

# ISCWSA / SPE Wellbore Positioning Technical Section

## Error Model Maintenance Work Group

Minutes of the Meeting at ISCWSA#44, Glasgow , 21<sup>st</sup> September 2016

### Present

Andy McGregor	Tech21	Phil Harbidge	Schlumberger
Jerry Codling	Landmark	Harry Wilson	Baker Hughes
Darren Aklestad	Schlumberger	Erik Nyrrnes	Statoil
Andy Sentence	DGI	Jon Bang	Gyrodatta
Andy Brooks	Independent	Steve Grindrod	Copsegrove
Adrian Ledroz	Gyrodatta	Stefan Maus	MagVar
Ed Dew	Pioneer	Jonathan Lightfoot	Occidental
Pete Clark	Chevron	Anas Sikal	Pathcontrol
Hans Dreisig	Maersk	Brett Van Steenwyk	Scientific Drilling
Laura Pirie	Scientific Drilling	Chad Hanak	SuperiorQC
Susan Macmillan	BGS	Steve Sawaryn	Consultant
Ciaran Beggan	BGS	Olivier Cousso	Total
Leida Monterrosa	Schlumberger	Nicolas Rigard	Total

### Documentation

Andy McGregor has produced a first draft of the error model definition document which is now ready for review. Also, Andy Brooks has provided some spreadsheets which layout the calculation of gyro test cases. These are very complete but need some simplification or explanation for the more general user.

**ACTION: Adrian Ledroz, Steve Grindrod, Ciaran Beggan to review the error model documentation.**

**ACTION: Andy McGregor to work with Andy Brook' spreadsheets.**

### Verification Test Cases

Steve Grindrod has provided verification diagnostic files for the latest MWD revisions on the three test wells. However, we have identified that a more complete set of verification data should include:

- I. MWD and MWD+Axial tie-ons are per the MWD paper, but using the latest revision 4 of the MWD model.
- II. Gyro to MWD tie-ons
- III. Inclination only models - using 'real' inclination data rather than the smooth synthetic well paths of the normal test wells.

**Actions – Darren Aklestad, Andy Sentence and Steve Grindrod.**

## **Gyro Model Verification**

As a continuation of the discussion about verification data sets, concerns were expressed that it has been difficult to replicate the test results for Test Gyro Model #3 on ISCWSA Test Well#3 as detailed in the gyro model paper.

Adrian Ledroz confirmed that re-initialisation of the gyro would be how Gyrodata tools would be function in hole and therefore the model should follow this. There were some thoughts that both interpolated points at 15 deg inclination were needed to model the test case and all 10m survey intervals in the curve.

This point should be clarified some we have confidence in our test data.

**Action: Adrian Ledroz, Steve Grindrod and Gerry Codling to examine this case and define new test values if necessary.**

## **Inclination Only Surveys - Tie-ons**

The guidance document on inclination only surveys has previously been published. Jerry Codling to add some further detail on how to handle tie-ons to regular surveys.

**Action: Jerry Codling**

## **Effect of Error Correlation on Uncertainty Value**

Work on the effect of correlated geomagnetic reference terms is on-going. This is needed for the correct use of combined covariance methods in the anti-collision methodology.

Andy McGregor implemented the method for handling partial correlation's that Jon Bang described at the previous meeting.

For the limit conditions of uncorrelated ( $\rho=0$ ) and fully correlated ( $\rho=1$ ) this broadly matched the results provided by Andy Sentence and Harry Wilson at the previous meeting and matched what theory would suggest.

Results were also run for partial correlations of 0.4 and 0.7 – these are values which are in line with previous estimates for surveys which share the same IFR or global model respectively. The results still showed some significant differences in ellipse dimensions from current combined covariance methods. As might be anticipated, these differences were most marked in scenarios where the geomagnetic reference terms had most significant in the overall error results i.e. multiple legs using standard magnetic models. The differences were less significant for single survey leg wells with IFR.

The analysis suggests that an analytical solution might be achievable. Also, it was noted that we only need to consider the non-vertical elements of maximum of four error sources (DECG, DBHG, MFI and MDI).

**Action: Andy McGregor and Jon Bang to look into this further**

## Geomagnetic Look Up Tables

Susan McMillan presented an update on work being done by BGS to update the lookup tables for modelling BGGM accuracy.

Accuracies have improved at the upper confidence limits. BGS hope to have the new tables available before the next meeting. There was a suggestion that focus on these tables should be created at 3-sigma for scaling back to 1-sigma. There was some debate over whether the same tables could be scaled for other global models and how other models could be validated without access to proprietary data.

A decision on whether to formal adopt these was postponed until we have the new tables.

## Course Length

Andy McGregor presented some results from an analysis a large database with many historic surveys. This showed that quite a significant percentage of the total footage of hole in the database was drilled at survey intervals greater than 140ft.

Based on Jerry Codling's previous work on including a course length term in the model – which presented in detail at previous meetings - Steve Grindrod showed some work looking at the effect of long course length models on the test wells – both the size of the ellipses at various course lengths and the change in wellbore position. This highlighted the problems which exist if the survey measurements miss a point of inflection of the wellpath.

Jerry Codling has some modified COMPASS IPM files which implement these models for MWD and for Film Based Magnetics and Gyro, both single and multi-shots.

IPM files will be distributed for others to test on their databases, with a view to formally accepting these changes at the next meeting.

**ACTION: All to evaluate the new XCL models and to consider whether we wish to adopt the new sources at the next meeting.**

## Validation Requirements

There was a brief discussion about what evidence a supplier would be expected to provide in order to validate or backup an error model which they have created. Use of test data, repeatability of calibration values, in-hole tests etc. were all mentioned. In addition, operating procedures, QA\QC tests and staff competency were highlighted. The group felt that no further guidance material was necessary.

## Hole Misalignments

When the ISCWSA Rev4 model was introduced, hole misalignment magnitudes were increased from 0.06 deg to 0.1 deg. This was in line with evidence presented at previous meetings by Pathcontrol which suggested that misalignments greater than 0.06 deg were possible.

Despite the option of having sliding and rotating toolcodes with systematic or random propagation respectively, most implementations of the model seem to assume systematic hole misalignments. This is the most conservative option. However, this means that we have both a larger magnitude and the most conservative propagation mode. This can have an influence on top hole anti-collision.

There was some limited discussion about whether we were being overly conservative. Various alternative suggestions were made – having both a systematic and random component or having a larger random only component.

There were various views in the room and no consensus was reached. This matter was held over for a future meeting.