TECH BRIEF

HIGH-INTEGRITY WELLBORE SURVEYING

AUTHORS

Gyrodata Inc.

- John Weston, SPE
- Roger Ekseth, SPE
- Kazimir Kovalenko, SPE

Baker Hughes

- Andrew Brooks, SPE
- Harry Wilson, SPE

SINTEF

- Torgeir Torkildsen, SPE

Statoil

- Erik Nyrnes, SPE

PUBLICATION

- Society of Petroleum Engineers
- SPE-133417, 2010

INDUSTRY CHALLENGE + OBJECTIVE

Position-uncertainty estimates are used to determine if there is an adequate probability of hitting a geological target, of avoiding collisions with offset wells and of drilling a successful relief well in the event of a blowout. Experts make these important decisions based on tool-error-model predictions. The validity of these predictions is highly dependent on the application of rigorous quality-control (QC) procedures to the survey data. As a result, directional survey QC procedures are crucial, and weaknesses in them can cause risks in terms of lost production, damage to infrastructure and loss of life.

The 2010-technical paper (SPE-133417) includes theoretical considerations, statistical analyses of real survey data as well as examples of failed surveys that made it through conventional QC procedures undetected. The technical paper evaluates a range of QC tests and shows which error terms are controlled by which tests. The results of the evaluation point out weaknesses in common practices. This paper also describes two methods of validating error models using cumulated QC data.

TECHNOLOGY + SERVICE SOLUTION

- Survey QC tests need to be conducted in order to validate survey accuracy claims. An understanding of the strengths and weaknesses of the several tests will promote good survey practices, which will provide optimum control of survey errors. The technical paper examines the following:
  - Standard confidence level;
  - Georeference QC tests;
  - Multi-station, repeated measurement and independent survey QC tests;
  - Recommended use of QC methods; and
  - Error-model validation.

RESULT + VALUE DELIVERED

- Systematic validation of error models is required to ensure directional data integrity and may be based on statistical analysis of cumulative QC test data on an on-going basis.
- A combination of dedicated QC processes involving georeference checks relative to the local Earth's gravity, magnetic and rotation fields, multistation tests, repeated measurements, and independent verification surveys are needed to ensure a survey reliability level that is consistent with the demands embedded in instrument performance/ error models.
- Georeference checks, multistation tests, and repeated measurements may protect against a wide range of potential gross errors and should be used to maximize the survey reliability when possible during a drilling process.
- A data check, consisting of combined comparisons of inclinations, azimuths, and coordinates relative to an independent verification survey, is the most powerful QC test method available. Georeference checks usually have to be supplemented with data checks based on a comparison of inclinations, azimuths, and/or coordinates relative to independent verification surveys to ensure optimal survey reliability.
- These QC procedures, together with a standardized 99.7% confidence level, should be incorporated into common practice for the wellbore survey operations.

gyrodata