What Depth ? More accurate Driller's Depth DwpD field results

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ISCWSA

Speaker Information

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April 11, 2018

Depth Solutions, DwpD Ltd.

Speaker Bio

Introduction

Depth Solutions, DwpD Ltd

+35 years trying to figure out where TD is

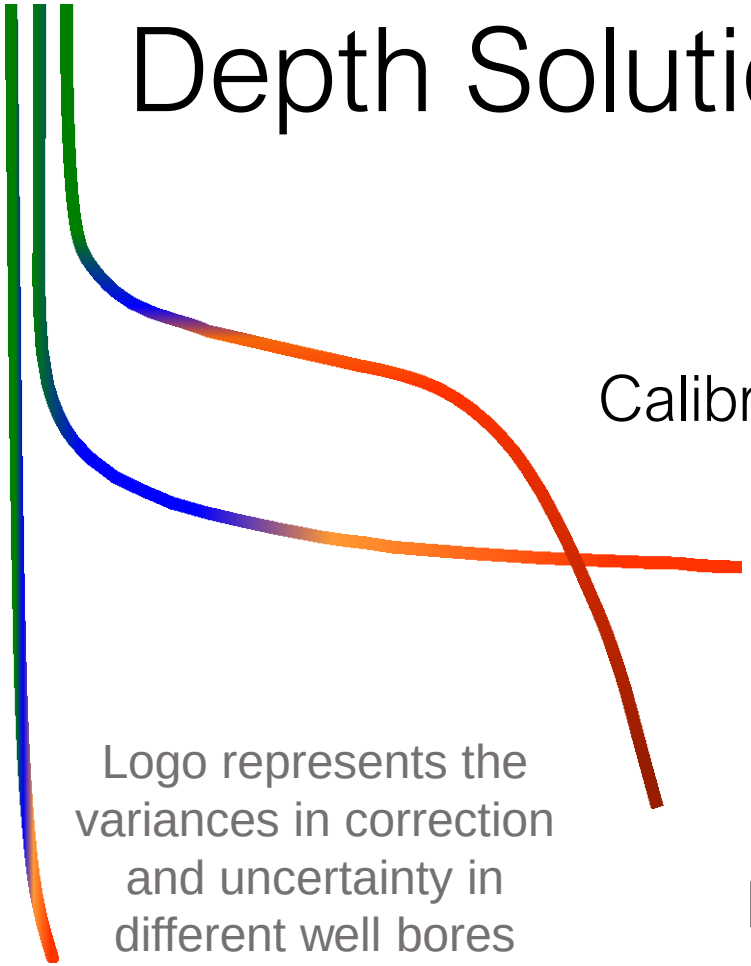
Aston University, Birmingham UK, BSc.,
Antwerpen Hogehandelsschool Belgium, MBA

Special interests

Along-hole depth measurement

- Calibration systems
- Correction methodologies
- Uncertainty determination
- TAH depth

Depth Solutions, DwpD Ltd.



Logo represents the variances in correction and uncertainty in different well bores

