ISCWSA 54: Collision Avoidance Work Group – Virtual Meeting

14.00 – 17.00 UK Time (08.00 – 11.00 Houston Time) 05th October 2021

MINUTES (For Internal ISCWSA Use Only)

Attendees

(may not be complete: Teams Function to pull attendee list not enabled yet by host's admin)

Attendee	Organisation
Gary Skinner	Baker Hughes
Harry Wilson	Baker Hughes
Ty Mitschke	Consultant
Mike Calkins	Three Sigma
Clark, Pete J	Chevron
Mahmoud ElGizawy	KM technology
Denis Reynaud	Pathcontrol
Kevin McClard	
Ross Lowdon	Schlumberger
Mike Attrell	Mostar Directional
Andy McGregor	H&P
Craig Sim	Dynamic Graphics
Phil Scott	Dynamic Graphics
Benny Poedjono	Consultant
Darren Aklestad	Schlumberger
Stephen Grindrod	Copesgrove Development
Lightfoot, Jonathan D	Occidental
Michael Strachan	Halliburton
Bill Allen	BP
Jerry Codling	Haliburton

Agenda

Agenda		
Activity	**Presenter**	**Title**
Introduction	Gary Skinner	Introduction
Status	Gary Skinner	Action Items
Topic	Pete Clark	Collision Avoidance Reporting
Report	Harry Wilson	Update from Sidetrack working group
Report	Bill Allen	BP: Move AC monitoring from Admin to Engineering Barrier
Report	Andy McGregor	Surface Margin and Rev 5 Misalignment Comparison
Discussion	Jerry/Darren	Uptake, Adoption, Education: WPTS AC Rule
Topic	Pete Clark	Bounding Boxes / Offset Well Selection

Agenda Items parked due to time constraints

Discussion	Gary Skinner	Use of a preferential clearance statistic
Discussion	Gary Skinner	Ancillary Rules

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Introductions

Ross Lowdon kicked off the meeting. With Steve Sawaryn's sad passing, a formal memorial will take place during the Wednesday main meeting session.

Ross thanked Gary Skinner for taking over as Chair of the CA Subcommittee and handed the meeting over.

Gary introduced himself and acknowledged the important role that Steve has played in the ISCWSA and the CA Subcommittee for many years

Action items from Prior Meeting

Take forward actions

Benny: In-depth discussion and Jonathan meeting combined to get the tasks done

Gary: Speak to Phil on Data Quality Assurance

Ty: – draft done – will send out for comments

Phil for virtual meeting

Pete Clark Collision Avoidance Reporting

Actions
1. Review ISCWSA CA lexicon to check current column labels are accommodated / provide translation table
2. Generate proposed standard for table content & headers / labels along with justification / reasoning
3. Review CA report necessary header information

Considerations
a) Planned and actual
b) Column ordering / coding of columns

Method
- Pete to progress
- Review with Gary, Darren & Bill
- Proposes to CA sub-committee

Collision Avoidance Reporting

Pete Clark

Chevron Wellbore Placement Focal Point

9/28/21

What's the issue?

- Information rich reporting for safety critical operations

- Differences in reported attributes
- Differences in nomenclature

- Operator reliance of Directional Drilling Business Partner
- Poor assimilation of reported information

Objective

- Get agreement on issue
- Get agreement to work towards standardization
  - Generate proposed collision avoidance report

Common Table Elements

Column	Headers (1)	Headers (2)	Headers (3)
Reference Well Measured Depth	Ref MD	Reference Measured Depth	Reference MD
Reference Well True Vertical Depth	Ref TVD	Reference Vertical Depth	Reference TVD
Offset Well Measured Depth	Offset MD	Offset Measured Depth	Offset MD
Offset Well True Vertical Depth	Offset TVD	Offset Vertical Depth	Offset TVD
Centerline to Centerline Wellbore Proximity	C-C Clear Dist	Distance Between Centers	Ct-Ct Distance
Minimum Acceptable Separtion Distance required to satisfy Collision Avoidance Rule	Rule MASD	Minimum Separation	Minimum Allowable Separation
Separation Factor	Sep Ratio	Separation Factor	OSF
Rule Status (Pass / Fail)	Rule Status		
Collision Avoidance Action Criteria		Warning	Status

- Eight common elements
- "Reference" & "Offset" are de facto standards
- Reporting includes reference to collision avoidance rule
- Four shared primary outputs are given different labels
- Rule Status (Pass / Fail) & Collision Avoidance Action Criteria
  - Substantive differences
  - Similar function

Additional Table Elements

Column	Headers (1)	Headers (2)	Headers (3)
Reference Well Local North Coordinate	Ref North		Reference NS
Reference Well Local East Coordinate	Ref East		Reference EW
Offset Well Local North Coordinate	Offset North		Offset NS
Offset Well Local East Coordinate	Offset East		Offset EW
Refrence Well Semi Major Axis Positional Uncertainty at Collision Avoidance Rule Confidence Level		Semi Major Axis Reference	
Offset Well Semi Major Axis Positional Uncertainty at Collision Avoidance Rule Confidence Level		Semi Major Axis Offset	
Orientation on Horizontal Plane from Reference to Offset Referenced to Map North	Horiz Bearing		Traveling Cylinder North Azimuth
Orientation from Reference to Offset Referenced to Plane Normal to Reference Well		Highside Toolface	
Difference in Local North Coordinate from Reference Well to Offset Well		Offset Wellbore Center (+N/-S)	
Difference in Local East Coordinate from Reference Well to Offset Well		Offset Wellbore Center (+E/-W)	
Ellipse Separation		Distance Between Ellipses	EOU-EOU Clearance
Allowable Deviation from Point (Center to Center minus MASD)	Available Space		Allowable Deviation from Reference
Collision Avoidance Action Criterion			Controlling Rule

- Steering information to avoid collision is not standardized / clear
- Ellipse Separation is challenged by combined covariance collision avoidance rule ($\sim\sqrt{(\sigma r^2 + \sigma o^2)}$)
- Should Allowable Deviation / Available Space be common?
- Scope to reduce report complexity given lack of heartache from missing information
  - Less may be more

Questions / Discussion…

Harry Wilson: Sidetrack working group update

Task migrated more towards error modelling, 6 people, 5 meetings conducted. Close to issuing report of findings

All about **relative uncertainty**, from sidetracks, but turns out it is mostly generic to all.

MD stretch is treated as global, optimal for DP stretch, but not true for wireline stretch. New term added depth stretch systematic typically applied to wireline stretch terms.

Sidetracks have zero uncertainty at sidetrack point, Andy McG. Is going to do some tests for comparison.

Benny: Q) What happens if I do stretch correction: A) No difference, there is still a residual.

WARNING: If we need to do anything specific with respect to Sidetracks, programmers need to be careful that it is only applicable to the sidetrack

Jerry: Depth uncertainty doesn't pay much part of clearances as ellipses are parallel at sidetrack point

Mike: Can't we trust pipe tally for sidetrack? If the same pipe is used possibly, but we cannot guarantee.

Future Actions / Discussions
- Discussion on practical implementation as on a sidetrack we will fail ACR immediately and for some reasonable distance, has to be some practical dispensation given so an MOC isn't needed. some discussion with a sensible boundary
- Might extend test well set from 1 sidetrack to add additional ones (including multi-lateral)
- Issue final report

Bill Allen: Improving AC Barriers

- Bill provided a spoiler of his presentation for the main meeting. Full presentation available on ISCWSA.NET

Andy McGregor Comparison of Rev 5 Misalignment terms with Sm

- ISCSWA Rev 5 larger to 400m; but by 120mm is 57% of rev 4
- With 15m slot sep Sm, is negligible
- 5m has more of an affect, Rev 5 is more conservative until 330/400m
- 3m Rev 5 are more conservative
- Benny: Slot sep 2-2.5m, so would need to be more cautions

Jerry Codling: SPE – WP TS RULE

- Only seen 2 so far, it IS a big deal as procedures/manuals need re-written
- Equinor/CoP/SLB has some of it in their rules already
- Number on platforms with 3-4ft separation
- All wells from platforms would need dispensation: (+ some land)
- **We haven't written anything about dispensation.**

Project Ahead Uncertainty

- There is reality in the 0.5m sigma PA
- If you have a procedure allowing higher frequency you could reduce Sigma PA
- **Bill**: Sigma PA: Jerry: We don't measure how far off the planned point we are
- **Bill**: BP rule was conservative, but ISCWSA is more so at surface

Require Dispensation

- 5m Dispensation rule.

