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Magnetic Referencing and Real-Time Survey Processing Enables Tighter Spacing of Long-Reach Wells

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Abstract

Positional uncertainty in wellbores is caused by numerous error sources and propagates in magnitude along the measured depth of the wellbore. This can be problematic when planning or drilling closely spaced long-reach wells while still satisfying collision avoidance policies. The ellipses of uncertainty associated with surveys acquired by standard Measurement While Drilling (MWD) tools are often too large to enable adequate separation factors between wells. MWD tools are instruments mounted inside the bottom hole assembly (BHA) and use an accelerometer and magnetometer sensor package to determine the inclination and magnetic azimuth while drilling. The magnetic azimuth is used to calculate a true (geographic) azimuth by adding the declination angle from a geomagnetic reference model. The largest sources of error in standard MWD survey are inaccuracies in the global geomagnetic reference model and magnetic interference from the BHA. These error sources can be reduced significantly by using a local geomagnetic In-Field Referencing (IFR) model and by subsequently applying multi-station analysis (MSA) corrections to the raw survey measurements.

IFR models are computed from locally acquired aeromagnetic measurements of the geomagnetic field. By solving LaPlace's equation, a 3D magnetic model of the local crustal magnetic anomalies is produced. This greatly improves the resolution and accuracy of the geomagnetic reference field used to determine wellbore direction. Once the geomagnetic reference field is accurately specified by IFR, magnetic interference from the drill string can be identified and removed through MSA correction. Decreasing the ellipses of uncertainty of the wellbore position will reduce collision risk, improve confidence in geological modeling, and maximize reservoir recovery.