# 43rd ISCWSA Meeting – Fort Worth, TX, USA – March 4, 2016

**Introduction**

(Son Pham)

- Safety overview: how to evacuate and what to do in case of emergency. No scheduled drills.
- Attendance is in the neighborhood of 110.
- The IADC has a rule that will not allow the SPE to arrange for sub-committee meetings while their conference is going. Robert Wylie had to take over that duty and did a great job making the arrangements.
- Much appreciation to our Sponsors (listed in the agenda). They certainly help to make this meeting possible.
- Current sponsorship paradigm asks companies to cover small pieces of the event, rather than the entire event. There are coffee breaks (6 of them), sub-committees, lunch, and networking events.
- Sponsorship levels are in Son's slides.
- Where to have meeting #44. The constitution stipulates we meet alongside the SPE ACTE. There is concern about the next location in Dubai. We have spoken with SPE and asked for a deviation from our constitution for the fall meeting. SPE has granted this request. We are now trying to find another location.
- Houston is the likely choice in the US. European cities include Aberdeen, Glasgow, and London. Please provide feedback to the officers so they can make an informed decision.
- We have purchased iscwsa.org from Steve Grindrod for $50.
- We are also seeking a third party to help revamp the website at an estimated cost of $3000.

**Schedule and Program Review**

(Jonathan Lightfoot)

- Overview of the agenda.
- We have a lunch presentation about anti-collision in space.
- We will also be electing the leads of the OWSG today. Elections scheduled for the next meeting will be discussed.
- There is also a poster out in the hallway. Be sure to look at it during breaks.

**Surface and Wellbore Positioning Errors and the Impact on Subsurface Models and Reservoir Estimates**

(Ed Stockhausen)

- Ed has produced several props for his presentation.
- Ed does well path planning and geosteering, not well planning which encompasses additional topics.
- 35 years of experience with Chevron, primarily with MWD/LWD data (no wireline).
- All methods for building reservoir models depend on geospatial data. Errors in the geospatial data can frustrate modeling efforts. Geophysicists that do not understand the error models often get frustrated with they can't tie the seismic data between multiple wells, for instance due to the use of different datums. Ed now uses a checklist.
- The Stockhausen effect could be called a gross error.
- Geologists tend to be very optimistic with regard to estimates of reserves.
- The value and success of wells depends on effective wellbore placement. Ed placed a paper on the tables concerned with using flexible well planning with an uncertainty management plan.
- On one well, for every foot of TVD error 100,000 barrels of production are lost. The Stockhausen Effect caused a well to be placed 19 feet too high in TVD, the well produced gas early, and the entire drilling campaign was suspended.
- Severely high doglegs due to aggressive BHAs can sometimes cause MWD failure when the tool rotates through these doglegs.
- A big problem is that operators don't learn what happened, and so the same mistakes get repeated.
- An example was provided (see the presentation for illustration) which analyzed the impact of TVD survey uncertainty on well placement in the reservoir.
- An example of the Stockhausen Effect was also given, with proof provided via a hole bored through concrete blocks.
- There is a desire to have a way to combine continuous and stationary surveys.

(Questions)

- Kevin McClard – Do you see less Stockhausen Effect with rotary steerables? Answer – Yes, you can still get it any time you change modes. If you don't take a survey every time you change modes, it can result in a 1 to 2 foot TVD error. Kevin – With rotary steerables you might not know when the mode changes due to the level of automation. Answer – Some tools will give a log of the tool settings in real time. Kevin – It seems that with motors, the data is there from the toolface measurements, and the industry should come up with a technique of combining the information.

