Collision Avoidance Sub-committee Update

Gary Skinner

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Agenda Topics

- Pete Clark: Inferred Wellbore Position
- Gary Skinner: Project Ahead Uncertainty

Inferred Wellbore Position

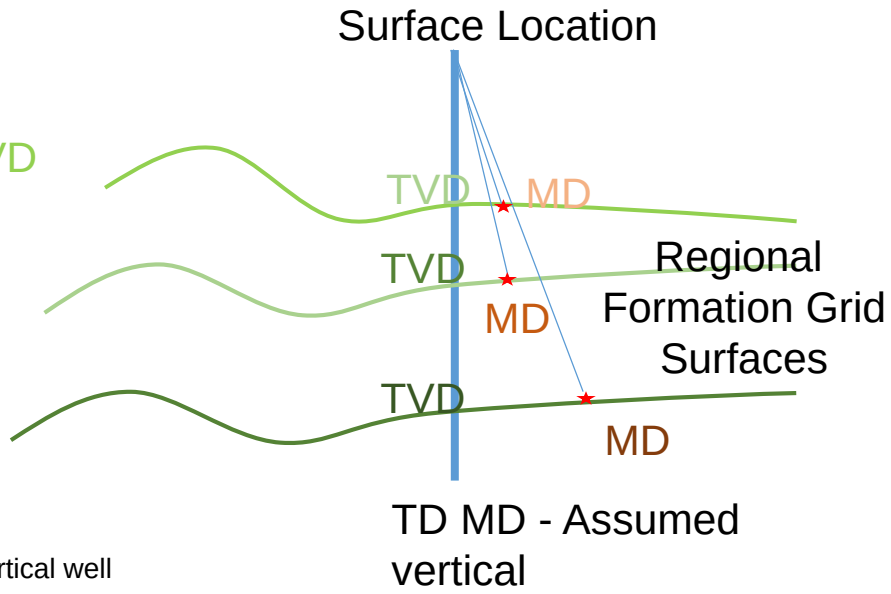
Pete Clark

Inferred Wellbore Position - Challenge

- Challenge
  - Many downhole wellbore positions defined by
    - Surface location
    - TD MD
  - No directional survey information
- Leads to
  - Assign “Blind” positional uncertainty model
  - ~46° cone
  - at TD error radius is greater than depth
    - Additional cost due to directional drilling to avoid possible well’s placement
    - Inefficiency risk assessing potentially unlikely well collision
      - Discount Blind wells as no risk

Inferred Wellbore Position – Proposal

- From existing measurements & models
  - Calculate TVD for formation grid using
    - Surface location
    - Regional formation top surfaces
  - Compare recorded top MD to projected TVD
    - Calculate **Sustained Inclination (SustInc)**
      - **SustInc** = ArcCosine(TVD / MD)
      - If **SustInc** < 5°
        - Assign “Inc-Only-Planned” PU model
      - If 5° ≤ **SustInc** < 10°
        - Assign “Inc-Only-Planned-10” PU model
      - If **SustInc** ≥ 10°
        - Assign “Blind” PU model
        - Not credible to consider this as a near vertical well
        - Means there’s no surveys for a deviated well & is why Blind is an appropriate model



Proposal

- Form a CA sub-committee work group
- Review this proposal
- Consider alternate approaches
- Optimize method
- Identify issues
- Produce guidance
  - To include the statement that good surveying practices should always be employed and resurveying wells missing surveys is best practice

