47th ISCWSA Meeting – Inverness, Scotland, UK – April 11, 2018

ATENDEES:

Name Last, First	Company
Aklestad, Darren	Schlumberger
Allan, Victor	Azimuth Oilfield Systems Ltd.
Almusained, Hamad	BHGE
Almutairi, Fahad	Bakerhughes a GE company
Ang, James	Bench Tree
Arevalo, Yezid	Schlumberger
Armstrong, Kevin	Sperry Drilling
Bang, Jon	Gyrodata
Barre, Bret	MS Directional
Barrett, Christopher	Halliburton AS
Blake, Erik	Icefield Tools Corporation
Bolt, Harald	Depth Solutions
Bowe, James	Halliburton
Brannan, Matthew	EIVA
Brooks, Andrew	Retired
Clark, Pete	Chevron ETC
Clarke, Ellen	British Geological Survey
Codling, Jeremy	Halliburton
Cowie, Fraser	Gyrodata Limited
DeVerse, Shawn	MagVAR
Dreisig, Hans	Maersk Oile og Gas A/S, a Total Company
Dufield, Robert	Superior QC
Edge, Matt	Geomatic Solutions
Erdos, David	Erdos Miller
Farmer, Scott	Total
Flores, Dan	Bench Tree
Gjertsen, Morten	Baker Hughes
Gleason, Brian	Scientific Drilling International
Gonsette, Alexandre	Royal Meteorological Institute of Belgium
Greensmith, Martyn	Merlin ERD
Grindrod, Steve	Copsegrove Developments Ltd
Hanak, Francis	Superior QC
Harbidge, Philip	PathControl
Hawkinson, Ben	Scientific Drilling
Hilgenfeld, Matthew	Native Navigation
Hogg, Chris	BP
Holmes, Anne	Sperry Drilling
Humbled, Francois	Centre de Physique du Globe
Jamieson, Angus	University of the Highlands & Islands
Jones, Michael	Scientific Drilling International
Karim, Amelia	Integrated GGRE Asia
Knight, Patrick	Sperry-Sun
Ledroz, Adrian	Gyrodata Inc
Lightfoot, Jonathan	Occidental Oil & Gas Corp.
Liu, Huan	University of Calgary

Name	Company
Long, Michael	Baker Hughes
Longorio, Phil	Scientific Drilling International
Lowdon, Ross	Schlumberger
Macmillan, Susan	Britsh Geological Survey
Mann, Carol	Dynamic Graphics, Inc.
Maus, Stefan	MagVAR
McEldowney, Pete	Contractor
McElhinney, Graham	Solutions52 Ltd
McGregor, Andy	AJ Consulting
McMillan, Callum	ConocoPhillips
Mitchell, Ian	Halliburton
Moberg, Ole-Vidar	Scientific Drilling
Monterrosa, Leida	Schlumberger
Morrow, Steve	Scientific Drilling
Nair, Manoj	University of Colorado/NOAA
Nessa, Jon Olav	ConocoPhillips
North, Ezra	Gyrodata Inc.
Noy, Koen	Shell
Nyrnes, Erik	Statoil ASA
Pattarini, Giorgio	Universitet i Stavanger
Poedjono, Benny	Schlumberger
Presley, Aric	IPM
REYNAUD, Denis	PATHCONTROL
Rhodes, Matthew	BP
Roitberg, Lee	Bench Tree
Ruiz, Nestor	MFR Blue Ocean
Sargeant, Stuart	Agilis Software Solutions Inc.
Satijn, Frank	Shell
Scott, Philip	Dynamic Graphics, Inc.
Sentance, Andy	DGI
Sergey, Shabanov	TOTAL
Sheridan, Max	Petrolink Services Ltd.
Skinner, Gary	Baker Hughes, a GE company
Smart, Barry	Gyrodata
St. Louis, Shaun	IPM
Tackmann, Gunnar	Baker Hughes, a GE Company
Thomas, Mark	Superior QC
Thomson, Alan	British Geological Survey
Trainer III, Robert	Gyrodata Incorporated
Turbitt, Chris	British Geological Survey
Vannoy, Heather	EOG Resources
VanSteenwyk, Brett	Scientific Drilling
Vant, Stewart	AJC
Willerth, Marc	MagVAR
Wilson, Henry	Baker Hughes
Wylie, Robert	xnDrilling, Inc.