General Discussion

- **Harry**: SPE rule is more conservative shallow, and less so deeper: as per consensus.
    - Some companies use 2 rules at surface (e.g. SLB), this is just slicker.
    - BH have 2 dispensations:
        - SM=0 if slot uncertainty is valid
        - Reduce Sigma PA to 0.15 if 10m course length used
- SM & SigmaPA are new and more conservative than the norm
- The reality of 5-7ft spacing was based on platform wells in the 80s when 1 in 10 wells had a collision; the probability is real, project ahead is valid.
- **Pete**: Chevron in process of re-writing standard and will contain the SPE Rule + the dispensation discussed by Harry and adopted by Baker.
- **Michael Strachan**: Will sigma PA be valid with systems that follow the plan
    - Harry: That is in line with reducing project ahead in line with course length
    - **Jerry**: I don't think you can say less than 10m Course length reduction
    - Possible to evaluate, but needs to be a general rule.
    - **Benny** can put an MOC in place.
- **Darren**: have we muddled things in the ACR instead of keeping it in the error model
    - **Gary:** error models aren't just about collision analysis, there are also valid reasons to modify them based on reference well practices.
    - **Harry:** Once the well is drilled it becomes an offset, where it doesn't have project ahead uncertainty

Comparison of TopHole Anti-Collision Results
Between Rev4 and Rev5

Rev5 Error Model Changes

- Rev5 introduces larger, random hole misalignments
- These increase ellipse size early in the well but error will then reduce deeper.
- How does this affect ISCWSA anti-collision results using surface margin.

ISCWSA CA Rule

$$SF = \frac{D - R_r - R_o - S_m}{k\sqrt{\sigma_S^2 + \sigma_{PA}^2}}$$

D	**The distance between a given point on the reference well and closest point in 3D space on the offset well.**	
R_r	The open hole radius of the reference well.	
R_o	The open hole radius of the offset well.	
S_m	Surface margin increases the effect radius of the offset well and is used to accommodate small, unidentified errors. It also defines the minimum allowable slot separation during facility design and ensures the separation rule will prohibit the activity before nominal contact when the uncertainties are zero.	0.3m
k	A dimensionless scaling factor which represents the number of standard deviations at which SF is evaluated. This is related to the confidence level in the SF result.	3.5
σ_S	The relative uncertainty between the reference and offset wells, at one standard deviation, along the direction of D determined from individual uncertainties of the two wells σ_r and σ_o	
σ_{PA}	Is the one standard deviation uncertainty in the project ahead from the current survey station to the bit and next survey station. This takes into account the ability of the driller to steer the well to the required point.	0.5m

Tests

- Use Ref Well and Well#1 from standard CA test set
  - Nominally parallel pair of J wells.
  - Vary the slot separation (100m in standard tests)
- In planned vertical portion introduce random inc (0-1°) and az (0-360°)
- Compare combined covariance uncertainty and CA results.
- Also ran with planned reference (inc=0). No significant impact on results.

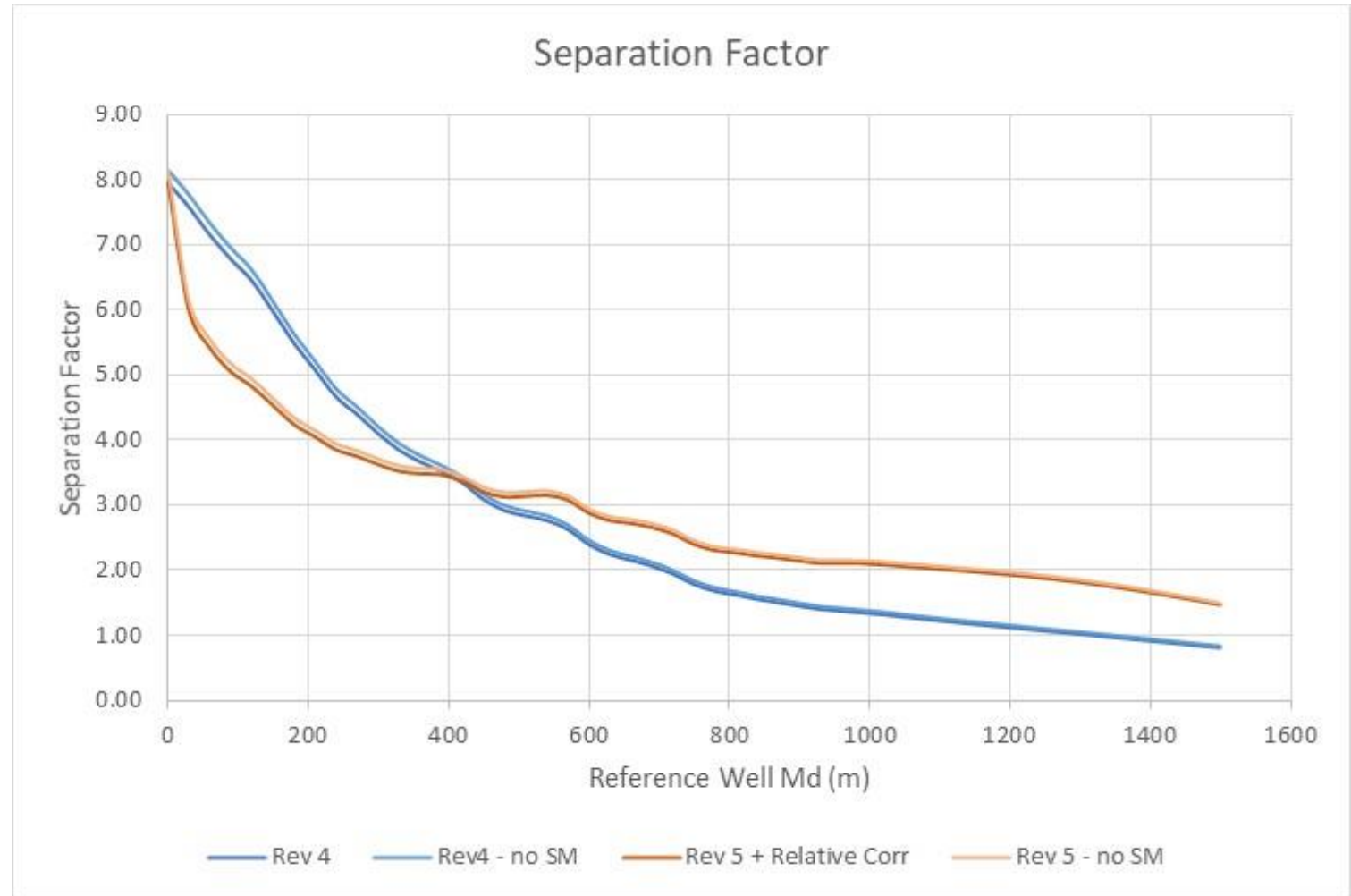# Ellipse Sizes

Rev5 larger to 400m.

By 1200m, Rev5 is 57% of rev 4.

As expected relative correlation of errors has no effect until wells build angle.
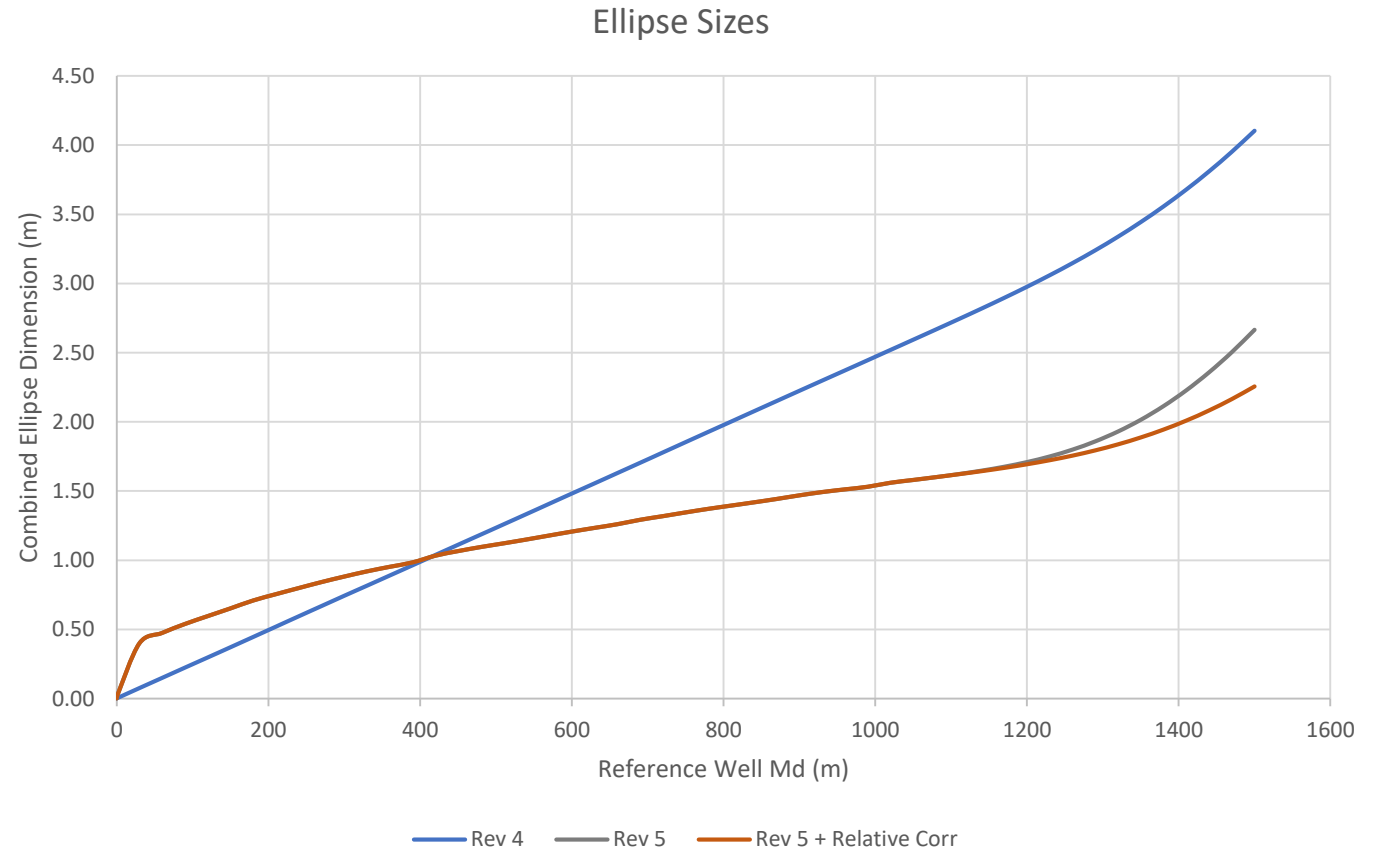
15m Slot Separation

