Minutes of the Nineteenth Meeting of the

Industry Steering Committee on Wellbore Survey Accuracy

Paris, France
2nd April 2004

Attendees:

Name	Company	E-Mail
David Kerridge	BGS	djk@bgs.ac.uk
Philip Gurden	Baker Hughes	philip.gurden@inteq.com
Harry Wilson	Baker Hughes	harry.Wilson@inteq.com
Andy Brooks	Baker Hughes	andrew.brooks@bakerhughes.com
Andy Sentance	Baker Hughes	andy.sentance@bakerhughes.com
John Shields	Baker Hughes	John.shields@bakerhughes.com
Matthew Rhodes(*)	BP	rhodesm1@bp.com
Matthew Kirkman	BP	matthew.kirkman@bp.com
Ed Stockhausen	ChevronTexaco	edjs@chevron.com
Bill Calhoun	ChevronTexaco	wmca@chevrontexaco.com
Steve Grindrod	CopseGrove	copsegrove@compuserve.com
Steve Mullin	Gyrodata	stevem@gyrodata.com
Kazimir Kovalenko	Gyrodata	kazimirk@gyrodata.com
Roger Ekseth	Gyrodata	rogere@gyrodata.com
Richard Steffensen	National Oilwell	richard.steffensen@national .com
John Turvill	Paradigm	jturvill@paradigmgeo.com
Graham McElhinney	Pathfinder	graham.mcelhinney@pathfinder-ltd.co.uk
Benny Poedjono	Schlumberger	poedjono1@slb.com
Chris Chia	Schlumberger	cchia1@slb.com
John McCullagh	Schlumberger	mccullagh@slb.com
Peter Fitzgerald	Schlumberger	peter.fitzgerald@slb.com
Philippe Theys	Schlumberger	theys5@slb.com
Ross Lowdon	Schlumberger	rlowdon@aberdeen.oilfield.slb.com
Wayne Philips	Schlumberger	phillips3@slb.com
Brett van Steenwyk	Scientific Drilling	bvanstee@ata-sd.com
Tim Price	Scientific Drilling	tprice@ata-sd.com
Allan Clark	Scientific Drilling	allan.clark@scientific-drilling.co.uk
Dave McRobbie	Sperry Sun	dave.mcrobbie@halliburton.com
William Allen	Sperry Sun	william.allen@halliburton.com
John Weston	Sperry Sun	john.weston@halliburton.com
Anne Holmes	Sperry Sun	anne.holmes@halliburton.com
David Chen	Sperry Sun	david.chen@halliburton.com
Angus Jamieson	TECH21	T21es@aol.com

Tom Southren	TECH21	tom@tech21.co.uk
Alan Mitchell	TOTAL	Alan.mitchell@total.com
Steve Holehouse	TOTAL	Steve.holehouse@total.com
Alain Louis	TOTAL	Alain.louis@total.com
Torgeir Torkildsen	Statoil	totor@statoil.com
Stein Havardstein	Statoil	steint@statoil.com
Oddvar Lotsberg	Statoil	oddvalo@statoil.com
K Mike Nero	Weatherford	Mike.nero@weatherford.com

1 Introductions

Matthew Rhodes and Steve Holehouse welcomed the group to the TOTAL office, Tour de Coupole, La Defense, Paris, France and after a brief HSE moment introduced the agenda for the day.

19th ISCWSA Agenda

2 Review of Action Items from ISCWSA 18 (Denver)

An Advanced Drilling and Engineering Handbook is being prepared and reviewed prior to it being submitted to the SPE for review, acceptance, and incorporation. Concurrently under review is BP's Survey Handbook within the SPE for publication. There appears to be a significant overlap and the BP Handbook is in revision at BP at this time. The revised BP Handbook will be available in the public domain. BP are seeking input from the various members of the committee for the revised handbook. However the Advanced Drilling and Engineering Handbook should be provided to the SPE as a priority.