Introduction

(Jonathan Lightfoot)

- Review of the mission statement and ISCWSA officers.
- Election of Secretary, Treasurer, Webmaster, and 2 Director at Large positions next meeting.
- Safety instructions.

Schedule and Program Review

(Ross Lowden)

- Overview of the agenda.
- There will be a demonstration of the magnetic field measurement process by BGS during the lunch break.
- Thanks to all the sponsors for this event.

Keynote Presentation – A New World of Surveying

(Roger Ekseth)

- Main topic: Similarities between oil/gas technology and brain surgery (wellbore drilling and deep brain simulation (DBS))
- "Uncertainties in Connection with the Determination of Wellbore Position" is the title of Roger's PhD dissertation, for those looking to seek it out. It is one of the foundational documents of the ISCWSA error model approach.
- Roger's work experience and education are a mixture of satellite navigation and wellbore positioning; he developed Parkinson's Disease in 2002 and had a DBS operation in 2012. It's this unique blend of experiences that provided the motivation for this presentation.
- DBS involves the drilling of holes into a patient's skull to place electrodes deep into the brain, which is analogous to drilling wellbores to hit a subterranean target deep underground.
- The ratio of target size to borehole length is similar in both applications: about 3 parts per 100.
- Both applications can be roughly divided into 3 sections; initial phase, drilling/operation phase, and production/stimulation phase.
- Both tasks are dangerous and can be fatal without proper planning and QC measures in place.
- During the investigation/preparation phase, reference maps are created (seismic vs. an MRI) relative to which instruments must be oriented.
- Mapping blunders are also a potential pitfall in both applications (using the wrong UTM map zone vs. using flipping the MRI image upside down, for instance).
- The drilling procedure can be divided into 3 parallel steps as well: the drilling of the initial borehole, intermediate drilling/running preliminary electrodes, and completing the well/replacing initial electrodes with permanent ones.

- Similar to oil and gas drilling, drilling off plan into the brain tissue during DBS can result in fatal results. There is also an analog to drilling into shallow gas pockets, in the form of drilling into blood vessels which can cause brain bleeding/stroke.
- Brain "movement" during replacement of the electrodes can lead to upside-down view and depression.
- The 3rd phase is the production stage. Wellbores/installations need to be maintained; in the same way, the battery that provides voltage to the DBS electrodes must be maintained every few years. Failure to do either can lead to immediate serious repercussions. On the DBS side, this would be termed Parkinson "freezing".

(Questions)

- None based on time.

Sub-Committee Activity Report: Collision Avoidance

(Harry Wilson on behalf of Steve Sawaryn)

- SPE 184730 and 187073 have been resubmitted for peer review and publication.
- The first paper had more significant revision requests than the second. Confidence is high that the second paper will be published. The outlook for the first paper is 50/50.
- How will the maintenance of the anti-collision recommendations be similar/different from the approach taken with the error models? The proposal was a single document on the ISCWSA website that will carry a revision number. Revisions would be no more frequent than annually.
- The group will look at the possibility of sign-ups to receive notifications concerning updates to the document. Dependent on website updates under investigation.
- API RP78 may refer to the ISCWSA document. Note that an Recommended Practice (RP) is intended to capture proven engineering practice. The ISCWSA is more of a body to look at continual improvements in engineering practices.
- The second major agenda item was the correlation of error sources well-to-well. This is of primary concern with geomagnetic reference terms and depth stretch terms. These terms are of the "global" variety in the error models.
- The correlations are not currently ignored, but they are simplified. This simplification can result in a 10% to 30% discrepancy, and the sign of the effect will be different in different scenarios. The current treatment can result in significant over and underestimation of relative uncertainty.
- The geomagnetic terms are particularly difficult to handle owing to the large number of reference models in use that handle various aspects of the reference magnetic field in different ways.
- The current favored idea is to expand the list of error terms to avoid partial correlations in individual error terms. Both approaches would add complexity, but the expanded term approach would result in less algorithmic complexity.
- From a standardization approach, the goal is to have a single document with both implementation and testing details.

