Operator's Wellbore Survey Group (OWSG) Report

Fort Worth, Texas March 4, 2016

OWSG Anti-Trust Statement

- **Anti-Trust Statement**
  - We are meeting to help develop and promote good practices in wellbore surveying necessary to support oil and gas operations which enhance safety and competition.
  - The meeting will be conducted in compliance with all laws including the antitrust laws, both state and federal. We will not discuss prices paid to suppliers or charged to customers nor will we endorse or disparage vendors or goods or services, divide markets, or discuss with whom we will or will not do business, nor other specific commercial terms, because these are matters for each company or individual to independently evaluate and determine.

This statement is displayed and read at the beginning of each meeting.

OWSG Mission

- **Operator's Wellbore Survey Group Mission Statement**
  - **To promote practices that provide confidence that reported wellbore positions are within their stated uncertainty.**

  - Note that this statement does not mention the "best" or "most accurate" surveys, just that the positions are what they say they are. If operators need reduced uncertainty it is up to them to specify that. It is up to their contractors to specify what uncertainty is provided, and show that they meet this specification.

OWSG Meeting Format

- All meetings to date (about 16) held in Houston
- Hosted by an operating company
  - Devon, Chevron, ConocoPhillips, BP, Shell, Talisman, Southwest Energy, Oxy, Anadarko
- Typically 12-20 members attending
- Approximately 80 members on mailing list

Outgoing Chairperson Information

- Neil Bergstrom (ex-Devon Energy, OKC)
- Wellbore Positioning Advisor (Independent Consultant)
- Colorado Geoscience, Inc.
- Denver, CO
- Co-founder and chair of OWSG since 2012

Incoming Chairperson Information

- Pete Clark
- Directional Drilling Subject Matter Expert (DD SME)
- Chevron Energy Technology Company (ETC)
- Founding member of OWSG
- Previous chair of ISCWSA / SPE WPTS

Agenda Items: March 2, 2016

- Mission and Anti-trust statement (Neil Bergstrom)
- OWSG Group Leadership, Goals, and Meeting Schedules
  - Change of leadership – Chair from Neil Bergstrom to Pete Clark.
  - Secretary TBD
  - Discussion of meeting schedule.
- Invited Presentation by MagVAR / Surcon: Survey QC and implementation
- API RP 78 initiative – Background and progress report
- OWSG Rev 2 (ISCWSA Rev 4) Positional Uncertaity (PU) models
  - SPE/IADC technical paper presented by Steve Grindrod
  - Expansion of set – add new models
  - Maintenance and coordination with ISCWSA Error Model Committee
- Any Other Business / Adjourn 5:00 pm

OWSG @ Fort Worth

- RP78
- OWSG Magnetic PU Model QC
- OWSG PU models v Error Model Maintenance Sub-Committee

RP78

Mag Model QC

- Presentation from MagVar / Surcon
  - Progress QC from rectangular to elliptical taking account of correlation in QC parameters
  - Dynamic with respect to attitude
  - Green, amber, red zones systematically identified
  - Presented overall and by parameter
  - Potential to incorporate failed QC with increased confidence level

OWSG & Error Model Maintenance

- OWSG created several sets of tool positional uncertainty models
  - Described in SPE 178843
  - Comprehensive & reference set
  - Compatible with ISCWSA / SPE WP TS PU model framework
  - Consistent & systematic approach to PU model
  - Vendor neutral
  - No warranty expressed or implied
  - Voluntary adoption

OWSG & Error Model Maintenance

- New tool parameter models can be created by any entity, for any purpose, at anytime etc.
- OWSG = A/B/E/O
- For a new model to be adopted as OWSG
  - Requires initial approval at OWSG meeting to “E” list
  - Consult with ISCWSA error model maintenance sub-committee to help ensure consistency
  - Subsequent agree adoption at OWSG meeting. Either remove from E to move from E to A/B
  - E models are not available on ISCWSA website

Conclusion

Appendix – Reference Slides

- Slides after this are carry-overs from previous meetings and may be used for reference.

BSEE Wellbore Surveying Technology Project Overview

Project Scope

Evaluate and catalogue the various operational performance capabilities and limitations of downhole surveying technology/tools; identify the current best practices, evaluate these technologies and practices; and propose improvements to BSEE regulations as related to wellbore surveying technology associated with surveying accuracy and survey management, as well as relief well/well intersection operations.

Focus is on high temperature tools (350°F and greater).

Project Schedule

Final report due August 2016.