Along-hole depth measurement

Calibration, correction and uncertainty

Consulting

Training

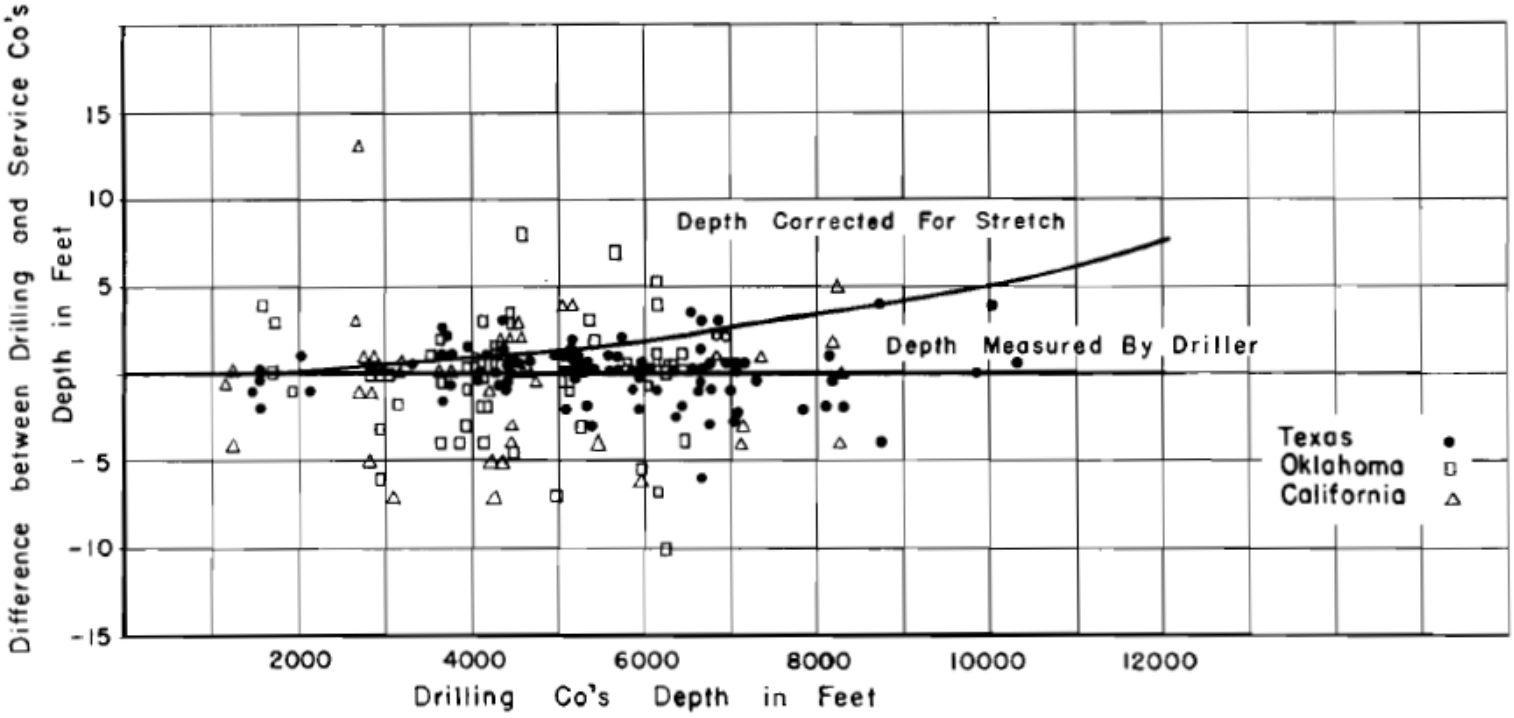
Audit

Depth data review and resolution

Understanding Depth And Uncertainty

- Depth as an issue
- Assumptions and expectations
- Drilling depth measurement
- Calibration and correction
- Way-point method and uncertainty
- First field test results
- The value model

Early Observations - 1938



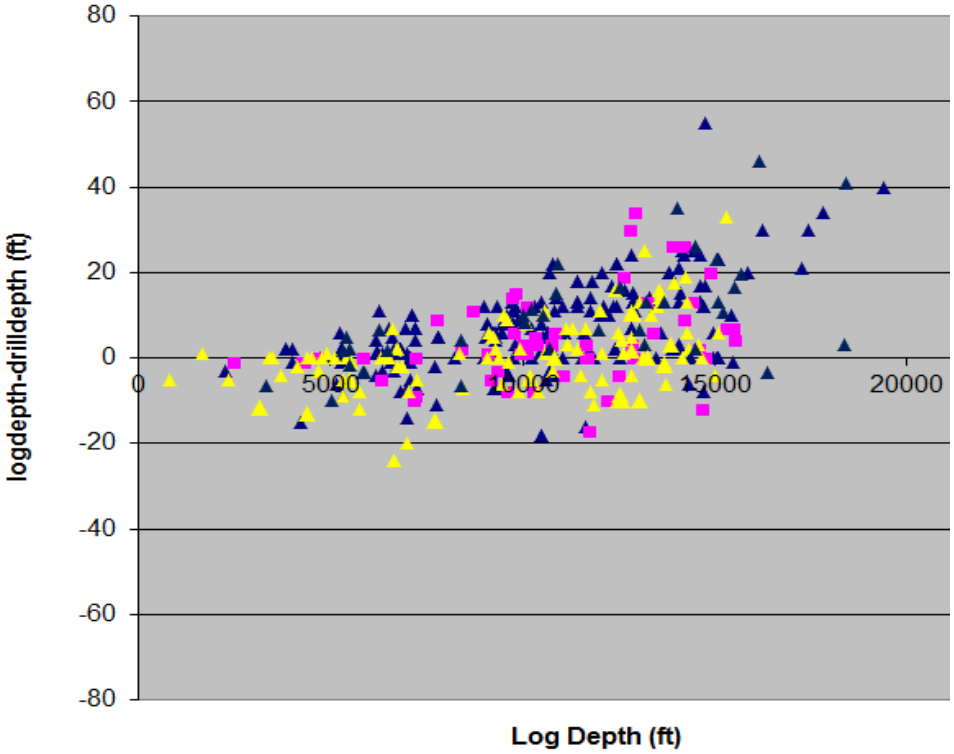
Gun-perforator measurements compared with those of drilling company.

