

Minutes of the Third Meeting of the
Industry Steering Committee on Wellbore Survey Accuracy

Anadrill Schlumberger, Sugar Land, Texas
31 May 1996

Those present:

Hugh Williamson (Chairman and Minutes)	BP Exploration
John Turvill	Halliburton
Brett Van Steenwyk	SDC/Applied Navigation Devices
Tim Price	SDC/Applied Navigation Devices
Koen Noy	Gyrodatta
Roger Ekseth	Statoil
Paul Rodney	Sperry-Sun
Anne Holmes	Sperry-Sun
Wayne Phillips	Anadrill
Philippe Theys	Anadrill
Steve Mullin	Baker Hughes INTEQ
Mark Hutchinson	Baker Hughes INTEQ
Robert Estes	Baker Hughes INTEQ
Tim Curran	Baker Hughes INTEQ
George Halsey	RF Rogaland Research
Torgeir Torkildsen	IKU
Steve Grindrod	Copsegrove Developments

1 Introduction

The Chairman welcomed those present and thanked Wayne Phillips for organising the venue.

2 Actions from last meeting

All the actions from the last meeting had been completed except the drafting of a document describing a standard means of expressing positional uncertainty.

3 The Questionnaire

Hugh Williamson was pleased with the response to the questionnaire (4 oil companies, 6 survey providers and 3 others) and noted that there appeared to be a common objective to set standards for terminology and accuracy specifications. There was also some agreement on the benefit of establishing a standard framework for modelling and validation of tool performance. Many service companies had expressed the hope that the Group would raise awareness and understanding of wellbore survey accuracy issues across the industry.

The level of commitment shown in the responses was generally encouraging, although it had been noted that the questionnaire had not covered commitment to implementing such standards and recommendations as were agreed by the Group. In this context, the following letter from Alewijn van Asperen was read to the Group:

Shell input for meeting 31/5/96 of Industry Steering Committee on Wellbore Survey Accuracy

Analysis of questionnaire

The feedback on the questionnaire turned out to be very useful in defining what oil companies and the survey industry expect from this Committee and gave some time to digest the statements made for a proper preparation of the next meeting. In broad terms the response of the four oil companies show similar needs, although each party gives a different angle of view, based on present experience and expertise. Unfortunately the survey industry response looks biased in pointing to problems originating from competitors with unreal claims, and clients who do not understand the problem or who by their own methods/requirements cause wasted time and effort. Based on the above analysis, their proposed solutions/objectives can at this stage probably not really solve the problems. E.g. "replacement of Wolff and De Wardt" suggests that wrong outdated theory is the key problem. This indicates in my view a misperception of the problems or at least ranking them incorrectly (see below).

What commitment can we expect ?

While the oil companies should be the sounding board/client representatives, the survey companies as an industry should make the commitment to work together to harmonise and raise survey standards. The commitments they offer according to the questionnaire are not always very tangible or explicit (e.g. "perhaps") and so do not give confidence that the efforts for participation by all of us will be a useful investment.

Follow-up

Basic Problem. In the questionnaire, Shell has offered to bring in field data. We have overwhelming field evidence in the last year (in fact even since the last meeting both for the North Sea area and Africa) that the first problem to be tackled by the survey industry

is at a much more basic level than what is so far on the table: ie. the level of training and knowledge of surveying methods by survey contractor staff in the field, in particular for MWD. This involves a whole range of small but extremely important elements, like

- manuals
- quality control on data and quality checking of tools
- proper units and minimum use of conversion factors
- proper use of and right input data in software.

This error source was also embedded in the write-up by Wayne Phillips and Hugh Williamson on sources of errors as "gross errors".

What is required ?

Survey Industry. Based on the above interpretation the Committee should in particular ask for commitment from each of the survey industry members that they will firstly work on clarification of these basic requirements and their implementation, as well as in general the commitment to implement, up to the level of their field operations, the products of the Committee.

Proposed Strategy for Oil Companies. The oil companies cannot solve the above basic survey industry problem as we see it from an operator's point of view. However, it explains the strategy proposed by Shell in the last meeting, that whatever tool error modelling and error propagation methods are used, the oil companies should ask, as client field evidence for each job, that quoted accuracies in tenders and contracts are indeed achieved in practice. The potential of a tool is only important as long as you define to what level the potential is met in individual field jobs. Referring back to slide 12 presented by Statoil in the previous meeting, different values for the same WdW error term are not "the worst that can happen to be avoided in the future", but can be realistic modelling by a survey company or client by linking the parameters to tool and running conditions and how they performed during the job relative to their potential (survey quality). Needless to say that Shell does not propose Wolff and de Wardt as the end-station for operators, but aggravated by the above basic problem, in many circumstances it is already impossible for survey companies to supply verifiable values for the simple WdW error terms.