(Questions)

- None.

Drillers Way-point Depth determination - field results

(Harald Bolt)

- Knowledge of along-hole depth errors dates back to at least 1938. 75 years later, the problem persists (Forsyth paper reference in presentation).
- Driller's Depth is computed from the pipe tally and the motion of the traveling block. The traveling block is used to control WOB and ROP, which are not directly related to depth.
- The drill pipe is used as the measurement instrument. How accurately is the pipe measured? 1:1000 accuracy on a bad day; up to 1.5:10000 using a laser (condition dependent).
- Applying corrections can be done at single points (at TD), or straight-line (linear?) corrections vs. measured depth. Another option is to do waypoint corrections by dividing the wellbore up in to segments.
- Note that the measurements that are made are at the surface. So the waypoint correction technique applies corrections at the surface.
- Another correction technique is incremental corrections, which apply corrections continuously along the well.
- There are lengthening effects and shortening effects on the drill pipe. When you pull out of hole, all of the shortening effects go away. Then you have the same model as wireline.
- The presentation has equations to be used for the waypoint method.
- The first field trial well had an inclination of 30 degrees and a TD of ~14,000 feet. In the example well, the elastic stretch correction dominated. The total correction at TD was about 90 feet according to the plot in the presentation.
- We can also begin to look at uncertainty based on the measurement accuracies and model parameter uncertainties.
- One of the benefits of this method is the ability to segment the corrections according to the drill pipe size used in different parts of the well.
- Different wells will have different combinations of stretch and thermal corrections. The second example well provides a different set of correction profiles for comparison to the first.
- The presentation contains a graph outlining a value model that is a qualitative depiction of the impact of correction and calibration techniques on accuracy and the drilling budget.
- The first field test results showed good correlation between LWD and wireline. This was a successful result.

(Questions)

- None based on time.

Continuous Wellbore Path Estimation Using Multiple Integrated MEMS Sensors

(Huan Liu)

- Kalman filters are a traditional position estimation routine, but they depend on proper knowledge of the prior uncertainty distributions.
- The experimental setup for this study involves 2 MEMS IMUs with 3 accels, mags, and gyros each. The communication system was a 1 km long cable. Repeaters can be used for longer distances.
- A 3D calibration stand was used for calibration using an encoder to determine the exact position. Centripetal acceleration force was utilized as part of the calibration process.
- Magnetic interference is reduced using 2 sensors with a known distance between them.
- Each 9 sensor IMU is input to a quaternion Kalman filter. Each filter feeds into an Adaptive Neural Network Fuzzy Logic algorithm.
- The external disturbance signal (magnetic) is handled well as long as the magnitude is within the training range. As long as the transient disturbance signal is within the training range, the ANFIS result is robust to it.
- For a field test, GPS was used to determine the accurate position of the path. MCM, spline, and ANFIS methods were compared with ANFIS coming out on top.
- The assumptions were that the two sensors were not influenced at the same time by the same level of magnetic interference. You also need high accuracy data as a teaching signal. Also dependent on the applicability of the training signal.

(Questions)

- Adrian Ledroz – Have you looked at the long-term uncertainty on the z-axis? Answer – You have to build an error model according to the drift specs of the sensors. All of these errors can be calibrated by ANFIS. If you have a teaching signal, then all of the results will just follow the teaching signal. Adrian – What about the double integration that occurs along hole? Answer – I don't use double integration to get position. We assume all the movement is curvilinear. So we use centripetal force along with the angles from the gyro to define the arcs.
- Angus Jamieson – The concern about the double integration also has to do with possible saturation of the z-axis acceleration while drilling. Answer – That's a limitation of the sensor that we assume would not be violated. You would need to improve the hardware if that's an issue.
- Matt Brannan – What is the output rate, and are you doing only a forward filter, or are you using a forward-backward filter? Answer – This survey was integrated at 50 Hz for the continuous survey. Only a forward filter was implemented for this test.