Difference in Total Depths.

FIG. 13

Reistle, C. E., Jr., and Sikes, S. T., Jr., 1938, Well-depth measurements: Am. Petroleum Inst. Drilling and Production Practice, 1938, p. 80–95

Later Observations – 2013 – 75 Years Later



- Unsure accuracies
- Inconsistent correlations
- Geological inconsistencies
- Reservoir description issues
- Diminished certainty
- Cost
- Asset valuation compromise

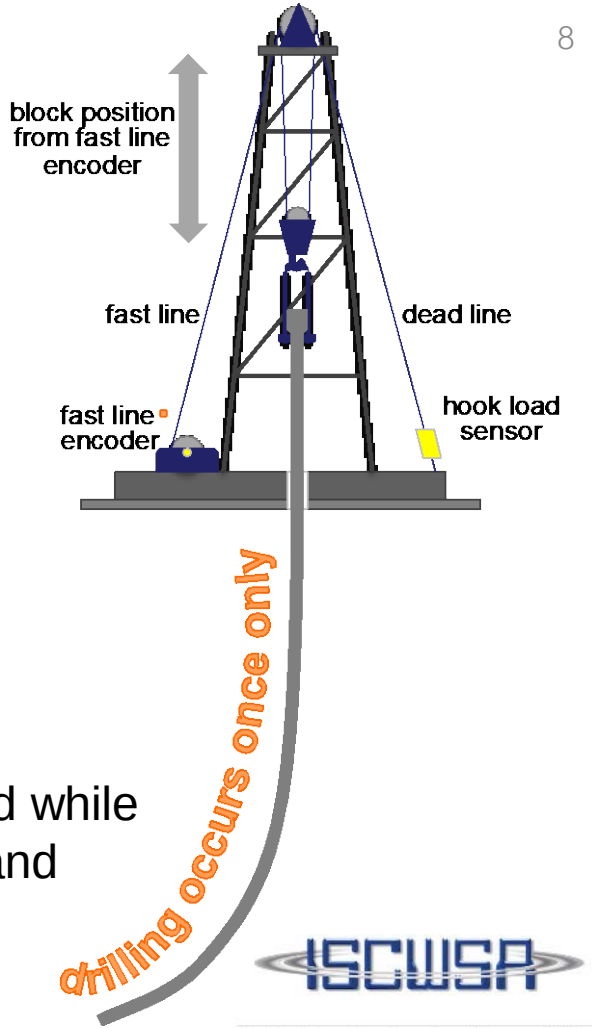
Forsyth D et.al., 2013, Improved Depth Quality Management: Where Old Theory Should Meet (Near) Future Practice, 2013, presented at SPWLA New Orleans Conference, New Orleans, June 2013

Driller's Depth 101

Pipe depth = pipe tally and surface travelling block movement.

Surface travelling block movement is used to control WoB and RoP, so block position is not necessarily related to changes in bit position.

LWD is based on bit position, recorded while drilling down, inferred from pipe tally and surface travelling block movement.



Calibration ??

What is the accuracy associated with the calibration process for measurement of driller's depth ?

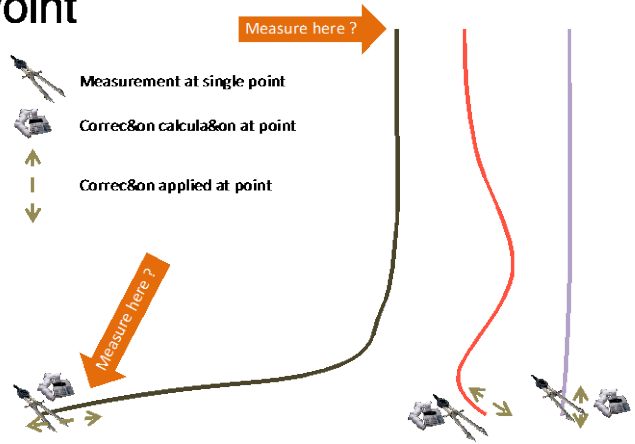
1:1,000 (if you're lucky)