Summary: proposed agenda point/questions for meeting 31/5/96

In line with the above, we propose the oil companies raise the following questions to be answered by the survey industry during the meeting or, when required, as it's follow-up.

1. Are survey companies prepared to improve their current field procedures ?
2. Are survey companies prepared to implement the outcome of steering group work ? (in view of the diversity of the responses and vague commitment statements).
3. To what level are survey companies prepared to open up so that the best state-of-the-art can be the end result of the workgroup's effort, ie. a statement from each of the companies is required as to what specific technologies/models they are prepared to make available for use by the steering group.

The Hague, 30/5/96.

In response to this letter, John Turvill and Steve Mullin felt that oil companies shared some responsibility for the general quality of MWD service, by continuing to stress the importance of low failure rates over the quality of results.

Wayne Phillips felt that survey providers could never guarantee survey quality, there being pathological cases where bad results were impossible to detect. Hugh Williamson

agreed, but felt that such cases only accounted for a small proportion of the gross errors that occur in practice.

Koen Noy interpreted the oil companies' requirement as wanting to know that a tool had indeed performed according to its stated model.

4 Standard Notation and Definitions

Steve Grindrod circulated "A Glossary of Borehole Survey Terms". He mentioned the multiple names currently used to describe some quantities and suggested a short list of standard terms:

Measured Depth
Inclination
Azimuth
Northing
Easting
True North
Grid Convergence
Magnetic Declination

Hugh Williamson felt that the terms "easting" and "northing" should refer only to standard mapping projection coordinates and not to coordinates specific to a well, slot or structure.

Philippe Theys was worried that the use of the terms Grid Convergence and Magnetic Declination at the rigsite might be unnecessary, especially in the eyes of clients. Hugh Williamson felt that it was important for MWD field personnel to understand these terms, even if they weren't used when communicating information at the rigsite.

John Turvill suggested that a definition of "up" was required, ie. whether the (z) depth coordinate was positive upwards or downwards.

In response to a question, Steve Grindrod stated that he currently had no plans to publish the Glossary, which he had developed as part of his training activities.

Action:

All members to suggest additions and alterations to the Glossary to Steve Grindrod by 30 Jun.

Steve Grindrod then presented a proposal for a standard notation (see the "Glossary, 3rd Draft"). Mark Hutchinson was worried that the Greek letters might confuse non-specialists and that an alternative list for general use might be required. John Turvill felt that the list should contain some terms specific to gyroscopic tools, to which Brett van Steenwyk responded that of the commonly used quantities, only Earth Rate was missing from the list.

In summary, the following expanded list can be compiled:

<u>Name</u>	<u>Mathematical Symbol</u>	<u>Alternative Notation</u>
Measured Depth	D	MD
Inclination	I	inc

Azimuth	A	azi
Northing	N	-
Easting	E	-
TVD	V	-
Latitude	ϕ (phi)	lat
Longitude	λ (lambda)	long
Grid Convergence	γ (gamma)	conv
Magnetic Declination	δ (delta)	decl
Toolface	τ (tau)	tf
Magnetic Dip Angle	θ (theta)	dip
Magnetic Flux	B	-
Magnetic Field Strength	H	-
Earth Rate	Ω (omega)	ER

Robert Estes suggested checking the list for compatibility with the SPE standard nomenclature.

Action:

Robert Estes to send copy of SPE standard nomenclature to Hugh Williamson/Steve Grindrod by 30 Jun.

The Group acknowledged that changing internal company documentation to meet the agreed standard would be very arduous, but agreed that all communications within the Group should, as far as possible, conform to it.

Mark Hutchinson urged the Group not to undersell itself on standardisation. He felt that a standard nomenclature even if not put into effect immediately, would be of benefit to future specialists.

Hugh Williamson noted that the terminology in the "Glossary" referring to positional uncertainty required more detail and standardisation. Philippe Theys suggested referring to the relevant ISO standards. Mark Hutchinson felt it important that any standard should incorporate terms comprehensible to the non-specialist in addition to formal definitions.

Actions:

- Philippe Theys to send details of the ISO references to Hugh Williamson by Jun 14.
- Hugh Williamson to prepare a document describing a standard means of specifying wellbore positional uncertainty for circulation prior to the next meeting. This will be done with reference to "Quality measures for navigation and positioning", a report prepared by IKU in 1993 which addresses this issue in detail.