- Effect of Sm is negligible at greater distances.

- Slot separation here is 15m.

- Darker lines have Sm = 0.3m

Separation Factor

5m slot separation

- Consider depth when Sf = 1

	Sm=0.3	Sm=0
Rev 4	295m	350m
Rev 5	164m	224m

- Rev5 more cautious until 330/400m.
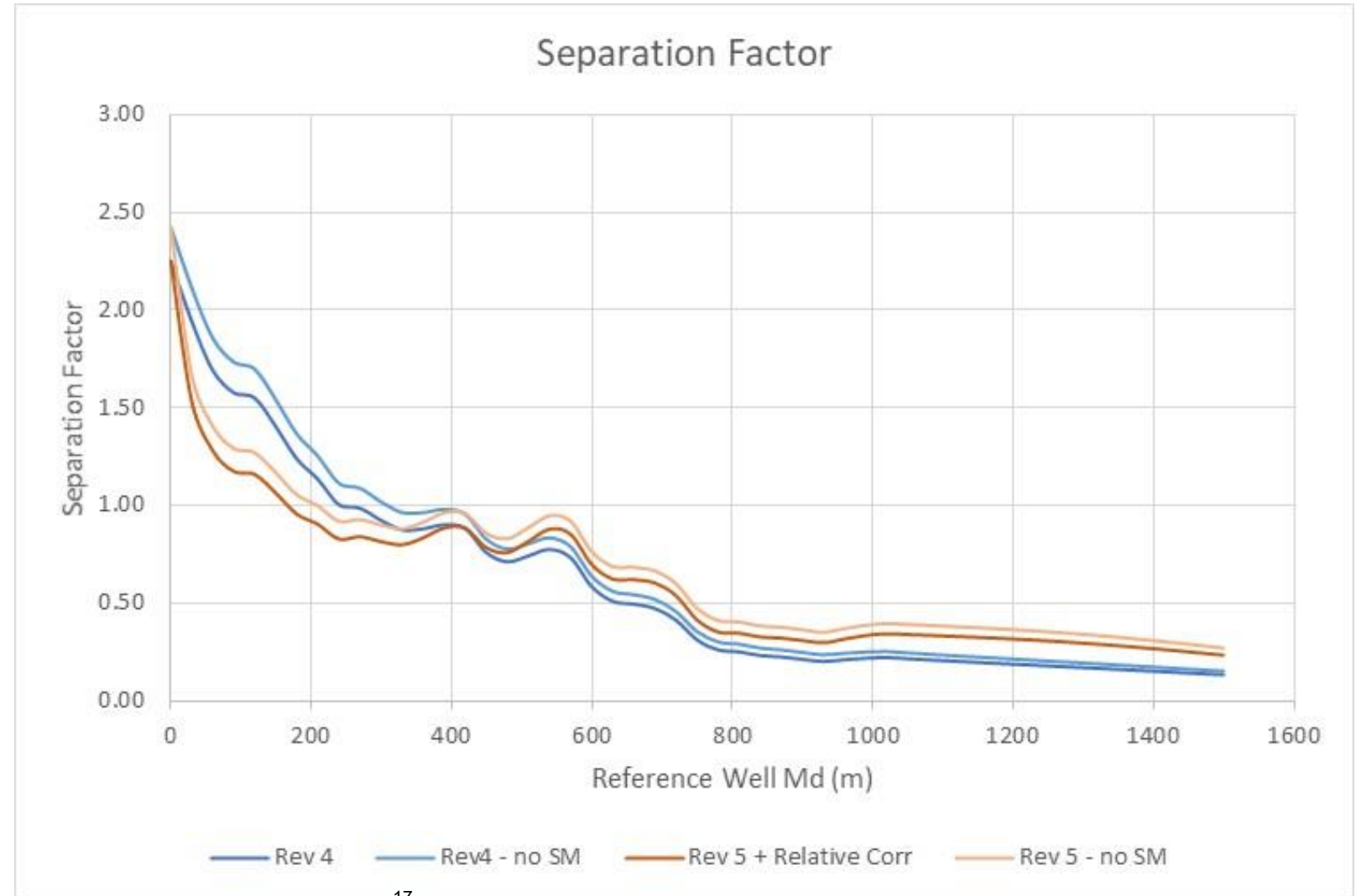
3m slot separation

- Consider depth when Sf = 1

	Sm=0.3	Sm=0
Rev 4	12.3m	28.9
Rev 5	6.4m	15.5m

- Rev5 only more cautious with Sm

Separation Factor

Rev 4 — Rev4 - no SM — Rev 5 + Relative Corr — Rev 5 - no SM
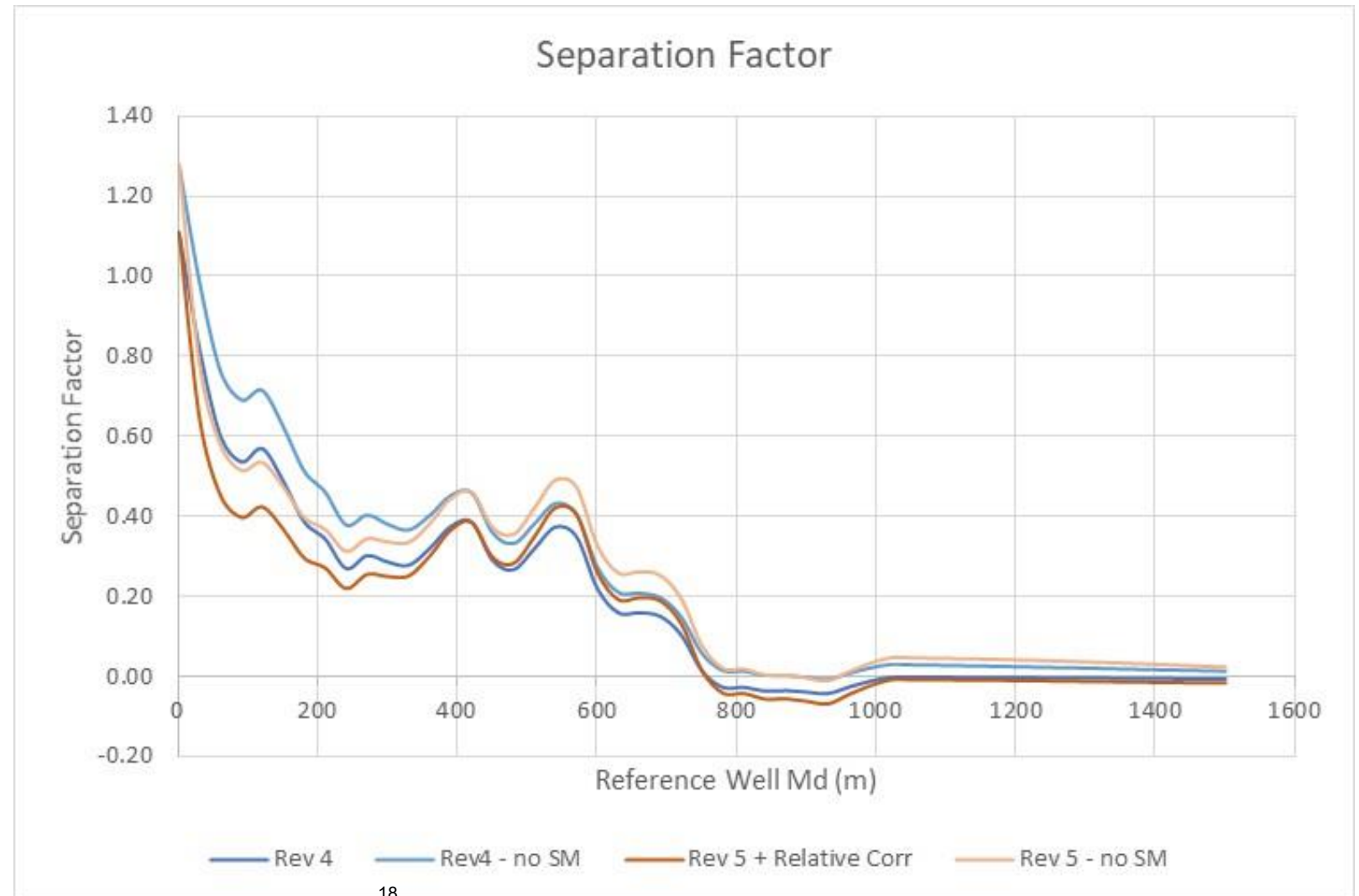
Effect of Sm

