

## ISCWSA MWD Error Model Revision 4

Details of changes in this revision:

- 1) The magnitudes of the borehole misalignment terms have been increased from 0.06deg to 0.1 deg.

This change was implemented because, after consideration, the group felt that the existing values were too optimistic particularly in top hole. Hence ellipse sizes can be expected to be larger in top hole.

- 2) Replacement of the existing AMID and AMIC drillstring interference terms (which had units in degrees) with the AMIL term (which is specified in nano-Tesla).

This reflects a change in how many companies do their non-mag spacing calculations. The older terms followed the philosophy in SPE67616, "A well-established industry practice is to require nonmagnetic spacing sufficient to keep the azimuth error below a fixed tolerance ~typically 0.5° at 1 s.d.! for assumed pole strengths and a given hole direction. This tolerance may need to be compromised in the least favorable hole directions."

The use of the AMIL term assumes that BHA's are designed with a specific length of non-mag and hence a consistent level of expected drillstring magnetic interference. This effect that this magnetic interference has on azimuth will then vary dependant on the well inclination, azimuth and the horizontal component of the Earth's magnetic field. For the same BHA, large angular errors can be expected at higher latitudes.

A magnitude of 220nT was chosen for AMIL, as a reasonable generic value. This gives reasonable agreement to the old model at mid-latitudes. However, the behaviour of the AMIL term is inherently different to AMIC+AMID and hence the error model will give different results depending on the well orientation and location.

- 3) Addition of DECR, DBHR, MDIR and MFIR terms to model random fluctuations in the geomagnetic reference field for declination, total field and dip.

These terms were added for consistency with some of the commonly used IFR models. They will have a limited effect on the ellipse sizes, but will influence any field acceptance criteria derived from the error model values.