

ISCWSA / SPE Wellbore Positioning Technical Section

Collision Avoidance Work Group

17th meeting, Amsterdam, The Netherlands, 31st October 2014

Attendees:

Group 1

Steve Sawaryn	BP
Andy Brooks	Schlumberger
Darren Aklestad	Schlumberger
Anas Sikal	Pathcontrol
Lee Roitberg	Benchtree
Erik Nyrnes	Statoil ASA
Torgier Torkildsen	Wellpos AS
Harry Wilson	Baker Hughes
Jon Bang	Gyrodata
Angus Jamieson	University of Highlands and Islands
Jerry Codling	Halliburton

Group 2

Aprameya Murali Dhara	Weatherford
Pete Clark	Chevron
Steve Grindrod	Copsgrove Developments Ltd
Tim White	USGS
Neil Bergstrom	Devon
James Ang	Bench Tree
Andy Sentence	Dynamic Graphics
Robert Bacon	BP

Group 3

Son Pham	ConocoPhillips
Adrian Ledroz	Gyrodata
Ian Mitchell	Halliburton
Benny Poedjono	Schlumberger
Hans Dreisig	Maersk Oil and Gas
Ross Lowden	Schlumberger
Bill Allen	BP

MINUTES OF MEETING

The goal of the Amsterdam meeting was to outline the proposed recommendations so that a few individuals can create a draft for discussion via email by the CA Workgroup prior to the London Drilling Meeting in March 2015, followed by confirmation of the recommendations by the CA Workgroup at that meeting.

One of the statements made at the New Orleans meeting was that a CA rule needs to be presented within a management framework. Because of this and for completeness, all three goals identified at the meeting need to be addressed. These will be addressed by three teams:

1. **Unified Collision Avoidance Rule [UCAR – Steve Sawaryn]:** Comparison of different collision avoidance methods, advantages and disadvantages.
2. **Assurance and Verification [A&V – Pete Clark]:** When business partner does collision avoidance scan, assurance that SF is acceptably similar? Create test framework and index. Base the approach around the Operator Group work.
3. **Management Principles [MP – Bill Allen]:** General expectation for the collision avoidance process. Base the approach around the existing ISCWSA Fundamentals of Good Collision Avoidance Management document.

Principles:

There were many more principles offered at the Long Beach meeting. These have not been wilfully ignored, but in selecting the eight below an attempt has been made to construct a minimum set, combining ideas where possible.

- 1) The recommendations may only refer to existing methods and algorithms, described in a recognised, publically available paper (preferably peer reviewed).
- 2) We will recognise that future improvements are likely and we will be open to evolving the recommendation in a controlled manner, through peer review and management of change.
- 3) The adopted method will distinguish between HSE and non-HSE collisions and be risk-sensitive.
- 4) We will address rule(s) for both planning and for execution.
- 5) We will test the feasibility and practicality of execution of any proposal.
- 6) We commit to developing and adopting the minimum set of rules that satisfies existing operating envelopes.
- 7) We will define the limitation of the stated recommendations, or algorithms.
- 8) The output generated by the attendees from the October 2014 meeting will be compiled into a draft recommendation by a group of 5 or so members endorsed by the wider group.

Outcome / Actions:

The draft outputs of the individual group activities to be prepared by mid-December 2014.

Group 1 – Collision Avoidance Rule

Following discussion, it was agreed to base the CA rule on the relative uncertainty between the two wells, combining the error ellipses as described in Hugh Williamson’s paper SPE67616 “Accuracy Prediction for Directional Measurements While Drilling”. The method:

- Permits correction for known adjustments, e.g. casing diameters
- Involves searching for a point of closest relative position
- Involves the calculation of the Separation Factor (SF) and Minimum Separation distance (MS) to determine the maximum of (SF, MS).
- The form of the governing equation, for the well being drilled is then

$$SF = \frac{C - (r_{h1} + r_{h2})}{\sqrt{U^2 + X^2}}$$

Where

SF = Separation Factor (dimensionless)

R_{h1} = Radius of the first well hole size (Length)

R_{h2} = radius of the second well hole size (Length)

U = Uncertainty (Length)

X = Drillability (Length)

There are a number of underlying assumptions, eg. for sidetracks, that the holes have been appropriately abandoned.

- Focus on the SF, describing it as an approximate one-sided collision risk, with a defined $k\sigma$
- Adopt the delimiter $SF = 1.0$
- The implementation then involves only the expansion of a single ellipse against a point as described in SPE 159840.
- The industry k values, or significance levels range from (2.9 to 4.2) so choose an intermediate value, say 3.5 as the recommended value (TBC after further tests).
- This formulation makes the direct relationship between proximity and collision probability less clear, but this is acceptable at this stage in order to progress.

Actions: (By 15th December)

It was agreed to assess the submission of three, synchronised abstracts to the 2015 SPE ATCE in Houston, covering the subjects below. The submission deadline is 26th January 2015 and the decision is subject to content and progress.

Group 1 – Unified Collision Avoidance Rule

- Provide estimates of "collision" probability for comparing the results for ellipse radii and pedal curve clearance principles, confirming or otherwise the acceptability of the value $k = 3.5$. **Action: Torgier Torkildsen**
- Document the first draft of the guidance, interpretation and use based on the notes. **Action: Eric Nytnes**
- Describe the need for the new term in the error models for uncorrelated terms, and the manner in which it would be used. The fall-back is the covariance matrix of the of the pedal curve method. **Action: Harry Wilson**
- Provide the two additional paper references describing the relative positional uncertainty between two wells. **Action: Von Bang (Complete)**

Group 2 – Assurance and Verification

First draft document to be provided for review by 15th December

Group 3 – Management Principles

First draft document to be provided for review by 15th December