Sm reduces Sf by an amount

- $\Delta SF = \dfrac{S_m}{k\sqrt{\sigma_s^2 + \sigma_{PA}^2}}$

Sm effect on Sf
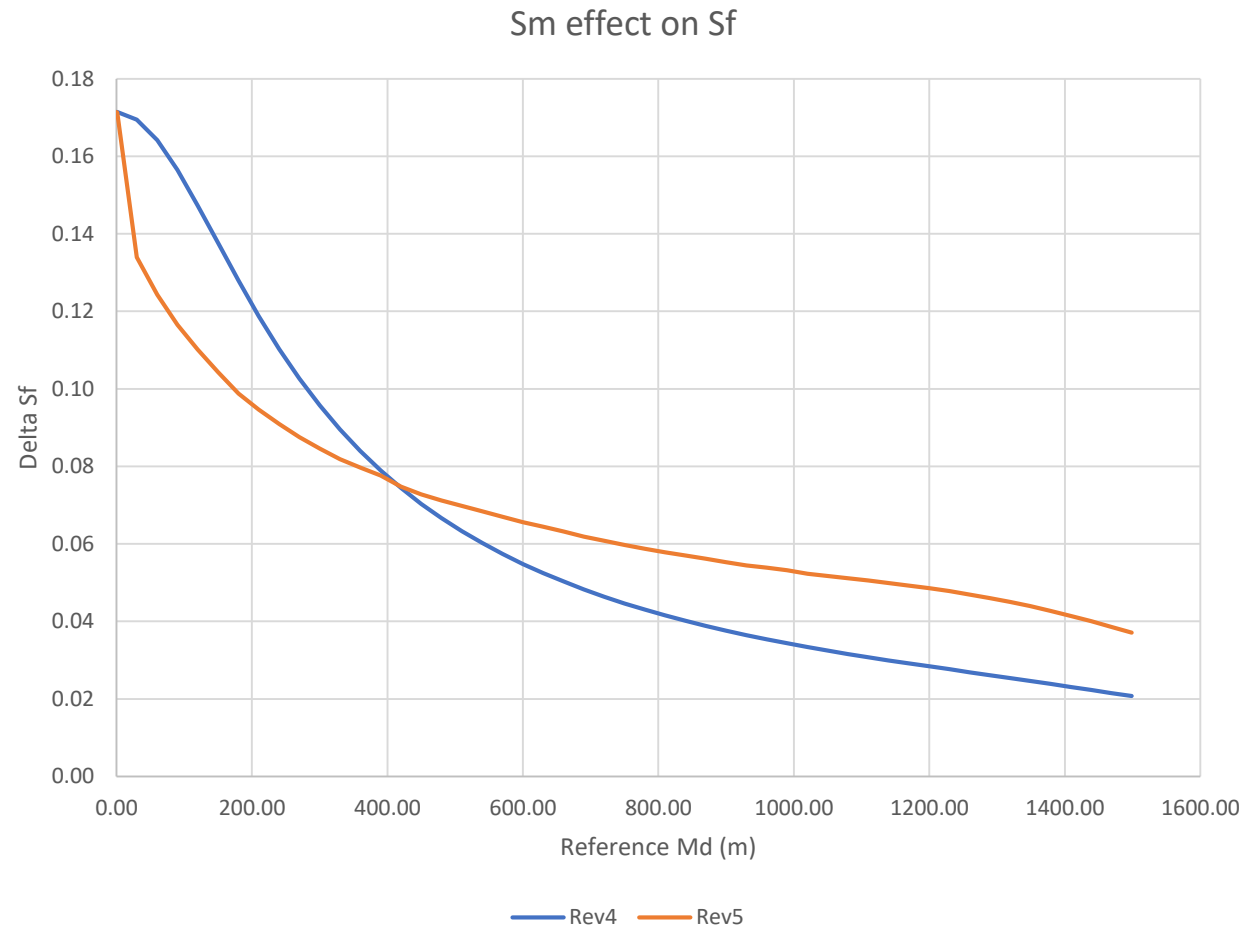
SPE – WP TS RULE

How is the take up ?

What problems?

Well Separations

• Because of PA Uncertainty

Separation Between Well Centres at Surface (ft)

Offshore Triple/Quad Conductors
Tight Platforms shallow offshore, batch drilled
4.5' Minimum Separation using WPTS Spacing for 30' stations
8.5' Minimum Separation using WPTS Spacing for 100' stations

Typical Platforms shallow offshore, adjacent wells depressured
Some Land pads - batch drilled to production casing

Offshore Platforms/subsea vary from 6.0-8.5'

Islands

Common Land Pads

PA – Error Component

- Project ahead error, how much?

- Currently 0.5m (at 1 sigma)

- It depends on how far you are projecting, or distance between measurements

- Study of vertical 3d surveys, how far drift from previous – seems to match 0.5m at 30m intervals.
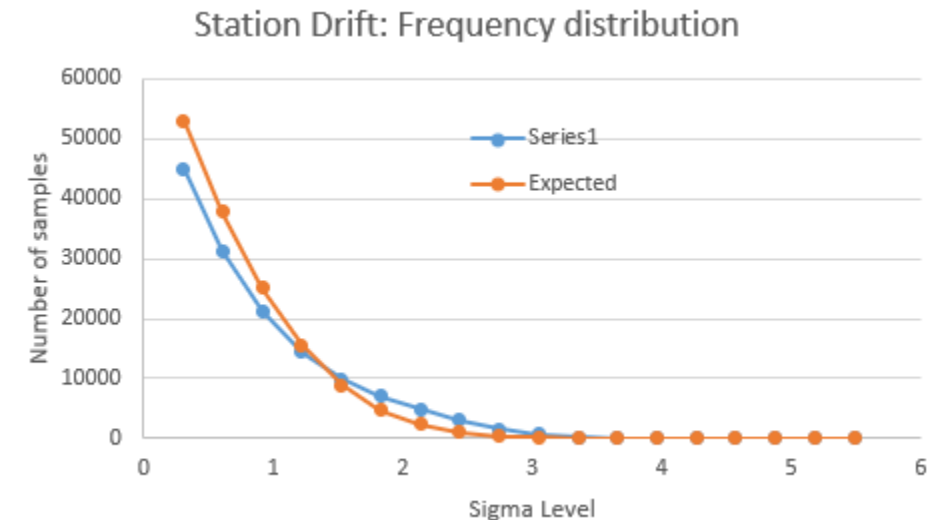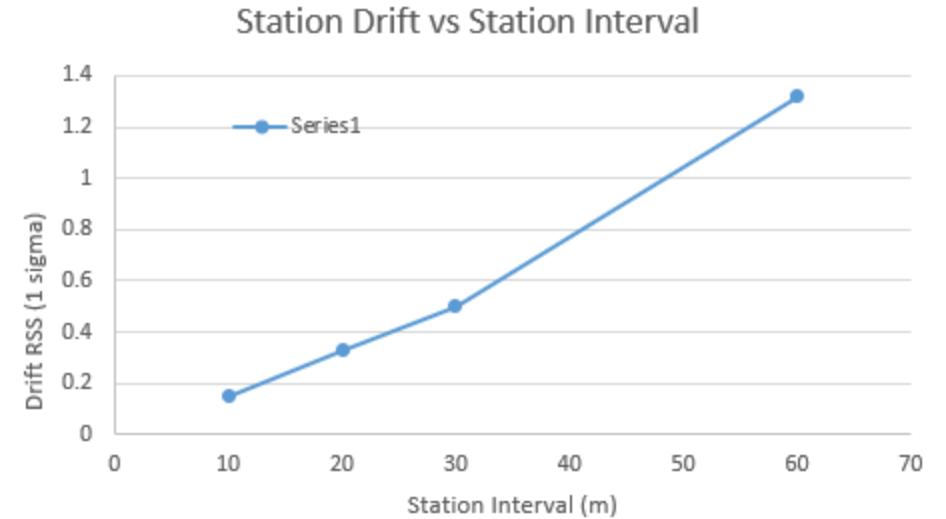
Horizontal well crossings