5 Error Sources Affecting Solid State Magnetic Survey Tools

Wayne Phillips presented the previously distributed list of error sources. Three possible additions to the list were suggested:

- non-modellable (residual) sensor errors
- sensor error due to quantization
- error due to magnetic properties of the mud (esp. haematite additives).

George Halsey then made a brief presentation summarising the Improved Drilling Data (IDD) project currently in progress in Rogalands, and described the depth error modelling work that had been done as part of it. Theoretical calculations had been made to predict the effect of various error sources on the total depth error, and the predictions had been tested against reality. One of the findings had been that drill-string stretch was consistently underestimated by theory.

Hugh Williamson suggested that all identified error sources could be characterised by answering the following questions:

1. Approximately what effect does it have on inclination/azimuth/position ?
2. What exactly causes it ? When does it occur ? Does it behave differently under different circumstances, and if so, which and how ?
3. How does it propagate ?
4. What is its magnitude dependent on ?
5. Can its magnitude be predicted/measured/bounded ?
6. What is or could be done to manage it ?
7. How could the above information be verified ?

It was suggested that question 3 could be made more explicit by dividing errors into random or systematic(correlated), but Hugh Williamson felt that this might simplify the analysis at too early a stage.

The Group then attempted to answer the above questions for BHA sag. It soon became apparent that this should have been characterised as "BHA misalignment" which could be caused by three basic mechanisms: sag, BHA geometry and hole geometry, and that each would have to be tackled independently.

There followed some discussion on the objectives behind the exercise, it not being clear whether the detailed descriptions of each error source were an end in themselves or a step towards a general error model. Steve Mullin felt that the bottom-up approach to error modelling didn't make use of the extensive work already done by some members of the Group. He suggested that what was required for each error source was

- either (a) a brief description of the source and reasoned argument why it wasn't necessary to include it in a general error model.
or (b) a complete description per the 7 questions above.

The Group agreed with this and decided to divide up the task as follows:

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|-----|---------------------------------|--|
| 1. | Tool Errors | All 4 major service companies (The models are to be based on a standardised Houston environment of G=1, B=50 micro-T, dip=60°, lat=30°). |
| 2.1 | Magnetic Declination Error | Paul Rodney |
| 2.2 | Drillstring Magnetisation Error | John Turvill |
| 2.3 | BHA Misalignment | Steve Mullin |
| 2.4 | Measured Depth Error | George Halsey |

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|---|---------------------------------|--|
| 3 | Post-Correction Residual Errors | No takers. It was felt that the mechanisms and mathematics of these errors were fairly well understood, and could be added to the other results at a later date. |
| 4 | Gross Errors | Hugh Williamson |

In addition to the above work, Koen Noy, Brett Van Steenwyk and Steve Mullin offered to compile a similar list of error sources for gyroscopic and inertial instruments.

Actions:

- Analyses of each error source to be prepared for presentation at the next meeting.
- Generic list of error sources affecting gyroscopic and inertial instruments to be prepared for presentation at the next meeting

6 The Committee and the Internet

The possibility of establishing a newsgroup or similar was discarded since few members would have access to the facility. However, nearly all members do have e-mail access, and the Group agreed to use this means of communication as far as possible in the future.

7 Any Other Business

Mark Hutchinson circulated copies of "Optimizing MWD Operations", a recent publication of the IMS, and suggested the Group should establish standard QA parameters for the three activities of tool calibration, data acquisition and data processing. This work could include the establishment of a "minimum dataset" (and associated format) which would facilitate data interpretation and preliminary quality analysis. This topic will be included as an item on the agenda of the next meeting.

Hugh Williamson stated that members of the Advanced Wells Forum had shown some interest in the establishment of a JIP to standardise and develop well position uncertainty analysis. He and Mike Pollard were keen to present a proposal to the next meeting of the Forum which would take place in mid-September, and before then, members of the Group would be canvassed on what the scope and deliverables of the project should be.

It was noted that only 2 oil companies were represented at the meeting, and that a greater participation from this part of the industry was clearly desirable and would be beneficial to the Group.

Action:

All members to encourage oil company contacts to participate in the Group.

8 Next Meeting

The date and venue of the next meeting was set for 10 October in Denver, Colorado, to coincide with the SPE Annual Technical Conference. A full day was expected to be required.

Action:

- John Turvill and Steve Mullin to organise arrangements for the meeting and advise members accordingly.