**Estimating the Economic Impact of Wellbore Positioning Errors on Reservoir Recovery**

(Stefan Maus)

- Objective is to come up with numbers that give the impact of lateral wellbore positioning errors on recovery of reserves.
- Positioning errors in a shale development with many parallel wellbores can cause some wells to be too close together and others to be too far apart, potentially missing reserves. The infraction of lease lines can also have significant economic impacts.
- Risks include wellbore position, lost recovery of reserves, and infraction of lease lines.
- There is an online simulator that anyone can go to for the purpose of assessing the impact of poor wellbore placement. The simulator uses ISCWSA/OWSG error models in its analysis.
- A monte carlo simulation is used to put random and systematic errors on the wellbore surveys, and thus on wellbore placement.
- An example was given with a 10 well section with 500 foot spacing. The simulator counts the number of lease line infractions and well-to-well cross overs.
- Assumptions about the drainage envelop are used to assess impact to recovery of reserves. The "drainage radius" was modeled as the 1 standard deviation distance of a Gaussian distribution.

(Lisa Grant)

- This has been an outgrowth of trying to get people to understand that the wells are not actually exactly on the lines on the page.
- Changes in simulated recovery rates were between 0.7% and 1.9%.
- There is also a sensitivity analysis capability and shows the effect of lateral length on production and lease line violations.
- A comparison of results for East/West vs. North/South wells indicated there's much value in orienting wells North/South.
- Lisa's opinion is that the estimates presented were conservative.
- This is a great tool to illustrate why we need enhanced surveying techniques.

(Questions)

- David Gibson – Now that this has been done, what has the impact been? Lisa – I have not gone yet to the field to use this, but I am very confident that it will go very well. I've done this drawing-wise with other assets, and it helps to create a complete change in attitude. The asset is the client, and you have to educate the asset.
- Pete Clark – I'll back up what Angus said. This is a great piece of work. Is it backed up by experience? Stefan – We have spoken with many people about the assumptions and we've tried to make it very conservative to maintain credibility. Feedback on the assumptions is very welcome. Lisa – I think it's going to become easier to quantify lost acres as more and more frac data becomes available. Stefan – Thanks to the OWSG to get a consolidated list of tool codes. Now we can compare all the different survey methods.

- ?? - Thank you for the presentation. Many times when we go to the field, the company man is more interested in drilling fast than collecting the necessary data. Lisa – You have to remember that the asset, not the driller, is the client. The client is the one that should be demanding the data collection. They are the ones that need to understand more so than the drillers.
- Ed Stockhausen – Getting back to the statement I made earlier, at Chevron you have to have a risk and uncertainty management plan. Then you can communicate to the asset team that you may not be able to achieve the value based well objectives with just standard surveying.

**Sub-Committee Activity Report: Collision Avoidance**

(Steve Sawaryn)

- The group has made excellent progress. We are now working on quantification, having finished the qualification part.
- We wanted to be able to communicate the complete anti-collision rule, with parameters, caveats, and written implementation notes. Plan is to present the results with a full presentation at the next meeting.
- We have been focusing on the collision avoidance rule. The next steps are assurance and verification, and then management principles.
- The intention is to create 2 SPE papers to act as the normative standard for what comes out.
- We have decided to keep the Gaussian probability distribution for now, and focus on documenting the limitations.
- We would also like to test the applicability with the well stock drilled to date. There is really no such thing as an average well, but we have to use something for comparison.
- The new rule was presented and terms explained to the group. A list of action items was also presented.

(Questions)

- Son Pham – One of the self-funded people working on this is Steve himself and we greatly appreciate that. The sub-committee is tackling a very challenging task, and Steve is one of the few people that can make it happen.

**Improving Lateral Surveys Using Memory MWD Data**

(Marc Willerth)

- Differing groups has different priorities. Drilling vs. Geology vs. Wellbore Placement.
- You are also fighting against the “Do More With Less” mantra, and the ease of deployment.