Tool Face Efficiency, Virtual Surveys, and Positional Uncertainty - an introductory discussion

(Robert Wylie)

- It can be very challenging to hold toolface, especially in very long laterals. Drillers are often judged by how well they can hold toolface.
- A Toolface Efficiency concept was put forward defined as the percentage of a slide pointing in the direction of the specified toolface. This is calculated as a projection of the actual toolface

vector onto the desired toolface vector (2D). This can be summed over all of the toolfaces measured in a slide.

- Build Efficiency can be defined as the percentage of a slide pointing in the direction of the average toolface of the slide. This provides more nuanced information on how the motor is performing.
- Virtual Measurements are defined as a parameter that is not measured directly, but is inferred from related measurements. Weight on Bit for instance = Hook Load (bit off bottom) – Hook Load (bit on bottom).
- A Virtual Survey can be calculated from a starting direction, a delta depth drilled, a toolface, and a bend. Virtual Surveys are used by directional drilling automation to gain a better knowledge of the wellbore position between measured surveys.
- Virtual Surveys can be used to give a better borehole shape, resulting in improved TVD.
- So how are TVD corrections quantified? Depth uncertainty, toolface uncertainty, and bend uncertainty contribute, but where do we go from this starting point.

(Questions)

- Jonathan Lightfoot – Out engineers are doing distribution plots covering a large amount of data. This applies to rotary steerables too. I will see if I can get permission to share some of the toolface efficiency plots our engineers have assembled, specifically for motors in the curve. Answer – One thing I should mention is that survey frequency can be adjusted to get surveys closer to the slides to get a better idea of the bend.
- Ross Lowden – Have you looked at continuous Inc and Az to fill in those gaps as well? Answer – I haven't had the opportunity yet.
- Angus Jamieson – There's another discrepancy that comes in between what slide percentages are assumed in the office and what's actually used in the field. The TVD error in the curve works out to the curve MD times (1 – slide ratio). Answer – One good thing about this is we are looking at the data directly, rather than depending on what the office tells us.
- Huan Liu – High accuracy surveys can directly reduce the course length. What reference system are you using to determine if the survey is accurate or not? Answer – The sensors we are using are the standard MWD survey sensors (3 axis mags and accels). They are very good guidance sensors, and have been modeled very well by the ISCWSA. It's not absolutely exact because the downhole geology can change our path.
- Gary Skinner – How dense was the data you were looking at for your virtual surveys, and was it real-time? Answer – It was all real-time. The data density depends on the speed of the telemetry.

Distinguished Service Award

(Jonathan Lightfoot)

- We take nominations (provide information on why your candidate is deserving) and the committee members vote. We will give one away at each meeting going forward.
- We also submit the recognized members to the SPE for distinguished speakerships.

(Adrian Ledroz)

- Roger Ekseth is the award winner for this meeting.
- Roger was Adrian's boss at Gyrodata and constantly able to provide the mathematical clarification necessary to move complicated problems forward.
- He was also very good at team building, taking his team members shark fishing, curling, etc.
- His PhD dissertation was a foundational document for the error model work that the ISCWSA has done from the beginning, including the well-known error model paper SPE 67616.
- He had a leading role in the development of safe and reliable QC standards.
- He was also the main inventor in several patents related to wellbore surveying.

Sub-Committee Activity Report: Well Intercept

(Benny Poedjono on behalf of Roger Goobie)

- The e-book has had 9500 downloads so far.
- The webcast introducing the e-book took place on March 28th.
- Both the e-book and the webcast recording are available through the SPE site and the ISCWSA site.
- The e-book will get some updates before final delivery to the Education Sub-Committee. The Well Intercept Sub-Committee is resolved, pending the updates to the e-book.

(Questions)

-

Earth Magnetic Anomaly Grid (EMAG2-v3) Update

(Manoj Nair)

- Largest open compilation of magnetic survey data
- Marine and airborne tracklines
- Precompiled grids over continental areas
- Satellite derived models
- There is a peer reviewed paper noted in the presentation that can be downloaded for free.
- There is also a URL that shows the magnetic anomaly map. The resolution is 2 arcminutes.
- There is a map API for software integration. Contact Manoj for more information.