- Calibration conditions
- Process consistency
- Results recording

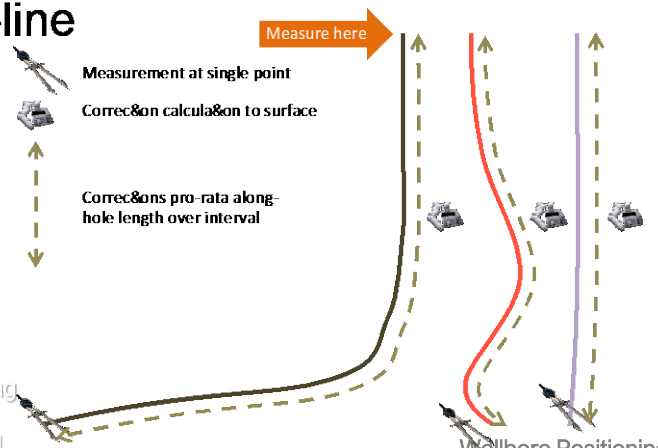
1.5:10,000 (conditions dependant)

Applying Corrections

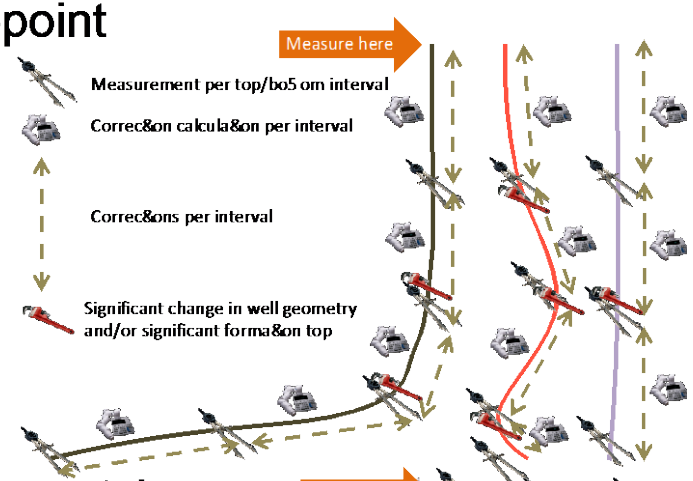
Single Point



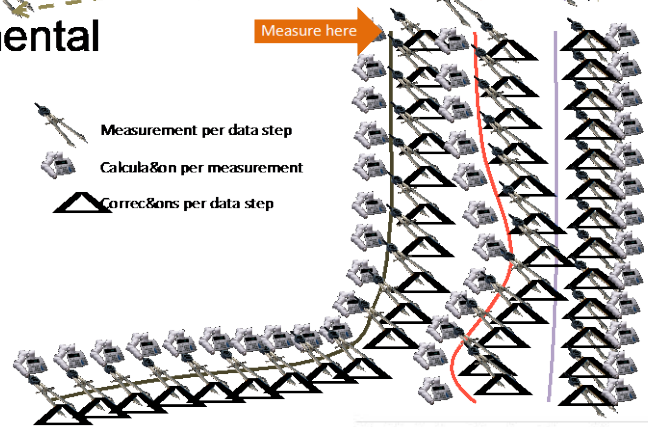
Straight-line



Way-point



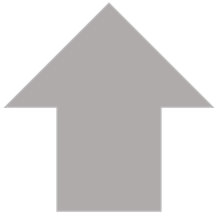
Incremental



Corrections while drilling vs POOH

LENGTHENING EFFECT

Tension profile (incl. sliding friction)
Temperature profile



same model as wireline !