- On individual surveyed the well with 2 MWD surveys in the same BHA. They differed in TVD by 22 feet by the end of the lateral.
- The growth of the error was linear with measured depth. There was no difference when rotating.
- Large positional errors can be created by extra non-magnetic drill collars, changing slide patters, or altering the BHA.
- Some fixes include stopping for additional surveys, using two sensors, or using continuous measurements.
- The continuous surveys of the two wells had only a 4 foot discrepancy in TVD at the end of the lateral.
- Incremental barriers stop things from getting deployed. We need a simple solution that eliminates barriers to deployment. The solution is to perform a multi-shot survey on the way out of the hole and store it in memory. Laying out a single at TVD will allow you to sample the well in different places.
- You can do a lot of things with the continuous memory data, including validating a double/combined MWD and pull out of hole survey.

(Questions)

- Shawn Deverse – When you see the large discrepancies between the in run and out run, do you see the one run catching surveys at the beginning of slides, and the other catching surveys at the end of slides? Answer – Yes that did somewhat happen here. Shawn – What about planning for surveys in the middle of slides? Answer – You could do that, but you have to carefully your slides.
- Neil Bergstrom – Great work. A pushback I often get is that memory data doesn't help us put the well in the correct position at all. I would compare it to the black box on an airplane. This is really an important diagnostic tool that can help increase awareness.
- Mahmoud ?? – Is there any focus on the errors in measured depth? Answer – Not in this analysis. Depth is absolutely a concern though.
- Todd Benson – We've seen this phenomenon over and over, and we see that it's often worst when your slides are all in the same direction. Answer – We definitely saw that in this case.
- Ed Stockhausen – You got the answer by combining surveys. I think we should combine them with continuous surveys.
- Todd Benson – We've worked with 13 or 14 tool vendors, and there are a lot of tools out there that are just not very accurate on continuous inclination.

**Overview and Progress Update for API RP78 "Surveying and Wellbore Positioning"**

(Lisa Grant & Pete Clark)

- The OWSG realized that we really need a minimum industry standard. We decided that the home of such a standard should be a standards organization: API.
- Lisa is the lead of the API section dedicated to bringing about this minimum standard.
- The effort started about 1 year ago. Anyone can participate; you don't have to be an API member. Only 1 vote is allocated per organization.
- The purpose is to come up with minimum standards for acquiring, storing, and using wellbore positioning data. We want to make sure the survey you have is properly represented. We are not going into advanced surveying techniques.
- Currently a straw man is built out, and we are in the process of adding meat to it. There will be opportunities for comment.
- The API grounding meeting will be the week of April 4th in Houston. Send a note to Roland Goodman (goodmanr@api.org) if you have interest. This is an API process.

(Questions)

- Jonathan asked if anyone objected to the effort, and there were no objections.

**Borehole Positioning and Tortuosity Standard Calculation Methods, "Where we are now and where we are going"**

(Darren Aklestad)

- There is an API document on wellbore position calculation methods. A history of the various calculation methods was presented.
- Borehole indicators include dogleg, tortuosity, and rugosity.
- There are 3 methods for calculating dogleg severity: Lubinski, Wilson, and Mason/ Taylor.
- Tortuosity is cumulative dogleg. There have been attempts to normalize this.
- Rugosity is wellbore diameter irregularity.
- Higher frequency surveys show much larger rates of change in the orientation of the wellbore.
- Advanced Spline Curve is a new method of calculating the wellbore position. The paper is SPE/IADC 178796.
- There was also a paper presented on a novel real-time tortuosity index. SPE/IADC 178869.

(Questions)

- Ed Stockhausen – The spline shape you showed, based on some analysis we did, was actually easier on the MWD tool than one long continuous arc.
- Mahmoud – No matter what method you do, the hole is still the same.

- Steve Sawaryn – I think establishing a lexicon for the definitions is an excellent first step. Geometrically there is the curvature and the geometric torsion. Steve has very developed thoughts on the three definitions that would be necessary to define.

**Orbital Debris Collision Avoidance, the act of manoeuvring a satellite to decrease the probability of collision. What can we learn from other industries? Also, High Resolution Satellite Imagery for Well Location Validation and Confirmation.**

(Taner Kodanaz & Lamar Landry)

- This was a lunch session.