The draft SPE/ISCWSA Constitution which incorporates revisions related to Additional Affiliations and Copyright Retention is now complete. Initial review of the draft version received tentative approval and a final version will be submitted to MEPA for approval. Continuing concerns related to SPE membership and "Guesting" (for Non SPE Members) was discussed at length without conclusion. The crux of the concern is related to the ISCWSA authority to distribute technical information freely and reasonable access by non-SPE members. The Constitution is planned to be approved by the end of April 2004. The section name will be the Wellbore Positioning Technical Section, WPTS. The SPE collaborative web site URL was displayed briefly. http://communities.spe.org/metadot/index.pl

At this time the WPTS, Wellbore Position Technical Section of the SPE will require the ISCWSA to add additional staff for reasonably satisfying the increasing growth of the group and more formal participation within the SPE. The proposed positions are as follows:

- Program Chairman Matthew Rhodes
- Membership Chairman Seeking Nominees
- Secretary/Scribe Seeking Nominees
- Web Master Seeking Nominees
- Treasurer Seeking Nominees

The term of each position is typically 4 years. No one volunteered for any of the positions at the time and a proposal was made to shorten the positions to 2 years. A suggestion was made that the Program Chairman should continue to be an Operator employee and not a Service Company employee in order to provide impartial and unbiased leadership.

The ISCWSA website, what is its status? Robert Wylie has not been available to work on the site due to recent personal issues. Is the ISCWSA web site even necessary considering the near SPE affiliation and SPE web space? SPE and E-guest should be sufficient for Members and close industry associates but how does and external search achieve access to ISCWSA information? How difficult will it be to provide public domain access to our information? An offline meeting will be held to review and consider the implications (and costs) of an ISCWSA website. www.ISCWSA.org

Depth Subcommittee update (Harry Wilson - BHI):

Harry gave a brief summary of the history behind the formation of a depth sub-committee and also highlighted key focus areas developed during the previous day's meeting.

In Denver presentations were made which identified uncertainties in how we currently measure and model depth. The Depth Subcommittee was formed and several teleconferences and one formal meeting have taken place. The general development has been segmented into the following broad categories:

- Depth Terminology and expression of terms in the error model, possible re-definition and expansion
- Review all components contributing to Depth Uncertainty
- Calibrate Model against data? How? Statistical map or experimental work?
- What is the goal? A good model from which reasonable well plans can be created and accurate measurements made, which provide minimum uncertainties for optimized resource recovery?
- Recommendations or an Audit tool?

Chris Chia has a draft summary for review by the Depth Subcommittee. Ed Stockhausen offered that his 40 well Nigerian study might provide a statistical baseline data set. This Depth study is planned for completion in nine months. Use of previously developed data from Rogalands U2 well might prove valuable, as all Gyro and Inertial survey systems were tested extensively here in the 80's. Is the "Proprietary "constraint so prohibitive that it precludes the use of effective standards? What or how much is too much complication for the value added? Do the Operators want a new method and at what cost?
At this point a Wire-line Depth presentation was made by Peter Fitzgerald of Schlumberger. In this he stated:
Review of the Drillers Depth and components, manual adjustment and corrections can be suspect and uncorrected depths are generally shallow (not accounting for tensile strain). Wire-line Depths use a fixed Surface reference. Measuring wheels are now highly refined systems and 'run-in' depths are considered better and "On-depth". When logging-up the

frictional forces aggravate the wire-line stretch errors making the depth errors worse. Using both logs allows for reasonable depth corrections to be applied to the depth sequences. Directional wells and their associated doglegs result in increased frictional effects and in general degrade the depth accuracy. These effects seem to be quantifiable and Schlumberger have a huge Open Hole and Cased Hole database used for their analysis. Stable logging run speeds are required for the best depth accuracy. Note: Down log variations are much smaller than up log variations. Increasing temperature causes and initial increase in the length of the wire-line but the armour construction and the centre conductor eventually cause the wire-line length to shrink with increasing temperature.

3 ISCWSA Revised Logo

The ISCWSA logos submitted for review were displayed, briefly discussed and then voted upon. The show of hands eliminated all but the digital font ISCWSA surrounded by a series of horizontal, blue ellipses. Some additional discussion related to the series of vertical ellipses surrounding the individual letters. Congratulations to Steve Mullin of Gyrodata for submitting the winning entry, shown below.

4 Precision Target – An integrated method for survey and subsurface analysis (Oddvar Lotsberg - Statoil)

A presentation was made by Oddvar Lotsberg of the Precision Target software. This software is a result of development done by Statoil, is patented and is currently available as part of the landmark Graphics suite of Reservoir optimization software called Decision Space. Subsurface uncertainties and geological markers are used to calculate and display optimum wellbore position. This integrated well planning, uncertainty and drilling tool needs testing and correlation with real data. ISCWSA was solicited for steering uncertainty algorithms and database information. For further information contact Oddvar via e-mail.