- It doesn't make sense??????
- Based on invalid assumption

Pedal Curve ☹

Ellipsoid Separation ☺
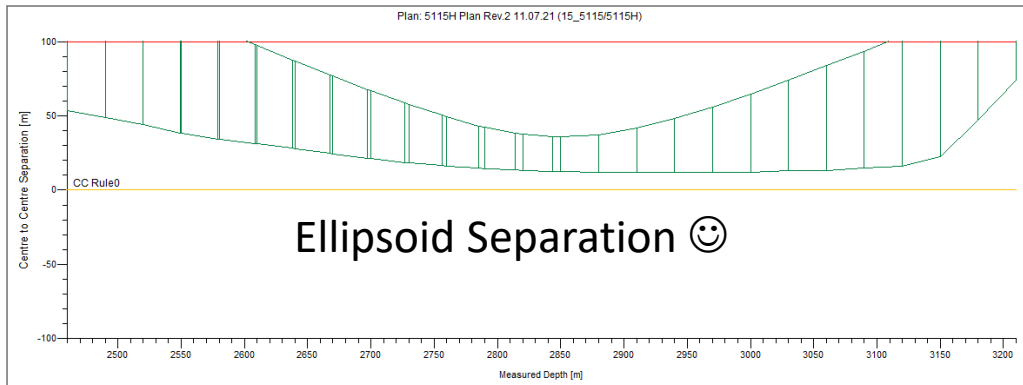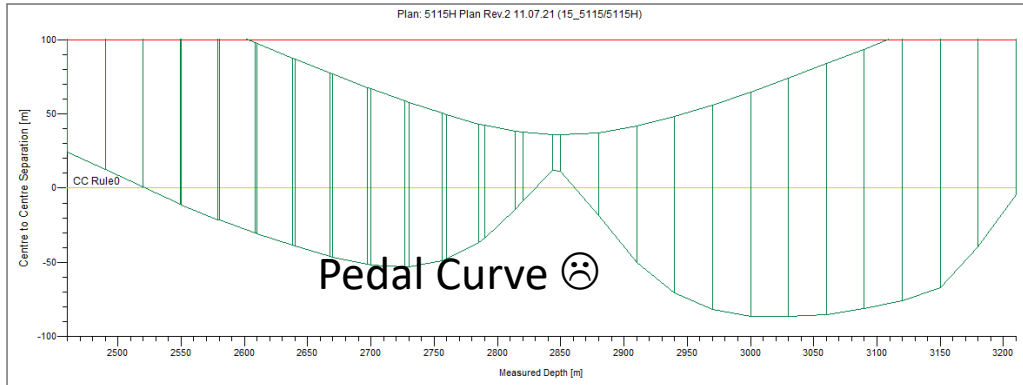
Dear Support,

We have a problem with AC analyses in Compass.
Design 5115H is 50 m below design 4114H and we see that ellipses don't cross, but the separation factor is 0.46 at the depth 3030 m. Why? How exactly is SF calculated in that case?
Our customer XXX needs the detailed explanation

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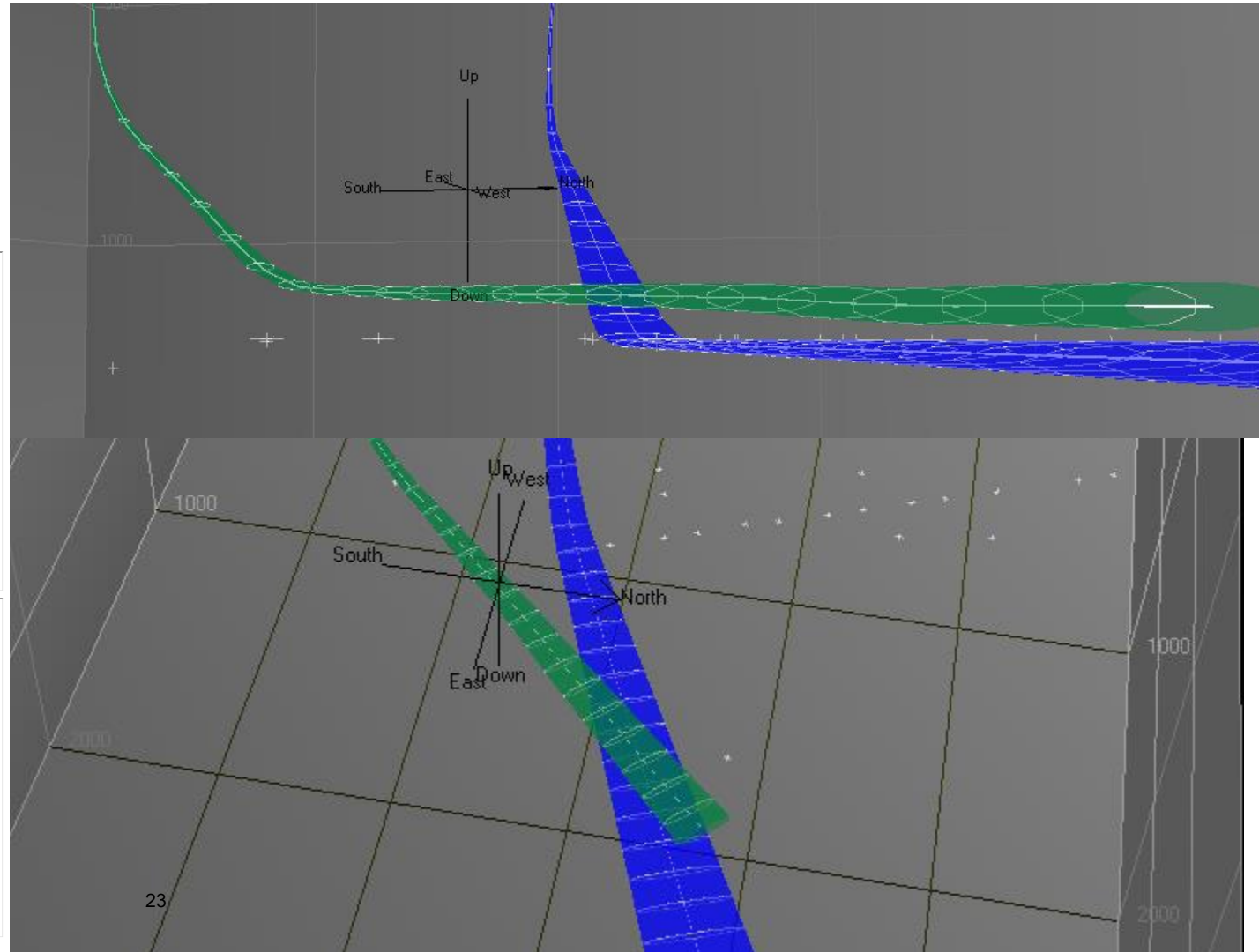
Require Dispensation

- AC rule does not define what to do with dispensation wells. But even with dispensation, there are economic consequences.

- Dispensation is paperwork – MOC

- Options
  - Fixed radius exclusion zone
  - AC Rule with reduced confidence/sigma level