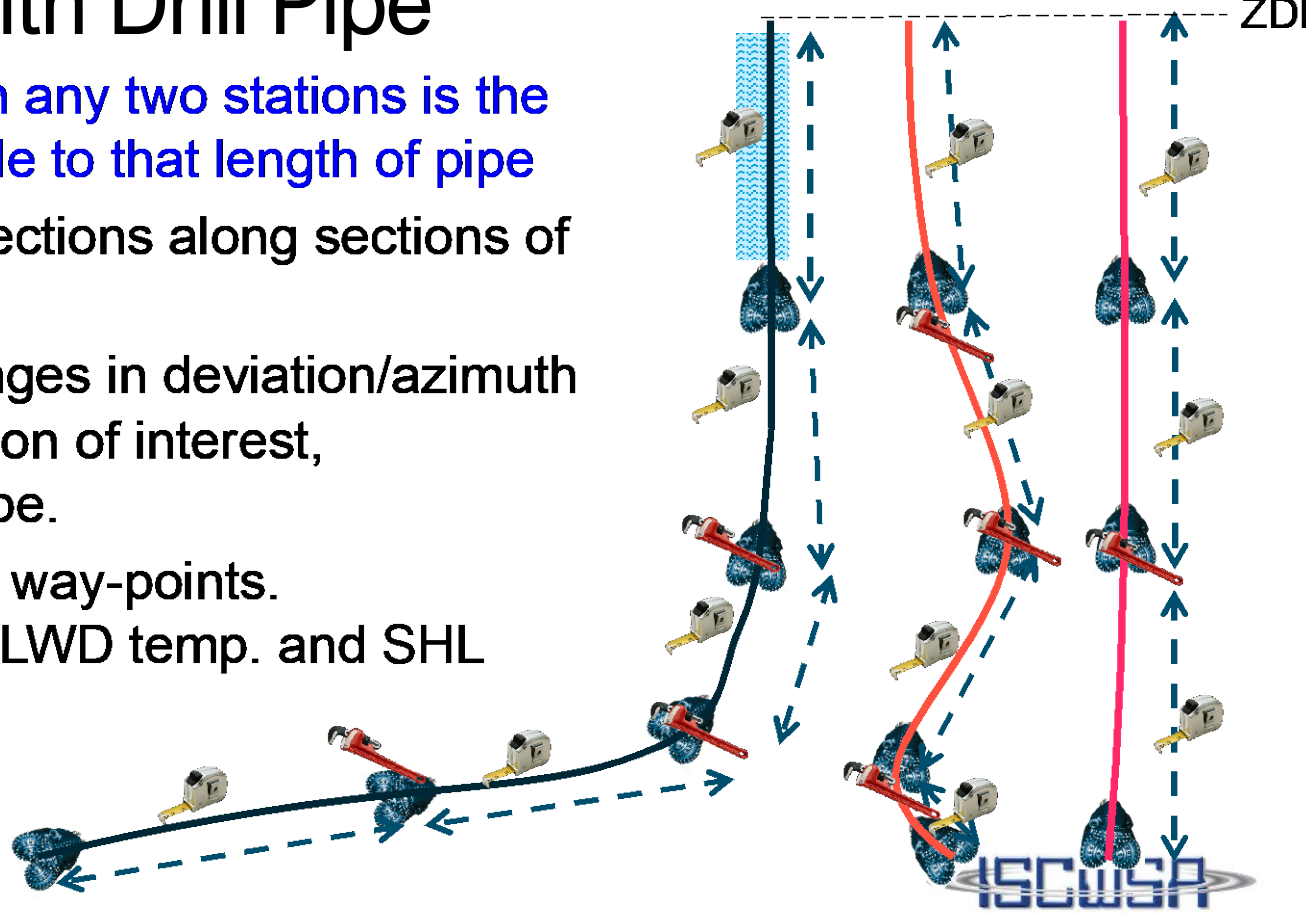
SHORTENING EFFECT

Sliding frictional forces
Differential pressure
Compressional torqueing
Tensional torqueing
Mud density
Mud velocity
Weight On Bit
Bit hydraulic pressure
Rotational frictional forces
Mud pressure

Way-point With Drill Pipe

Correction between any two stations is the correction applicable to that length of pipe

- Interpolate corrections along sections of similar gradient.
- Significant changes in deviation/azimuth or top of formation of interest, or change of pipe.
- Bit positions at way-points. Log LWD GR, LWD temp. and SHL