Precision Target

5 Wellpath ML – An industry standard transfer format for well deviation data (Matthew Kirkman – Bp, John Shields & Andy Sentance – BHI)

WellpathML, a new standard transfer format for wellbore deviation data has been proposed and was presented by Mathew Kirkman. This transfer standard is XML based

and will facilitate web based data management. In conjunction with the evolving WITSML standard these developments should result in reduced data handling and reduced data risk. Enhanced efficiency and reduced data corruption are also expected by linking WellpathML to WITSML. John Shields provided a technical overview and referenced the www.witsml.org web site for further reviewing the standards and options. XML or extensible markup language is a document and language form, self-checking as well as human and machine-readable. It facilitates easy data transfer. John gave a definition of the system, surface to TD, the use of filters to parse out the necessary data and some practical content tools. The content validation and hierarchy are completed. Facilities include manual and interpolated information, information sharing and calculation method. XML is used for survey calculation and well planning. Star sheets are impressive. Schema are all public domain and require only "local access". There may be a future implementation of Survey standards using WellpathML if endorsed. The definition of real time data and the differentiation between real-time data and accepted well path data were mentioned. For further information please contact Matthew, John or Andy via e-mail.

WellpathML

6 An Update on BHA Pole Strength Measurements (Harry Wilson – BHI)

Harry discussed a recent BHA pole strength study. The magnetic interference, which results from the proximity of BHA elements, continues to be troublesome. The axial magnetic interference is a reoccurring error source that is volatile. 2 basic elements of the model were tested including spacing and relative pole strength. The recent use of rotary steerable tools and the variations in non-magnetic spacing may result in the requirement to quantify (or estimate) sources of axial magnetic interference and perhaps to attempt to correct for interference. A series of yard measurements were made using the INTEQ EMS tool and various Rotary Closed Loop System BHA elements. The basic test geometry positioned the EMS tool with its long axis aligned East/West and horizontal. Readings were taken with the tool to establish a set of baseline data. Various BHA elements (from recent jobs) were placed sequentially in proximity to the EMS probe and the resultant readings were recorded. After the BHA components were removed the baseline readings were repeated to establish the most basic statistical reference from which erroneous data could be deduced. The test data consisted of 108 samples which provided the following summary Mean = -44 micro Weber, Sdev 229, Max 545 micro Weber, Min –830, micro Weber. There were 47 positive samples and 60 negative samples. The mean was criticized as misleading and the general consensus was that while the data could be used to verify the established nominal conditions used in the error model, corrections should not be made based on the data acquired. Several members made references to historical studies and that future efforts should fully utilize all available supporting reference data. For more information contact Harry via e-mail.

INTEQ Pole Strength Study

7 Developing the Definer Survey (Tom Southren & Angus Jamieson – TECH21, Ed Stockhausen – Chevron Texaco)

T. Southren of Tech 21 presented “Definer Surveys” which are the proposed use of all of the available survey and trajectory data including BHA orientation (slide sheets) to develop an over-sampled, curve fit, well path which purports to produce an improved (more accurate) wellbore position. The static surveys are assumed correct and create the baseline wellbore position reference. Angus Jamieson gave a brief presentation related to the newest version of the Tech 21 Software package that incorporates BHA sag and accommodates borehole curvature. This is part of the improved suite of Well Planning, BHA Design and Survey Calculation programs available form TECH21. Please contact either Tom or Ed for further information.

8 The ISCWSA Standard Gyro Error Model (Torgeir Torkildsen – Statoil)

Torgier Tokildsen of Statoil presented the recently completed Gyro Error Model project summary. This concludes a three year development project and will be published in technical presentations and on the SPE website. The model was designed to accommodate both stationary and continuous survey modes. Error Terms have been developed for Inclination, Azimuth, Sensor and other related Uncertainty components. The effort seems to be complete in all respects except that it doesn’t address or attempt to map back to the Wolff and DeWardt model created in the 70’s. The mode selection flowcharts are quite thorough. A series of “Representative” error terms were created to establish the algorithmic accuracy of the program. PLEASE NOTE: the terms are not intended as the baseline error terms for use with the model. The specific error terms will need to be provided by the Gyro Manufacturers and Service companies. The positional error calculation portion of this program is the same as the Magnetic MWD model. The model has resulted in 48 error terms compared to the magnetic models 35 terms. The program outputs position covariance elements for use in calculating uncertainty volumes but does not calculate the volumes directly. Minor corrections to the model will be published in May and SPE 90408 will be presented in September at the SPE ATCE in Houston. The group discussed the need for published error terms and the method of differentiating between old gyro uncertainty calculations and the new gyro error model calculations.