- Dispensation stops at plug/SSSV depth
  - Return to major risk
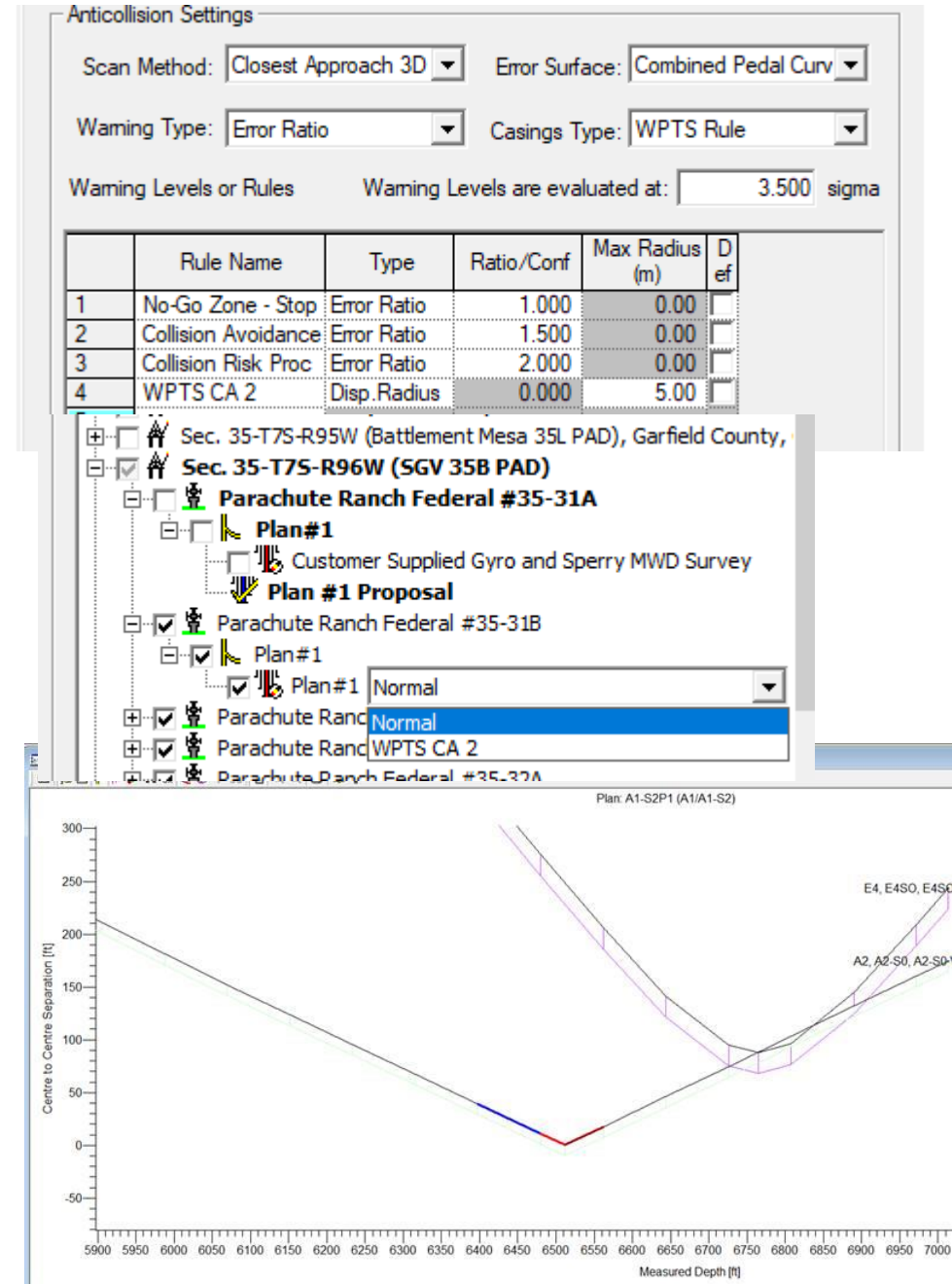
Sidetrack Handling

- Currently uses method of subtracting covariance at depth of divergence – can be over conservative

- Option 1: Calculate errors from divergence depth down – fairly simple

- Option 2: does not handle continuous gyros – complex

- Removal of 'global' depth and declination errors - OK

Wellbore 10 Sidetrack different ACR Methods
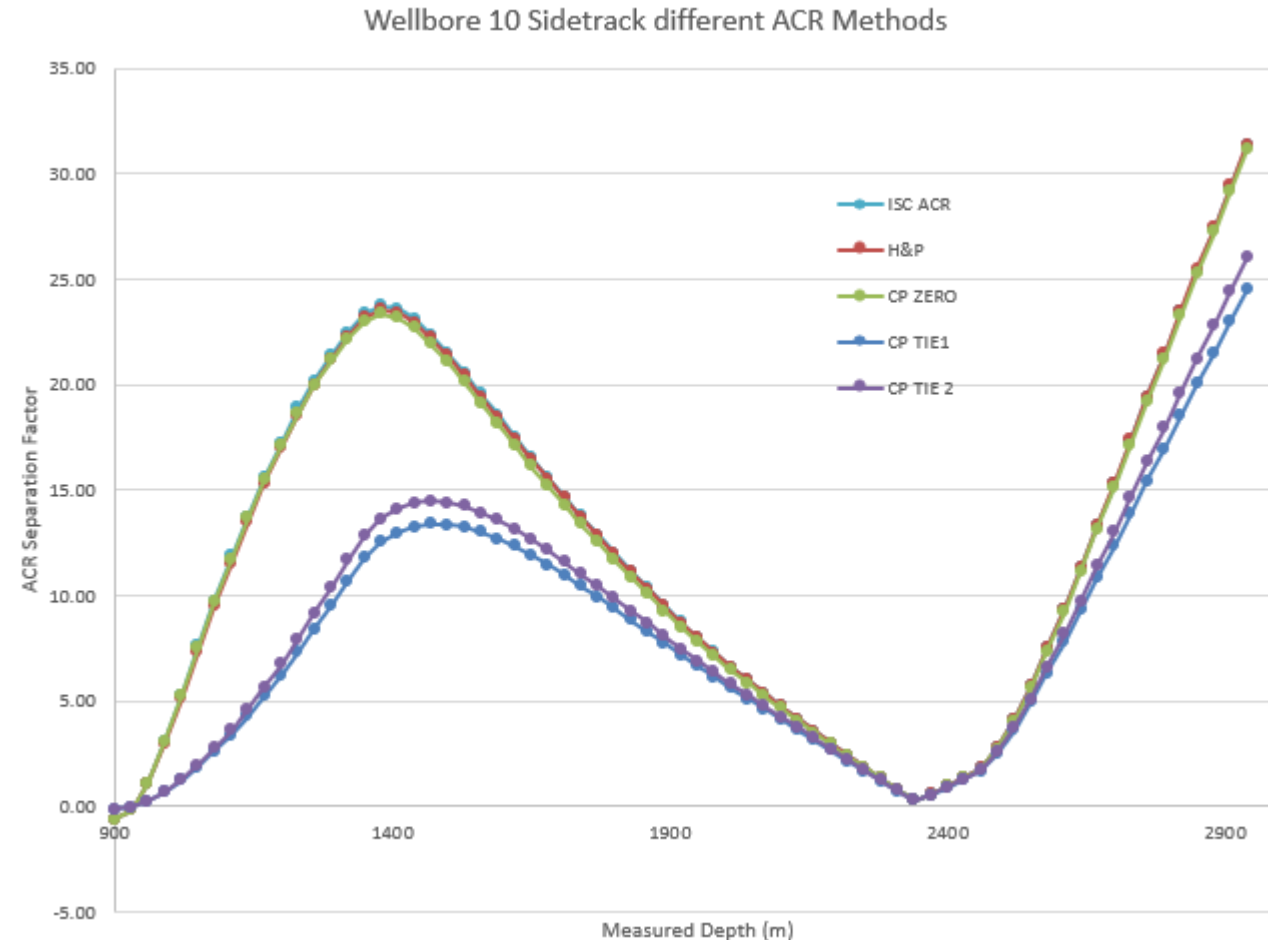
Pete Offset Selection Proposal

- Think there is a gap in identifying what is and what isn't an offset.
- Most collisions occur due to data being missed from the clearance scan. This has happened to us.
- Max bounding box as radius of MD: works for blind type error model
- **Benny**: all the wells need to be in the database, contractor asks for data nearby.
    - What Pete is proposing is good for the Operator's perspective
    - Jonathan has a different view: figure out how to flag if they are not in the database.
- [Blind error model has an issue, needs to truncate at a value]
- **Mike** – challenging for service company, take more wells than we need. If software is better at bulk importing that would help.
- **Darren** – rely on regulatory databases, usually the information is sufficient to know that you need more data
- **Harry** – a bit confused as to the purpose: chicken / egg.
    - As an operator if you had access to all the well information, you would apply this process to thin this down.
    - Pete- yes, IHS data allows us to do this for the US
- **Harry** – service company would like to get this list of **potential list**, then we refine it. If we have a list within e.g. 20 miles yours looks a bit clunky.
    - We have a set of potential offsets from the operator, e.g. 120 wells, We scan against them all wells and report wells that are within 50m of failing MASD rule.
    - **Darren** – this was purely for optimisation of computing speed. Databases can do bounding box analysis in seconds
- **Jerry** – shows that data has been scanned against; JSON for sharing data
- **Bill** - like the discussion, but feels the same as describing TC as a simple tool.
    - Global filter is really good at identifying offsets, outside the probabilities are small that you could get another.
- Mapping out the steps may be the next step
- DEFINE:
    - Data
    - Filtering mechanism
    - Categorising
- Pete: what I like:
    - Blind wells turning up as offsets, get in the way of the story line
    - Good practices are rewarded
- Pete: Blind model is very handy as a backstop
- Pete: The motivation for getting people to look at getting better data is that you use the blind model.
- **Benny**: 2 things, understand risk and go/no go.
    - When service company arrives at rigsite and if it isn't in their database what do you do.

Offset Selection Proposal

Pete Clark

Chevron Wellbore Placement Focal Point

9/27/21

What's the need?