**Sub-Committee Activity Report: Error Model**

(Andy McGregor)

- Working on a document based on what's in the e-book. Intended primarily for implementers.
- There is also a spreadsheet in development that demonstrates implementation and has example code.
- There is a need to fill in gaps on verification data for tie-ons and inclination only surveys.
- The correlation of error sources (magnetic references) may not be handled properly for anti-collision calculations. Is the effect of this correlation a practical concern? Some analysis done by the group indicates that it can be very important. Especially for standard referencing. But the assumptions currently in use are generally conservative. The exception are wells drilled toward each other.
- Looking at adding a course length term to the error model based on some empirical analysis.
- Discussed management rules, including when it would be appropriate to use a Blind Drilling error model.
- Relationship with the OWSG: Error Model Sub-Committee establishes the framework, weighting functions, and geomagnetic uncertainties. Experimental and contractor models will not be published on the website. The primary set will be on the website.

(Questions)

- Ed Stockhausen – We should have a statement on surveys that speaks to the fact that gross errors are not included in the model. Lisa Grant – I hear that Ed is volunteering to address this. We have been discussing survey frequency. Ed – Continuous surveys are not as accurate as stationary surveys, but they are more accurate than the assumption of minimum curvature.
- Adrian Ledroz – You could always run a gyro after the fact, to tell you better where the well is.

**Election of OWSG Chairperson and Announcement of Upcoming Elections**

- We will elect 2 Directors at Large next meeting, and then two a year later. Then we will continue in this pattern. This was done to provide enough advanced notice to the organization.
- Pete Clark was unanimously elected chair of the OWSG
- Jordan Meyer was unanimously elected secretary of the OWSG
- We will send out an election schedule covering the next two years. Please contact the Directors at Large if you would like to run.
- The duties of the Directors at Large were clarified to the group.

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

(Neil Bergstrom)

- The anti-trust statement is read at the beginning of each meeting (see presentation for content).
- Mailing list is currently around 80 members. Typically, 12-20 members attend. All meetings to-date have been held in Houston.
- Products have been the OWSG Error Model set, and the initiation of the API minimum industry standards group.
- Neil was one of the founding members, but is moving on from Devon. Pete Clark volunteered to take the leadership of the group over.

(Pete Clark)

- Let's formally thank Neil for his dedication and hard work.
- Agenda of last meeting is in the presentation.
- There was an invited presentation from MagVAR / Surcon. Spoke about dynamically calculation of QC limits. Also discussed the potential use of scaling confidence level to deal with data that was failing QC.
- OWSG Error Models: SPE 178843 was presented yesterday. The paper describes the models. The models are meant to be vendor neutral. There is no warranty expressed or implied.
- New models are initially put into the OWSG "E" model group. It is eventually either dropped or moved to the "A" or "B" group. This would involve discussion with the ISCWSA Error Model sub-committee. The "E" set will not be available on the website.

(Questions)

- None.

**The effect of survey station frequency on wellbore position accuracy**

(Jerry Codling)

- The goal of the study was to put terms in the error model that capture the effect of varying survey length.
- The method consisted of looking at continuous gyro surveys with stations reported at 10-30' intervals, then remove alternate stations and look at the difference at TD.
- The gyro data was taken from multiple different gyro surveying systems.
- See the presentation for graphs of some of the data.
- A model was created to try to capture the trends as a function of angle change and survey interval length.
- The analysis showed the Stockhausen Effect is very small when there is not much angle change over the survey interval; maybe adding 1 foot every 1000 feet for standard surveying practices. Large angle change makes the issue more significant, on the order of 8 feet per 1000 feet.
- Formulation is not yet fully reviewed.
- There is a concern that publishing error terms for infrequent stations may lead to abuse, but there is a demand for it.
- A minimum tortuosity should be applied in the equations to get an effective result.

