TECH BRIEF

THE RELIABILITY PROBLEM RELATED TO DIRECTIONAL SURVEY DATA

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INDUSTRY CHALLENGE + OBJECTIVE

Like all measurements, downhole directional surveys are subject to error. The validity of error model of wellbore positional accuracy is highly dependent on the application of rigorous quality control (QC) procedures. Failure to apply necessary operational procedures causes the reliability of generated survey data to be called into question. Survey errors can be significant with respect to the positional objectives for a well. Directional survey data that does not conform to the associated model predictions presents a risk in terms of lost production, damage to infrastructure and loss of life.

The technical paper (IADC/SPE 103734) lists multiple sources of survey error, describes internal data checks that are capable of identifying many of them and highlights those that cannot be checked. Error terms that cannot be identified using internal QC procedures require alternative QC measures. In this paper, real wellbore survey data are used to illustrate how the use of inadequate QC procedures can lead to invalid survey data being accepted as valid.

TECHNOLOGY + SERVICE SOLUTION

- Survey error models, also known as instrument performance models, provide an estimate of the position uncertainty associated with any proposed survey program.
  - Gravity error test to QC the inclination and/or tool face measurements performed with xyz accelerometer systems;
  - Horizontal Earth rate test to QC the azimuth measurements performed with xy gyrocompassing instruments;
  - Total magnetic field + dip test to QC the azimuth measurements performed with xyz magnetometer instruments;
  - Rotation-shot misalignment test to QC the inclination measurements for misalignment errors; and
  - Dual-depth difference test to QC the depth measurements when two independent depth measurements are present.
- The quality of single-station/single depth QC tests are usually dependent on tool/wellbore orientation.
- Multi-station versions of many of these tests are often used, such as the multi-station accelerometer, gyro and magnetometer tests. The paper describes how these tests can be expanded to create a full multi-station estimation process for gyroscopic or magnetic systems with simultaneous estimation of azimuth angles and systematic errors. The effectiveness of all such tests are dependent on wellbore geometry.

RESULT + VALUE DELIVERED

- Position uncertainty estimates are invalid when associated with unreliable survey data. The survey QC is sometimes not sufficiently rigorous to assure reliability.
- Internal data checks can provide a significant degree of reliability.
- Multi-station test/analysis is the most powerful method of internal control.
- Internal data checks alone cannot assure survey data reliability; for example, it is not possible to QC magnetic declination and sag error.
- Supplementary data and additional quality tests are required for high-integrity wellbore positions.

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