- Collision Risk associated with
  - Adjacent lease
  - Comingled operatorship

- Wellbore positions may not be public record

- Need common way of assessing collision risk offsets to facilitate appropriate data transfer

- Systematic selection process reduces potential for missed offset

- Currently various methods are in use, e.g. SF≤3 or C-C ≤100ft

Objective

- Gain feedback
- Lodge proposal for future consideration

Offset Selection Requirements

- Select all potential collision risk wells
- Agile and iterates with changes in reference well design

Offset Selection Desirable Properties

- Proportional with reference and offset well positional uncertainties
- Restrict selection to genuine collision risk wells, providing appropriate focus
- Sufficiently simple to explain and implement
- Identify wells in a form that can be shared
- Implementable as algorithm
- Potentially links to risk consequence assessment

Bounding Box

- Draw horizontal boxes around reference and other wells
  - Overlapping boxes results in other well being considered an offset

- **Pro**

- Easy to picture

- Simple arithmetic calculation

- Conservative

- Calculation triggered on change

- Stored in database

- Potential to nest in data organizational hierarchy

- Eliminates non-risk wells

- **Con**

- Orientation is arbitrary

- Assumes commonality of depth
  - could be extended to cuboids but with insufficient benefit

Bounding Box Overlap

Offset

Other

Offset

Offset

Reference

Other

Other

Other

33
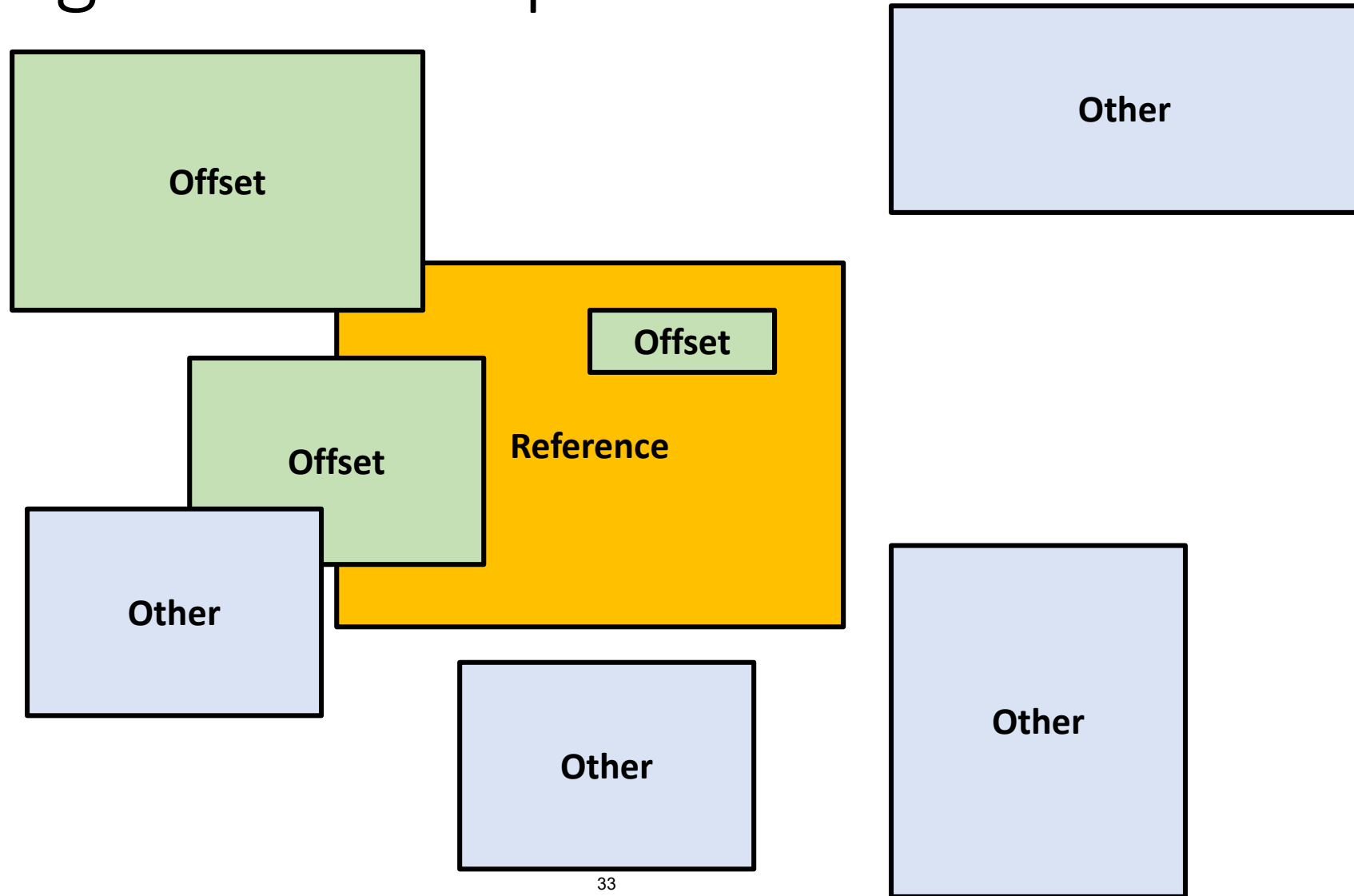
# Eliminates Non-Risk Wells
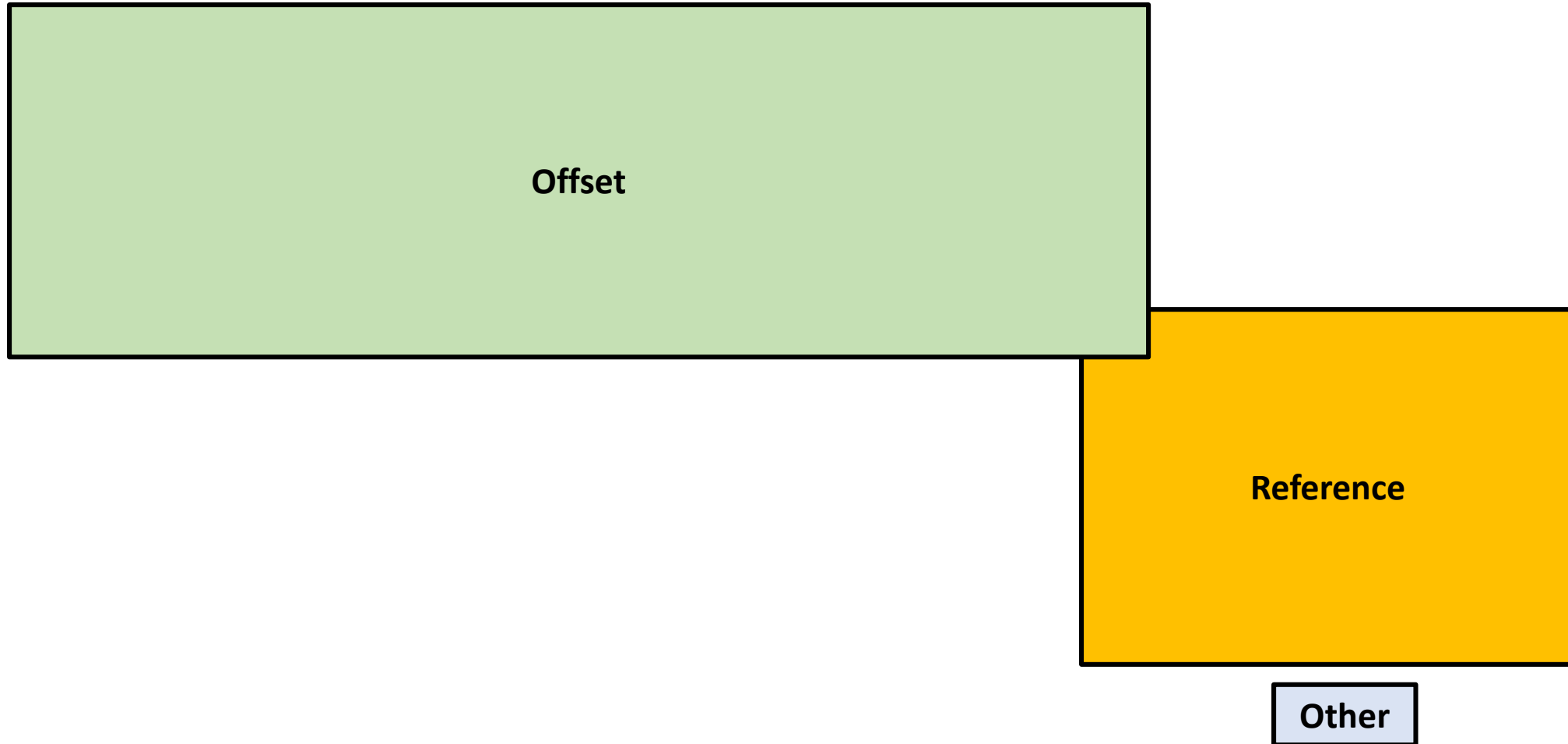
Bounding Box Dimensions (Preliminary)