Wellbore Positioning Pub Quiz Contest

(Angus Jamieson & Carol Mann)

- Check slides for quiz.
- The January birthday table won with a perfect score.

(Questions)

- None.

Survey QC, Decision Making, and a Modest Proposal for Error Models

(Marc Willerth)

- Proposition: Survey QC should be possible without being an expert in survey QC. Much the same way you can drive a car without being a mechanic.
- Most who drill a well and consume the data many not be experts in surveying.
- Pre-error model: measure deviation from references: many standards and usually fixed thresholds.
- SPE 103734 was a step forward in that it allowed us to smartly compute qualifier limits.
- Another step forward would be to account for the error covariance from the error model, dependent on the direction of the survey.
- The consumer of survey data needs the following questions: 1) Do I keep drilling? and 2) Do I re-survey?
- We can get there by moving toward survey sets. We can correlate errors between sets.
- The first survey would use normal QC. The second survey would use a conditional QC tolerance, which is now a smaller ellipse. This is called “Marginal Sigma”.
- There is an orientation dependence built in to this concept.
- If you have consecutive surveys that fail this qc, you have something going on that is not in your error model.
- Another option is to calculate a p-value based on the whole survey set. This tells you how unexpected the group of qualifier residuals are as a whole relative to the expected variance from the error model.
- The idea is to compare signal lines (from these QC methods) to the red tolerance lines computed from the error model.
- The new measures are very good in identifying fundamental shifts in the nature of the errors vs. measured depth. These types of shifts are more readily available from tighter qualifier limits that are concerned only with differences from what came before.
- A suggestion is to say in the error model header which values are to be used for QC, and then define explicit weighting functions. This removes ambiguity in implementing error-model based QC.
- The most important thing is that survey QC becomes a routine calculation.

(Question)

- Chad Hanak (Secretary was asking the question).

Holistic approach to survey error budgets

(Martin Rayson)

- One if the problems in geomatics is data silos. There is very little communication of the error characteristics of the data as it moves from silo to silo.
- Well headers are important in propagating the knowledge of the error in the data between silos.
- The is a question of whether the surface location has a very small ellipse, or if it really should have a much larger ellipse.
- Many errors come in at the data loading stage.
- We need to work from one unified coordinate reference system. A 3D CRS is preferable. It's the native CRS for the data, and we shouldn't downgrade it by transforming it to 2D.
- The Gaussian law of covariance propagation can be used to map errors in one silo to the framework of the next silo.
- For instance, the error/uncertainty in the position of the seismic sources and receivers should be calculated from the relative GPS measurement accuracy and carried along as an important error describing the uncertainty in the position of the seismic data within the CRS.
- The trace positions are often interpolated between actual measurements. Owing a feathering effect in the receiver string, this interpolation between actual measurements also adds error to the trace location.
- Each trace is assigned a position in ca projected 2D CRS if known. However, there is no way to document the uncertainty in these trace locations in any of the standard file formats except P1/11.
- During the loading of the seismic data into an interpretation workstation, the selection of the CRS is a critical step that, if wrong, can introduce hundreds of meters of error into the position of the data.
- What we are aiming for is a proposed well location with associated error ellipse that has the uncertainty of the seismic data incorporated.

(Questions)

- Stefan Maus – You've been speaking of the lateral error at the surface. What about at depth? Do they have larger lateral errors? Answer – The targets will typically more constrained in the vertical than laterally. However, we are more concerned with the first 600 meters below the sea bed from a horizontal point of view. At depth, the velocity models will dominate the error budget in the vertical direction.
- Benny Poedjono – Velocity is a critical part. Let's not focus solely on the top. The bottom accuracy is important too and should be addressed. Answer – The frequency of data attenuates with depth, which reduces the precision at depth. This affects the estimate of the formation dip for instance. The bottom line is that the seismic data has a large effect on drilling, and we want to capture/document that so it can be properly accumulated through the stages.
- Pete Clark – What is the role of the operator in the adoption/creation of P1/11? Answer - This is sponsored by an operator that is also a regulator. This is helpful in that we have a large volume of readily available data/reports.