BSEE
Bureau of Safety and Environmental Enforcement

Membership Survey Results

OWSG Focus Area	Total Ranking Score (1-10)	Total Points	Highest Priority (10-Points)	Medium Priority (6-Points)	Low Priority (3-Points)	Not a Priority (0-Points)	Completed - Updates Only (1-Points)	Not Applicable within Group Scope
Industry Surveying Quality Assurance Guidelines and Good Practice Recommendations; Common Industry Requirements and Guidelines for Magnetic and Gyroscopic Surveying	**10.0**	**232.0**	19	7	0	0	0	0
OWSG Tool Error Models - Guidelines & Recommended Practices	**9.4**	**219.0**	18	6	1	1	0	0
Standardization of Magnetic MWD Field Acceptance Criteria and Reference Values. Guidance on the use of advanced Geomagnetic Models to improve wellbore survey accuracy (BGGM, HDGM, IFR1, IFR2 & Multi-Station Analysis)	**7.8**	**182.0**	11	10	4	0	0	1
Probability of Collision Calculation Guidelines and Recommended Practice for Parallel Wells and Crossing Wells	**7.8**	**180.0**	11	10	3	1	1	0
Standard Wellbore Directional Survey Report Format including Quality Control Plots for FAC based on the OWSG Error Models and Wellbore Trajectory	**6.2**	**144.0**	3	17	4	1	0	1
Standardized Data and Attribute Transfer Format for Raw Sensor Data, Survey Data and Header Reference Information	**6.0**	**140.0**	4	14	5	2	1	0
Regulatory Requirements and Recommended Industry Survey Rules for Survey Frequency for various section types (Tangent and Directional Steered Sections), Survey Reporting, Tie-In Points, North Reference, Reference Datum, Certification, etc.)	**5.4**	**125.0**	2	15	5	3	0	1
Recommended practice for Non-Mag Spacing and Guidelines for Measuring Residual Magnetism and Degaussing BHA Components	**5.3**	**123.0**	2	13	8	2	1	0
TVD Accuracy and Benchmark Survey Practices	**5.3**	**123.0**	2	13	8	2	1	0
Wellbore Planning, Anti-Collision Reporting and Wall Ploting Check Lists	**5.1**	**118.0**	3	10	9	2	1	1
Common practice and Guidelines for Facility and Well Surface Location Measurements and related Uncertainty using certified well location Plats, differential GPS devices and Aerial Imagery Tools such as GIS (Geographic Information Systems) Maps.	**5.1**	**118.0**	4	8	10	3	0	1
End of Well Reporting Recommended Practice for Directional Records of Vertical, Directional and Horizontal Wells	**5.0**	**115.0**	4	9	7	5	0	1
Streaming raw magnetic sensor measurements via WITSML and live real-time FAC verification. Including B-Total while rotating for proximity detection, etc. Develop real-time charts and Recommended Practices	**4.8**	**112.0**	1	12	10	2	0	0
Recommended Practice for the Communication of Declination and Grid Convergence	**3.7**	**85.0**	2	5	10	3	5	1
Recommended Practice for Well and Wellbore Names and Global Well Identification Framework for Unique Well Identification Numbers	**3.5**	**82.0**	1	9	5	5	3	3

Top 6 Desired Initiatives

Industry Surveying Quality Assurance Guidelines and Good Practice Recommendations; Common Industry Requirements and Guidelines for Magnetic and Gyroscopic Surveying	10.0	232.0
OWSG Tool Error Models - Guidelines & Recommended Practices	9.4	219.0
Standardization of Magnetic MWD Field Acceptance Criteria and Reference Values. Guidance on the use of advanced Geomagnetic Models to improve wellbore survey accuracy (BGGM, HDGM, IFR1, IFR2 & Multi-Station Analysis)	7.8	182.0
Probability of Collision Calculation Guidelines and Recommended Practice for Parallel Wells and Crossing Wells	7.8	180.0
Standard Wellbore Directional Survey Report Format including Quality Control Plots for FAC based on the OWSG Error Models and Wellbore Trajectory	6.2	144.0
Standardized Data and Attribute Transfer Format for Raw Sensor Data, Survey Data and Header Reference Information	6.0	140.0

OWSG PU Models – Now Rev 2

- Objective
  - Offered to the industry as a set of standard positional uncertainty models, covering the range of past and existing survey systems, covering a range of corrections and applications, in order to harmonize positional uncertainty and collision avoidance calculations between different service providers

Rev 2 Differences

- Reduce AMIL from 300 to 220 nT
- Add random uncertainties for reference field to generate ellipses for IFR2 smaller than for IFR1.

OWSG PU Model Sets

- A – Common use generic models
- B – Rare use generic models
- C – Contractor provided models
- D – Template models (for use in application testing only)
- E – Extended, prior to adoption
- 0 – Obsolete models

OWSG ipm FILES

- Provided by Landmark

- Set A includes
  - FINDS (should be in “B”)
  - The 6 ISCWSA gyro templates (By definition these are set “D”)
  - A model labeled “MWD_Interp_Azi” (sounds useful but not included elsewhere in the OWSG set of Models)

- Set B missing
  - FINDS (Can be found in the “A” set)
  - Blind + Trend

- Implemented in COMPASS R5000.1.13
  - Selection method

OWSG Recommended Practice

- Declination & Convergence

Magnetic Exclusion Zone

- Objective
  - Concurrence on industry magnetic exclusion zone norm

Allowable Deviation

- Objective: Common understanding of terms & terminology
- Allowable Deviation = Clearance Distance = Available Space

= Center to Center – “Minimum Separation”

= Center to Center – MASD

Where MASD = Minimum Acceptable Separation Distance

- Use: Managing offset to plan