- XY extent of wellpath ± positional uncertainty

- Positional uncertainty includes surface & wellbore

- 13σ confidence level
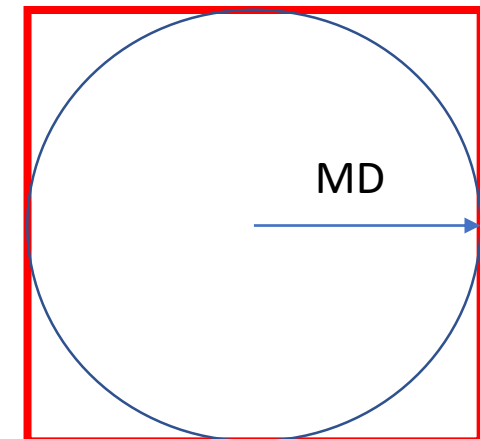 - Captures all SF < 3 @ 3σ with √2 scaling for combined covariance
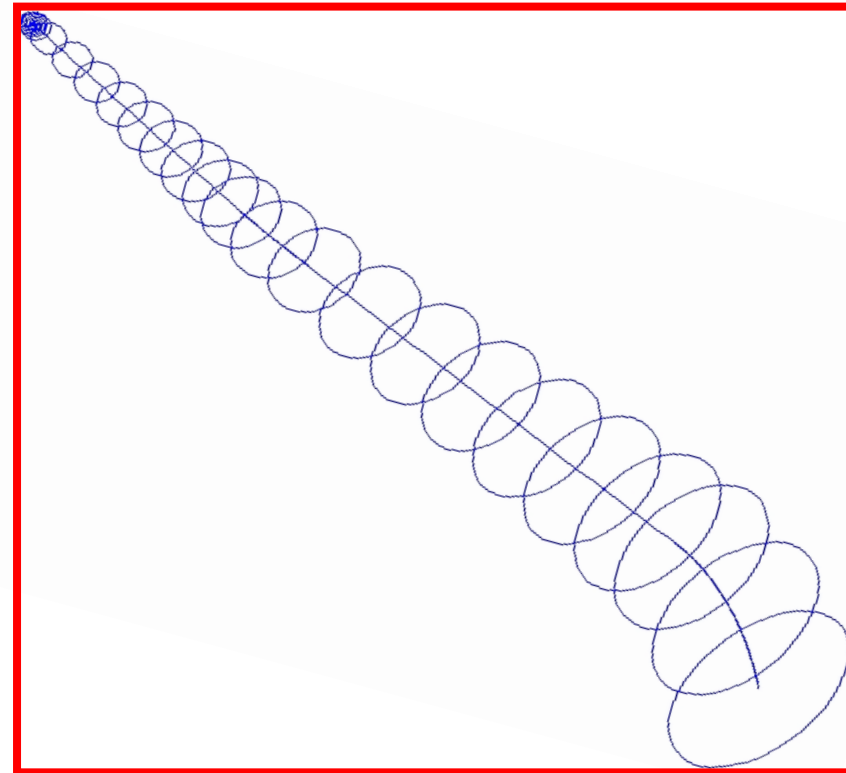
Bounding Box Challenges

- Minimum & Maximum

- Min.
  - No survey program
  - "zero" error

- Max.
  - Blind; radius exceeds MD @ 3σ

- ±XY min/max evaluated independently
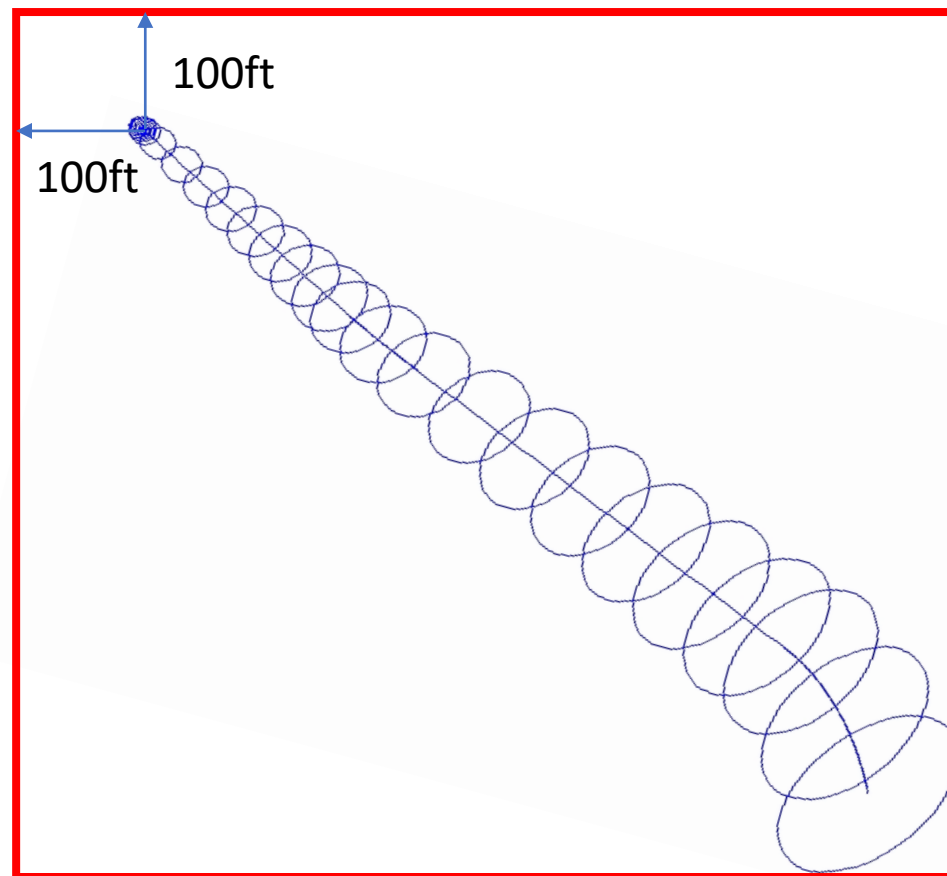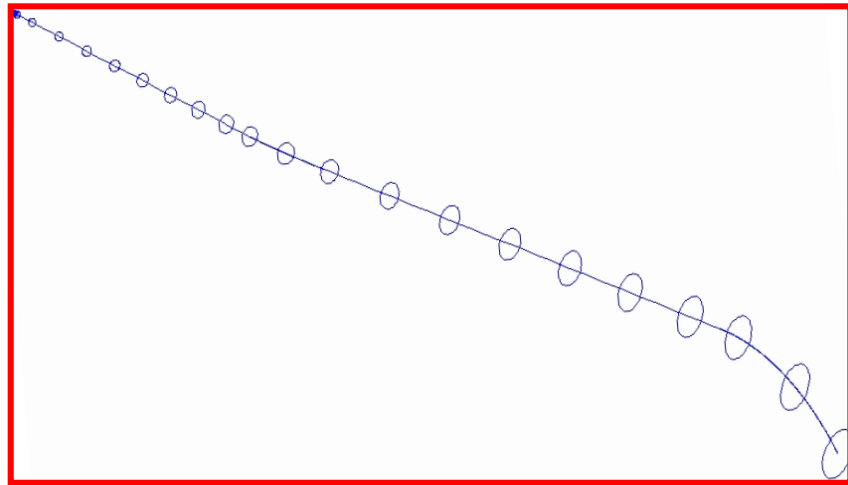
Min.

100ft

Max.

MD

36
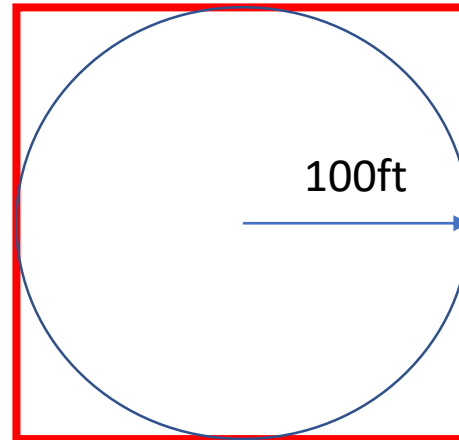
Bounding Box Dimensions (Modified by min/max)

- Expected to capture all wells on same pad / platform

100ft

100ft

Questions…

Actions and Closeout

Bill: **Ty** – close out the CA docs update on the web: **Closeout In OCTOBER**

Formatting, Labelling etc.

Pete – actions from reporting nomenclature

Bill – will send out an invite for the Project Ahead questions

Gary: Lexicon between CA/EM/QAQC -> Education Subcommittee Mahmood

Notes for Future Meetings

For future talks/items/discussions:

Each presenter must answer the following questions on a closing slide, can be after questions are taken. This allows me to better understand and plan

- Is any additional work needed?
- What action items do **you** take from here?
- What action items are needed from **CA Sub-committee members**?
- What action items are needed from **other** ISCWSA Sub-committees?
- Would this topic benefit from presentation at the main meeting?