(Questions)

- Lisa Grant – Were you looking at vertical, horizontal, or absolute change? Answer – I would look at the vertical and horizontal angle changes independently. Lisa – What about 3D wells vs. 2D wells. Answer – I haven't isolated that data yet. That's an area I need to look into.
- Neil Bergstrom – Are these terms implemented in the latest version of Compass? Specifically, the delta angles? Answer - You do have access to those terms. You will have access to course length.
- Ed Stockhausen – The ratio of the slide to the rotate is an important factor. You can look at the paper I put on the tables.
- Lisa Grant – Do you imagine pulling the interval from the data that was entered? That would be preferable. Answer – The algorithm for surveys will use the reported length. But with plans, Compass automatically interpolates every 100 ft. There is an enhancement needed for that.

**"Gravity, isn't it a constant and the same everywhere?"**

(Robert Wylie)

- Started off with an illegible summary.
- We define down as the direction of gravity. That's not an exact reference of down.

- We measure acceleration, NOT gravity.
- There is also centrifugal force, which we measure in addition to gravity. This causes a bulge in the Earth at the Equator.
- The mass distribution of the Earth causes spatial gravitational variations.
- Because the radius of the Earth is different at the Equator than it is at the poles, acceleration due to gravity will also be different at the surface of the Earth.
- There's a standard equation for gravity as a function of altitude and latitude. It's available on Wikipedia, so it must be true.
- Sensors calibrated in one location can appear to be off when taken to another geolocation. Care should be taken to use a reasonable global gravitational model as a reference when performing calibration.

(Questions)

- Angus Jamieson – I was asked to do a calibration audit. When he put to tool into the chassis, it didn't matter what angle it was oriented at, it always read 89.9 degrees. It was because he had used the wrong value of g and had a persistent 2 mg bias.
- Pete Clark – Do we ever calibrate accelerometers individually? Answer – We used to do them individually. I personally look at them as individual sensors. There are companies that do total field calibration that treat them all as a triad.
- Robert Estes – To Angus's point, what that example shows is that there is a dead band in the system where it won't respond to changes in orientation.
- Son Pham – What value should be used when I step off the edge of the flat Earth?

**Sub-Committee Activity Report: Education**

(Steve Mullin)

- The last workshop got a very high rating from the attendees. We've been asked to repeat it again, but it won't be before Spring of 2017.
- Immediately following the hits and misses in Galveston, we wanted to do a workshop on the effect of poor well placement on reserves. We were able to get the right people put together for it, but the number of registrants were too low. However, the workshop committee were very keen to carry on that effort. We are going to think about doing it as a 2.5 day workshop.
- SPE Middle East wanted us to take the Hits and Misses Workshop over there. We foresee travel being difficult to get approved. Further, previous Middle East events have been poorly attended. So we are looking to do a smaller event such as a topical lunch with the SPE in September. Robert Wylie will head that up. We will poll the attendees at the lunch to see if they would attend a 2 day workshop in the future.
- The education committee is the editorial board for the e-book. Angus has created 3 new chapters and updated the chapter on survey intervals. Review will hopefully be done by the end of March.

- Steve has been discussing creating some SPE webinars with Shasta. He will be putting together a list of potential subjects.
- We have been talking about getting more educational material on the website. David Gibson is heading that up. He is looking for people willing to make small or large contributions to the website.

(Angus Jamieson)

- The new course had its first uptake, and the students have completed it and they will be taking the exam next week.
- We started with 25 students, but 9 had to pull out during the term of the course. So the university is running the course at a loss. The view is to continue running the course for this year and to honor all the published start dates for this year. Hopefully losses can be made up in future years.
- We've changed the structure of how we price the course. If someone within your organization has been in the course, they can be your tutor, and then we cut the price down to $1000 from the standard online price of $3000. If you have lost your job and would still like to do the course, have a word with Angus.

