ISCWSA / SPE Wellbore Positioning Technical Section

Error Model Maintenance Work Group

Minutes of the Meeting at ISCWSA#41, Excel London, 19th March 2015

Present

Andy McGregor	Tech21	Harry Wilson	Baker Hughes
Son Pham	Conoco Phillips	James Ang	Benchtree
Anas Sikal	Pathcontrol	Lee Roitberg	Benchtree
Anne Holmes	Sperry Drilling	Brett van Steenwyk	Scientific Drilling
Jim Bowe	Sperry Drilling	Ellen Clarke	BGS
Steve Grindrod	Copsegrove	Susan McMillan	BGS
Adrian Ledroz	Gyrodata	Jerry Codling	Landmark
Jon Bang	Gyrodata	Andy Sentence	Dynamic Graphics
Stefan Maus	MagVar		
Erik Nyrnes	Statoil		

Membership

Membership of the error model committee stands at 54, with many non-attending members. The group agreed that going forward minutes will be posted on the website. All current members will be asked if they wish to continue.

Action: Andy McGregor to e-mail member list

Error Model Documentation

Steve has compiled all the ISCWSA MWD model revisions in the same spreadsheet format used for OWSG, along with rev3 diagnostic files. There's been little other progress on the error model documentation since last meeting. Andy Sentence volunteered to join the sub-group for this task.

There was also discussion about making it very clear on the web site that the committee does not certify vendor's models.

Action: Andy McGregor to circulate document to the sub-group outline by end of April
Action: Andy McGregor to add a section to website re (non) certification.

OWSG Model

Steve Grindrod described proposed changes to the OWSG models which will become OWSG Rev2. These include a change to the AMIL term value from 300nT to 220nT and also the addition of random terms for the geomagnetic reference fields as described by Stefan Maus as the previous meeting. He also presented results from a number of OWSG models on the ISCWSA test wells. See that attached file OWSG_Rev2_Steve_Grindrod.ppt.

The OWSG is also moving towards defining field acceptance criteria to go with the models that it has created.

ISCWSA MWD Rev4

At the previous meeting adoption of the AMIL term was agreed, but the term value left undefined. 227nT would match the AMIC+AMID terms at the worst case 90/90 orientation, for mid-latitudes with Bhorizontal = 20,000nT. But AMIL then returns smaller azimuth uncertainties than AMIC+ AMID at other attitudes.

The meeting agreed to adopt the same 220nT value as the OWSG Rev2.

The increase of misalignment terms from 0.06 deg to 0.1 deg was discussed at a previous meeting, in order to be more conservative for anti-collision calculations in low angle wells. The meeting agreed that these values would be adopted for the ISCWSA model.

Along with the addition of the random component of the geomagnetic field discussed at the last meeting, these changes constitute rev4 of the ISCWSA MWD model.

Action: Steve Grindrod to update spreadsheet definitions to include Rev4.

Lookup Tables for Geomagnetic Reference Error Sources

Susan McMillan gave a presentation on the lookup tables for BGGM uncertainty. She concluded that the current four parameter sets cannot accommodate the underlying physics as well as the lookup tables, that the current values are generally quite conservative so that reductions in uncertainties could be expected – particularly so for dip at mid-latitudes and that the only term which might be a little optimistic was Btotal at high latitudes. See the attached presentation *BGGM_Lookup_Tables_Susan_McMillan.pptx*

Harry Wilson also offered to share details of BHI specific terms which use the horizontal component of the field to model more variations than the ISCWSA current terms.

There was a long debate about whether lookup tables were needed, whether different tables would be needed for the various other magnetic models available, if the lookup tables needed to be tool code specific to model variations in the disturbance field, how best to implement the tables and to handle updates, if they should be included with the code for the magnetic models etc.

Ultimately no consensus was reached and therefore a small work group was formed to take this further and make a recommendation. This group comprises Steve Grindrod, Gerry Codling, Susan McMillan, Stefan Maus and Anne Holmes.

Action: Work group to report back at next meeting.
Action: Harry Wilson to provide details of Baker Hughes terms

Correlation of Magnetic Field Error Sources

The anti-collision committee are trying to standardise on a unified method of performing anti-collision calculations. They have decided on combining the covariance matrices from the primary and offset wells, but to do this correctly requires that any correlation between error sources is taken into account. In particular questions arose to correlation between the geomagnetic reference terms.

Harry Wilson, Torgeir Torkildsen and Stefan Maus have done some work trying to quantify the correlations. See that attached Excel spreadsheet *Wellpath correlation between geomagnetic reference values_15Mar15.xlsx.* This analysis gives estimated correlation coefficients between 0.04 and 0.78.

The error model does not allow partial correlations only integer correlation coefficients are currently defined, either 0 (uncorrelated) or 1 (totally correlated) via the various propagation modes (random, systematic, well by well and global)

Given this, the aim had been to come up with representative ballpark correlation numbers rather than very precise values. BGS were asked to review the work that had been done in establishing the values in the spreadsheet.

The original definition of the MWD error model only considered one magnetic model (BGGM) and therefore assumed that the geomagnetic terms were correlated via coefficient 3. However, current common practise they have not been implemented in this way and covariance matrices are summed and hence the geomagnetic terms are handled as if they were uncorrelated. In most scenarios this is a conservative option.

Nowadays, with several different magnetic models and IFR1, IFR2 from different providers the situation is more complex.

The discussion covered the values in the spreadsheet; how to handle these possible combinations from a procedural point of view; the relative azimuth of two wells can be a factor and may require that the uncertainties are summed from the end of one well up to surface and then back down the second well; if any distortions would be created by arbitrarily assign the partial correlation values to integers 1 or 0 and also how to handle different magnetic references from leg to leg in the same well.

Later in the anti-collision meeting it was agreed that this matter was important and that we should probably look to define a technically correct solution to cover future scenarios.

Action: BGS to review spreadsheet.
Action: Further discussion deferred to next meeting.

Inclination Only Models

The current recommendations for handling inclination only models, recommends that well be positioned vertically and that inclination measurements are used in the uncertainty calculations. TVD is set equal to MD with an additional uncertainty allowance to compensate for the resulting error in TVD. Concerns have been raised about this due to the need for repeatable TVD for example for reservoir modelling.

Without azimuth it is not possible to create a consistent set of md, inclination, tvd and well position. Something must be compromised. Harry Wilson ran through the alternatives.
The meeting agreed that md and inclination should be as measured, tvd derived from this data but that the well ΔEast and ΔNorth forced to zero.
Action: Harry Wilson to update the Recommendations for Inclination Only document.

Variation of Uncertainty in IFR2 Corrections with Distance from Observatory

Ellen Clarke gave a presentation of early results from a work in progress at BGS which looks at how the accuracy of IFR2 corrections varies with distance from a magnetic observatory. This was done by looking at the disturbance field errors between high latitude observatories at differing separation distances. Data from several years has been included, allowing an analysis of how these errors have varied historically. Essentially this work is trying to quantify at what is the limiting distance from an observatory for IFR2 corrections to be beneficial. It is hoped that Ellen will present the final results when this work is complete.

Course Length

Discussion on course length deferred due to time constraints.