Roger Ekseth was asked if the gyro service companies could support the values to which he answered yes.

John Turvill asked if he could expect a generic gyro error model?

Torgeir & Harry Wilson argued that the difficulty with gyro was that the technologies within different companies were unique as opposed to with MWD technology where they were all the same.

ISCWSA General
Gyro Error Model

9 Developments in Gravity MWD (Graham Mcelhinney – Pathfinder, Steve Grindrod – CopseGrove Consultants

The Pathfinder Gravity MWD system was presented. This system utilizes two tri-axial accelerometer packages built into a single drill-collar to detect and calculate trajectory changes in the BHA. The information is used to calculate driller's toolface angle from which borehole position can then be calculated. The system is intended for use when magnetic interference conditions are encountered. The system accuracy is highly dependent upon an accurate starting reference azimuth however post Azimuth references can be used to further enhance the system accuracy.

Oddvar Lotsberg was wary of the fact that the Gravity MWD tool was in direct competition with the gyro companies. Graham thought that both technologies had their own particular market.

Andy Brooks wondered what the optimum spacing of the tri-axial accelerometers was? Graham answered that the optimum spacing would depend upon both the size and stiffness of the BHA and also the anticipated degree of Dog Leg Severity.

Dave McRobbie spoke of an old Sperry Sun tool known as the 'Kink-meter' that worked in essentially the same way, by measuring the angular change between 2 sets of inclinometers.

Due to the intellectual property aspects of this technology no presentation is available for viewing. Contact Graham or Steve for further information.

10 Developments in 3D Visualization and Multi-Well Development Planning (Angus Jamieson – TECH21)

Angus Jamieson presented the status of the DVRC (Drilling & Visualization Research Consortium). The fromer BP funded program now has the support of Chevron Texaco, AGIP and Exxon Mobil amongst others. They believe that the product is now ready for commercial application and perceive a future where these types of tools become the standard for analysis and development for the industry. 5D, see presentation, wherein Interactive Planning, Planning While Drilling, Target Optimization, Collision Avoidance and Interactive Survey Program development occurs. Continuous reservoir development optimization is the goal, well after well, so that the most efficient resource recovery is achieved. Data collaboration (to reduce satellite costs) will encourage Real Time data sharing and the use of these types of tools. Smaller utilities (application programs) are for sale including BHA analysis, Torque and Drag, Geodetics etc… For further information please contact Angus via e-mail.

TECH21 5D

11 Drilling fluid affects MWD azimuth and wellbore position (Torgeir Torkildsen – Statoil)

Torgeir outlined his presentation of Drilling Fluid Magnetic Affects which was presented in March in Dallas at the SPE (Paper #87169). A summary of magnetic errors, mathematical models and laboratory tests that were conducted to demonstrate the effects of contaminating drilling fluids with various mud additives and ferrous materials and help validate the MWD standard error model. Axial errors were undetectable but the radial errors vary as $1/4X^2$ (where X = 0.2) yielding approximately 1% field dampening. Fluid use (aging) aggravates the interference affects, illmenite and Barite materials were used, the testing did not yield statistically valuable results and instrumentation variations were observed, EMS = 0.063. The analysis appears to be dependent on symmetry conditions (or the lack thereof). Conclusion: use non-magnetic drill collars to minimize axial interference and use Gyros for field referencing. For further information you can download SPE87169 or alternatively contact Torgeir via e-mail.

11 Thank you & Arrangements for the 18th Meeting

The meeting was closed after a brief discussion related to hosting the next meeting. Harry Wilson volunteered that Baker Hughes INTEQ would host in Houston immediately after the Fall ATCE (SPE). Sub-committee meetings will be held on Thursday 30th September with the main committee meeting being held upon Friday 1st October.

On behalf of the entire committee I should like to thank Steve Holehouse of TOTAL for his efforts in arranging the venue and refreshments for this meeting and the depth sub-committee meeting the previous day. I am sure you will all agree they were excellent.

Thank you, as ever, to all those who gave presentations. The meetings would simply not function nor attract their large attendance if it were not for these.

These minutes were recorded by Mike Nero, Weatherford. Thank you Mike.

Matthew Rhodes
May 2004