Project Ahead Uncertainty

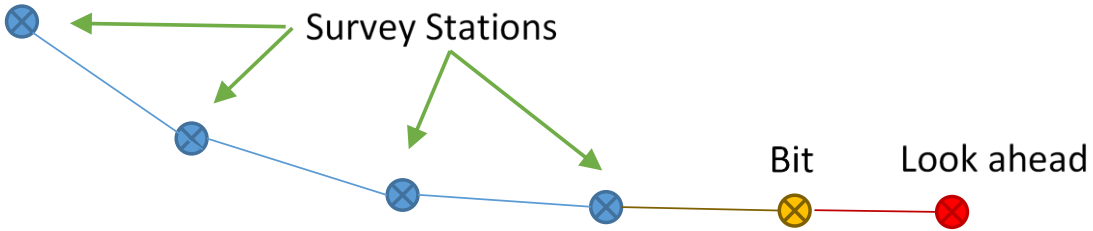
Gary Skinner

Project Ahead Uncertainty – Sigma PA

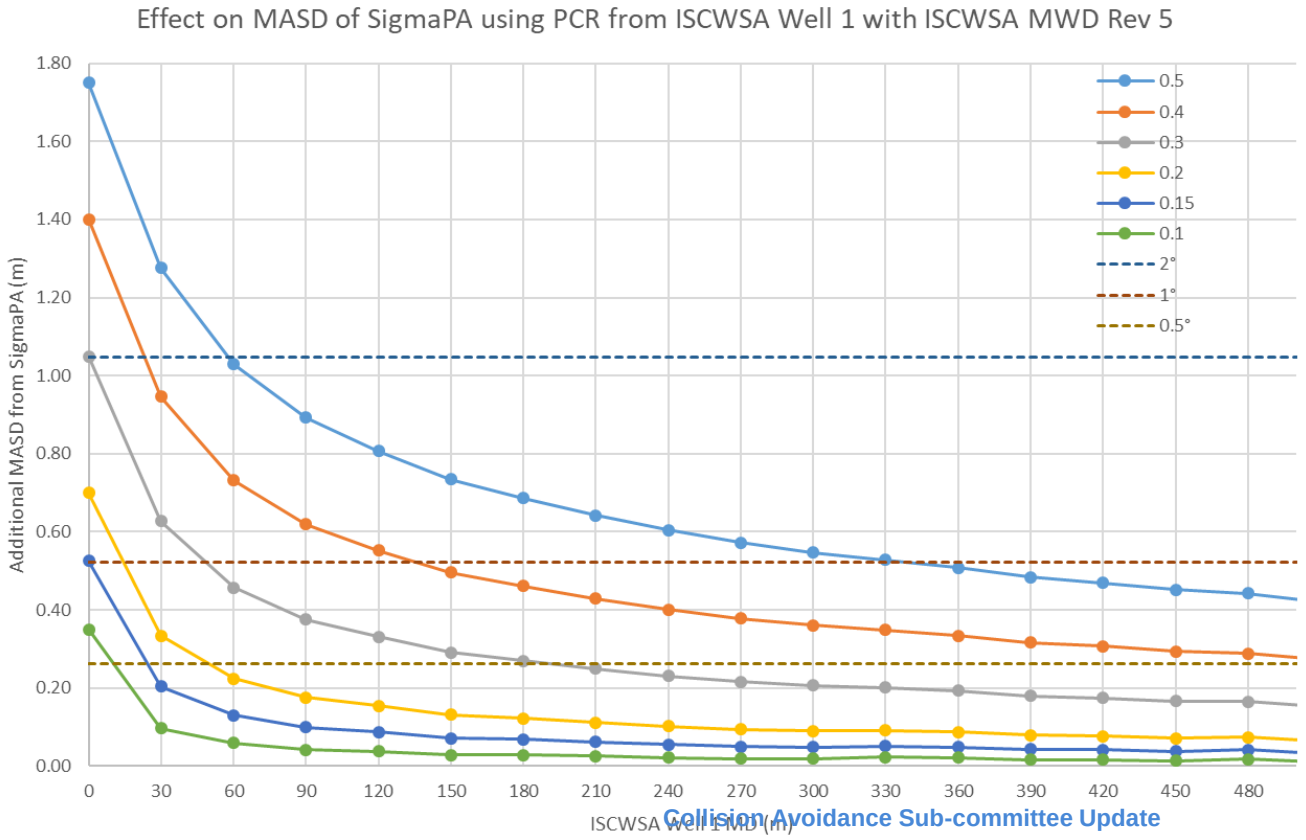
$$\frac{Dist - \left(HoleRad_{ref} + HoleRad_{off}\right) - Sm}{k\sqrt{\sigma_s^2 + \boldsymbol{\sigma_{pa}^2}}}$$

- SPE-187073 provides the following information
- *Quantifies the 1-SD [standard deviation] uncertainty in the projection ahead of the current survey station.*
- *Its value is partially correlated with the **projection distance**, determined as the current survey depth to the bit plus the next survey interval.*
- *The magnitude of the actual uncertainty also depends on the **planned curvature** and on the actual **BHA performance** at the wellbore attitude in the formation being drilled.*
- *The project-ahead uncertainty is only an approximation, and although it is predominantly oriented normal to the reference well, it is mathematically convenient to define **σpa** as being the radius of a sphere.*

Factors in Project Ahead Uncertainty



- Projection to bit distance
- Look ahead distance



- Effect on MASD
- Parallel Wells - ISCWSA #1
- ISCWSA MWD R5
- Dashed lines horiz. drift @30m
  - Equivalent to **required** directional control

Rule	Proj to bit (m)	Lookahead (m)	σ_{pa} (m)	Angular Control equivalent
WPTS	-	≤30	0.5	≤2.5°
10m survey	≤20	≤10	0.3	≤0.5°
Continuous survey	≤10	≤5	0.15	≤0.15°

- Angular Control Equivalent is the directional control required throughout the collision risk zone

Actions

- Publish draft document on CA Subcommittee page for feedback
- Proposed values:
  - 0.01 meter per meter (1%) combined projection to bit and lookahead distance
  - minimum σ_{pa} = 0.15m
  - Perform a full risk assessment if you want to reduce it
- RP78 will recommend the SPE ACR Rule
- For RP78 what is the best option for Sigma-PA:
  - Only include the Paper's value of 0.5m?
  - Incorporate reduced factor(s)?
  - Incorporate a statement that sigma-PA and Surface Margin may be changed where additional process or technology are used to control their risks and risk assessment performed