GyroMWD Gross Error Detection

(Ben Hawkinson)

- A GyroMWD survey involves a stationary survey in which the gyro is used to detect North via a multi-position gyrocompass procedure.
- Spinning mass gyros represent the largest share of the MWD gyro fleet, though other technologies are coming to maturity.
- Indexing usually can reduce biases in MWD spinning mass gyros; noise is minimized by system design. The gravity dependent errors (mass unbalance) is a primary remaining error source.
- Typical gyro deployment starts off with top hole deployment in near-vertical wells. This may involve drilling through cement, which is rough and subjects the gyro to shocks and vibrations. These are bad for a gyro.
- Some gyro QC techniques can be found in SPE 103734 and 90408. Basically the computed horizontal Earth rate is compared to the theoretical value for the latitude. This can be done over a range of toolfaces. Some errors area undetectable, depending on the direction of the well.
- A multistation test was developed to utilize variations in the direction of the wellbore in order to better detect otherwise poorly observable errors. A big problem is that many important wellbore sections have little directional variation, especially in top hole. Also, drilling may damage the gyro, reducing the efficacy of the MSA test.
- Movement during the gyro survey can often be mistaken for critical shifts in mass unbalance terms. Movement must be < 0.001 deg/s. Horizontal Earth rate is 0.021 deg/s.
- The best way to verify gyro survey QC is good is to use benchmark surveys. There are many types of benchmark comparison scenarios (see slides). Benchmarking azimuths works best at higher inclinations.

(Questions)

- Answer to Chad Hanak - The error models are correct under the assumption that the gyro is free of gross error, same as MWD. The benchmark discussion is specific to GyroMWD survey, specifically at higher inclinations. It is a test for gross errors.
- Answer to Harry Wilson – It's important to keep validation at the forefront of planning. Especially since GyroMWD is often used in higher risk scenarios.
- Marc Willerth – Could you have a method for doing QC by taking repeated benchmarks at a given depth. Answer - Yes, absolutely.
- Phil Harbidge – How do you provide data to operators so they can audit the quality of the data or possibly upgrade it later on? Answer – I can only speak for SDI. It's rather difficult to provide data that can be updated later. We provide computed data and a quality report.
- Matthew Rhodes – In top hole, you are generally in unconsolidated formations as well, so washout becomes a concern. You could potentially lose the measured inclination due to this effect. Is there anything in the works to compute surveys and transmit them to surface quicker? Answer – On the part of the data acquisition, tighter integration between gyro and MWD companies could hold some promise.

Sub-committee Activity Report: Education

(Carol Mann)

- Steve Sawaryn was selected as an SPE Distinguished Lecturer. For 2018 we have nominated Steve Grindrod. His talk will deal with survey data management.
- Please email Carol of Chad Hanak with people you'd like to nominate for the SPE Distinguished Lecture spots.
- The wellbore ranging technologies webinar took place on March 28.
- MagVar has agreed to do a webinar on the economic impact of wellbore positioning errors in the future.
- Once again, please email Carol of Chad Hanak with webinar suggestions.
- The topical luncheon at the 2017 SPE ATCE was sold out. Another was planned for 2018 ATCE, but the SPE has decided to discontinue topical lunches.
- SPE ATCE half day special session (Tuesday pm) scheduled for this year. This is a joint initiative with DSATS, DETS, and OGDQ. The topic will be The Automation of Well Placement.
- Applied Technology Workshops: We've done four "Hits and Misses". We may do this again in 2019/2020 at the SPE's request.
- We have some PowerPoint slides that give a brief overview of the ISCWSA. They are for general use. We also have a signature that you can add to your email and a logo you can download.
- Website content updates:
    - The Pub Quiz will go online
    - The meeting notes may become categorized

(Questions)

- None.

