method, minimum curvature method and Radius of curvature method. Field examples to calculate the necessary data and solve some examples related to horizontal drilling in general. 1st example is to show how the TVD can be corrected (TVD drop), sliding distance and rotating mode will be calculated. The 2nd example, in which is the bit at penetrating the oil/water contact. The penetration depth of the bit as well as the measured depth in the water-zone will be calculated.

**Surveying Tools and procedures:**

Surveying tools in general, reasons for taking survey, accurate knowledge of the course while drilling etc., Single shot survey, which is applied in vertical drilling to check the deviation in vertical drilling and types of single shot survey (wire line, Totco drop before POOH), the importance of NMDC in vertical drilling, which is used to shield the Survey tools.

Types of North references: True, magnetic and grid north. Magnetic interference and magnetic declination correction.

Magnetic interference and its influence on taking survey, Non-magnetic DC and minimum length of DC required ignoring the magnetic interference.

Survey systems: Mechanical survey systems and Electronic Magnetic Survey system

**Optimum length of horizontal wells will be also presented.**