(Questions)

- None.

**Sub-committee Activity Report: Well Intercept**

(Roger Goobie)

- Lower than normal turnout due to economy. Some members were presenting at the SPE at the time.
- The meeting was very productive.
- We have an almost complete lexicon.
- We have a large bibliography that is being organized / categorized.
- We are generating an e-book, and hope to write a paper from it.
- We have an agreement in place to pull data from the Halliburton "Customer Guide to Relief Well Ranging." Terms and conditions of the agreement were discussed and are in the presentation.
- The chapters of the e-book have been delegated out, and overall we are about 50% done.
- Email Roger up if you want to contribute to the e-book.
- We also worked on a history of relief wells that may be a topic of a future full presentation.
- We are also looking for case studies for the e-book.

(Questions)

- Steve Sawaryn – The comment on liability, I was under the impression that the SPE does not take on liability for any published material. Son – Shasta sent the agreement to the SPE legal team who approved it.

**General Overview of Ranging and Intercept Practices plus a Technical Review of Horizontal to Vertical and Opposing End to End Horizontal Wellpath Intercepts.**

(Tyler Milford)

- Magnetic ranging services can be grouped into access dependent ranging and access independent ranging. The latter does not require access to the target wellbore.
- Access independent methods are usually used for blowout control, plug and abandonment, and wireline recovery.
- A video of a relief well drilling process is part of the presentation. There were 3 phases: locate, follow, and intercept.
- Once a pass-by ranging run has been conducted, the process enters the follow phase. At this point active and passive ranging are combined to get the ellipse as small as possible.
- The intercept phase can take quite a while due to the large number or ranging runs required.
- To mill and re-enter a well, you need to be lined up to within an inch or two.
- Access dependent interception types include toe-to-toe interceptions, toe to heel interceptions, and horizontal to vertical interceptions. Rotating magnet techniques are most commonly used for this type of well.
- Often more than one type of ranging technologies are required on a single job.

(Questions)

- Lisa Grant – When you have a blowout in a crowded well platform, I'm concerned about the ability to find the well due to the interference. Answer – It's difficult to deal with and could be a problem if there is no access to the target well. Lisa – What about pre-magnetized casing? We've looked at that before. Answer – Another thing you can do is make sure there is enough spacing at the ranging / interception depth. Lisa – Do you look at interference from other offset wells during the planning of a relief well. Answer – Yes we do that. It's easier onshore than offshore.
- Son Pham – How does drilling through salt formations affect your ranging strategy. Answer – It's more about high resistivity formations than specifically salt. You could perhaps move the source around, or you may have to pre-magnetize casing so you can use passive magnetic ranging.

**Webmaster's Report**

(Robert Wylie on behalf of Phil Harbidge)

- We are taking over iscwsa.org and linking it to iscwsa.net.
- Upgrade work proposed to iscwsa.net in 2016.
- The SPE WPTS has about 1041 members. About half the members are engineers.
- There are some reservoir and production personnel among the membership.
- The geographical spread is very diverse.
- Please send feedback to the ISCWSA committee.
- There is a LinkedIn group for the ISCWSA.

**Treasurer's Report**

(Robert Wylie)

- No full treasurer report this time due to having too many moving parts with the dual conferences this week.
- I am thinking about moving late registration a week earlier for better planning.
- We are in good shape with a bank balance of around $75,000 before today. We have some liabilities owed to the SPE that could be up to $15,000. And we have forecast web updates of $3,000. And we have an unpaid sponsorship from last time of $2,000.
- Thanks to Carol Mann for help with registration this morning.
- Our cost this time was about $22,000. We've received $10,500 in cash from our sponsors, and about $15,000 in registration fees. Thanks to all our sponsors.

**Closing Statement**

(Son Pham)

- Thanks to the committee for their efforts in putting on this event.
- Would also like to thank the participants for making it here in this downturn.