Sub-committee Activity Report: Operator Wellbore Survey Group (OWSG)

(Pete Clark)

- Pete is the API RP78 chair in addition to the OWSG chair.
- Last OWSG meeting was at ConocoPhillips on 1/24/2018. Meeting minutes are contained in the slides.
- The OWSG position uncertainty models are seeing ongoing adoption. No issues have been reported due to adoption.
- There was a discussion on the potential of standardization on the ISCWSA collision avoidance rules and practices. Two issues were raised that are open items. Two operators are planning adoption in the near future.
- The API RP78 group had a general meeting on 1/11/2018. The presentation is available on the API site.
- There were a number of new section leads. Thanks to Michael Donahue, Mary Malihpour, and Benny Poedjono for offering to lead sections.
- The timeline for RP78 is: first draft in June of 2018, cohesive document by end of 2018, leading to balloting, and end of 2019 for publication.
- The notes also contain a updated layout for the document.

(Questions)

- Carol Mann – What does the ballot process entail? Answer – I don't really know. Contributors are offered up the document as it stands and can post comments. We then need to address those comments.
- Marc Willerth – Is the legal review from the API after balloting included in that year? Answer – I was told to expect about a year, so I think it's included.

Sub-Committee Activity Report: Error Model

(Andy McGregor)

- There's an error model definition document now on the website that brings together the information in the MWD and gyro papers. It will be a living document.
- There are release notes for the latest release.
- There is a spreadsheet definition of the current ISCWSA models (same format as the OWSG models). The ISCWSA models are aligned with the OWSG models.
- Rev. 5 includes the XCL (extended course length) term. It's become clear that some details for implementation were missing. These are being ironed out, with the hope of releasing an update ASAP.
- There was a discussion of finalizing a WITSML standard for transferring error models. Currently the working group is very small. The goal is to have a draft by the end of the year, with an eye for completing it by the end of next year.
- There was also a discussion about revising the misalignment terms in the error models (XYM3/4). These operate in the low angle part of the well. Jerry Codlings suggestion seems to fit the data better, but we need some more data to validate the data.
- The proposal is to increase the XYM3/4 term magnitude to 0.3 degrees and make them random.
- Harry Wilson brought up some questions about the systematic DREF term: what it's trying to model and if it's doing that as intended. The effect is small, but we want to get it right.
- Another question brought up was the handling of transitions between directional to Inclination Only models.
- Tie-ons from directional survey to blind drilling were also discussed. Two major software packages handle the issue in different ways with substantial differences. This will be investigated further, but the issue is really with extreme cases.

(Questions)

- Harry Wilson – The XCL term is already published in the OWSG model, correct? Answer – It's published with a note that it's still being reviewed.

Webmaster's Report

(Phil Harbidge)

- Phil is proposing a reboot of the QA/QC Sub-Committee. The purpose would be to create a document that defines the format, name, and units for each field that is required to QA/QC a wellbore position.
- Another goal would be to capture all common wellbore positioning data naming conventions and units in the form of a lexicon.
- There was a kickoff meeting last year. Please send an email to Phil if you would like to participate (before the end of April).
- Regarding the website, we are searching for options for a website upgrade (this will be an expense). Standardization of naming will help in the web search optimization. Our current site does not come up well in search engines. We need to make it easier to search for the information we provide from search engines directly.
- Please send website criticisms to Phil. Philip.harbidge@pathcontrol.com

(Questions)

- Robert Wylie – You will need pipe stretch information and BHA information as well.

Treasurer's Report

(Robert Wylie)

- San Antonio had an attendance of 104 people. There was a net income of about $5500. The AV cost seemed to be a bit high, and will be watched more closely in the future.
- We have about 90 people at this meeting.
- Thanks to AJC, Schlumberger, Path Control, and MagVar for sponsoring the event and various activities this year.
- Our bank balance prior to this meeting was about $114,000. Our situation is fairly healthy. We do need to think about how to use the money to promote the industry in the future.

(Questions)

- None.

Secretary's Report

(Chad Hanak)

- Send me your new email if it has changed.

(Questions)

- None.

Closing Statement

(Jonathan Lightfoot)

- Thanks to all of the sponsors and attendees for participating.
- Thanks to the Kingsmill Hotel, they were very accommodating.
- Thanks to the officers for helping to put this event together, and to those who submitted abstracts for presentations.
- Also, thanks to the individual companies that supported your attendance at this meeting.
- The date and location of the Fall 2018 meeting is Dallas, TX, USA. The general meeting will likely be on a Thursday in conjunction with the SPE ATCE.