TECH BRIEF

HIGH-INTEGRITY WELLBORE SURVEYS: METHODS FOR ELIMINATING GROSS ERRORS

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INDUSTRY CHALLENGE + OBJECTIVE

Unreliable directional survey data can pose potential safety issues and end up increasing commercial costs for operators. The application of quality control (QC) checks can help provide a significant degree of reliability for survey data. However, QC checks do not provide comprehensive reliability assurance.

A 2007-technical paper (SPE/IADC 105558) documents weaknesses in conventional directional survey QC procedures through theoretical considerations, statistical analyses of real survey data and real examples of failed surveys that made it through conventional QC procedures without detection.

TECHNOLOGY + SERVICE SOLUTION

- Statistical tests are used to ensure that directional survey measurements have an accuracy that is compatible with the applied error model. Internal QC checks, which are based only on single-source downhole data, are not sufficient to fully validate a survey against its error model (see SPE 103734).
- External QC checks, including the independent cross checking of all aspects of data acquisition and data processing, are required to fully validate a survey against its error model. The following QC tests are described in this technical paper:
  - An in-run/out-run measurement test designed to control misalignment errors.
  - A continuous azimuth drift test used to check cumulative azimuth errors, caused by a gyro drift and random walk, in-continuous gyro and inertial navigation system surveys.
  - An inclination difference test used to check the combined effect of all inclination error terms.
  - An azimuth difference test used to check the combined effect of all azimuth error terms.
  - A co-ordinate difference test used to control the combined effect of multiple error terms that contribute to overall survey accuracy.
- The paper also describes how the global validation of tool error models can be carried out based on statistical analysis, given that sufficient downhole data collected under real operational conditions is available.

RESULT + VALUE DELIVERED

- For survey data to contribute to the drilling of safe and productive wells, it is necessary that the survey error models truly reflect the accuracy of the actual surveys. Position uncertainty estimates are invalid when they are associated with unreliable survey data.
- The independent cross checking of all aspects of data acquisition and processing is a good practice and aids the identification of gross errors. However, it does not provide the numerical quantification of agreement between data and error model prediction that independent redundant surveys do.
- The highest level of reliability is achieved by the application of three QC techniques: internal checks, external checks and independent cross checking.
- A combination of QC tests based on inclination, azimuth and co-ordinate differences relative to an independent verification survey is the most powerful QC tool available.
- Although a second independent survey cannot separately identify all potential errors, it is still the most powerful external data QC check.

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