UK Patent Application No.GB1702825.9

Way-point POOH correction

Straight-line model – but applied over discrete intervals

Thermal correction

$$TieIn$$

$$HUD$$

$$Seg \times Th.Coeff_{Seg}$$

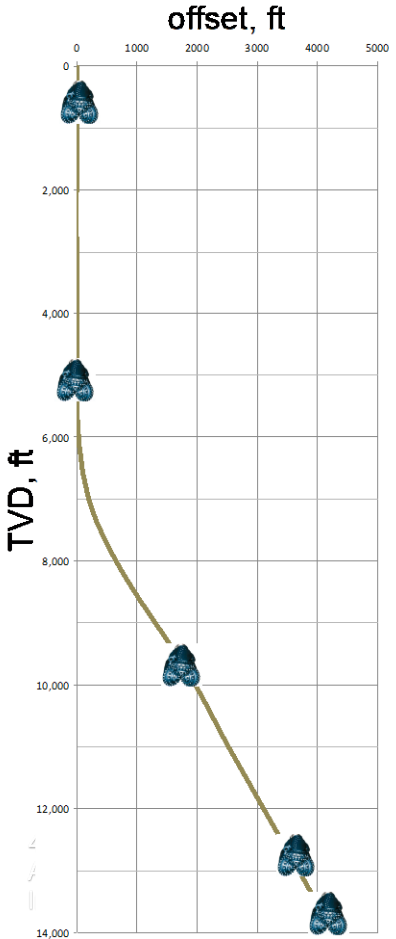
material constant

usually = 0

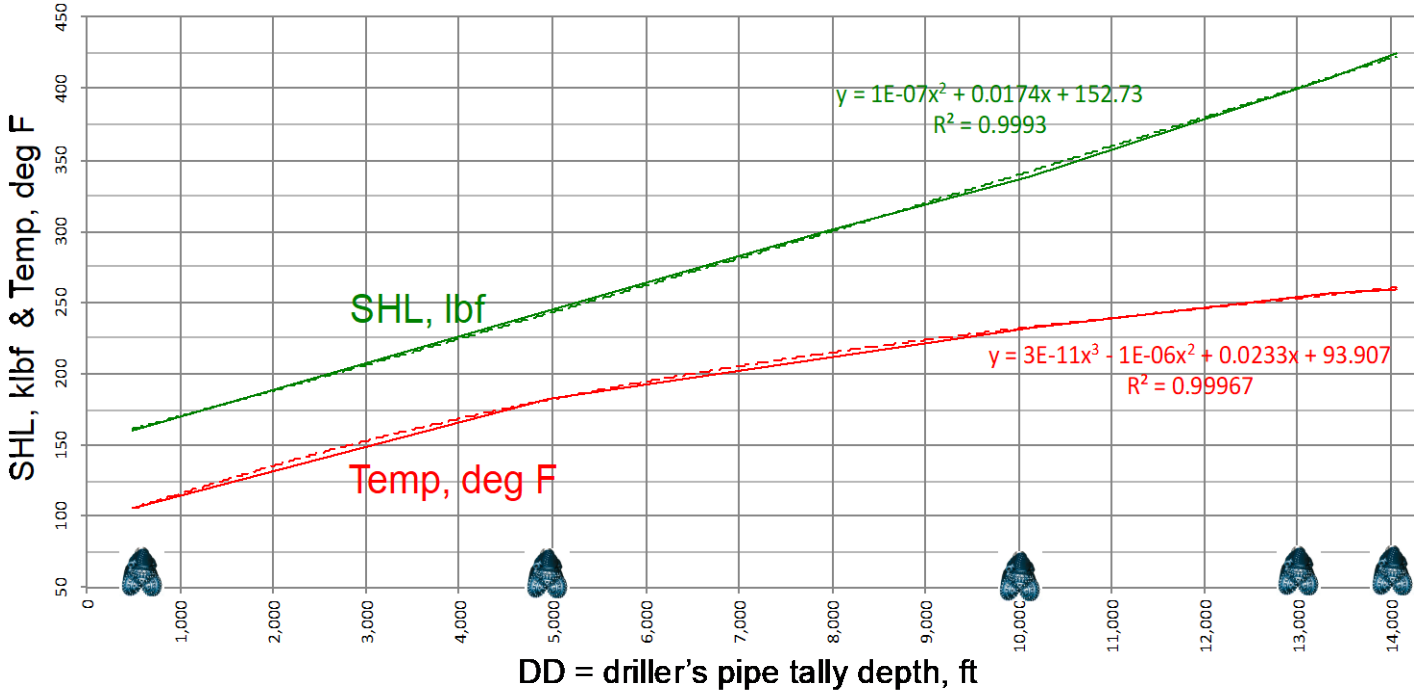
Elastic stretch correction

Calb.Length[1] includes Thermal.Corr

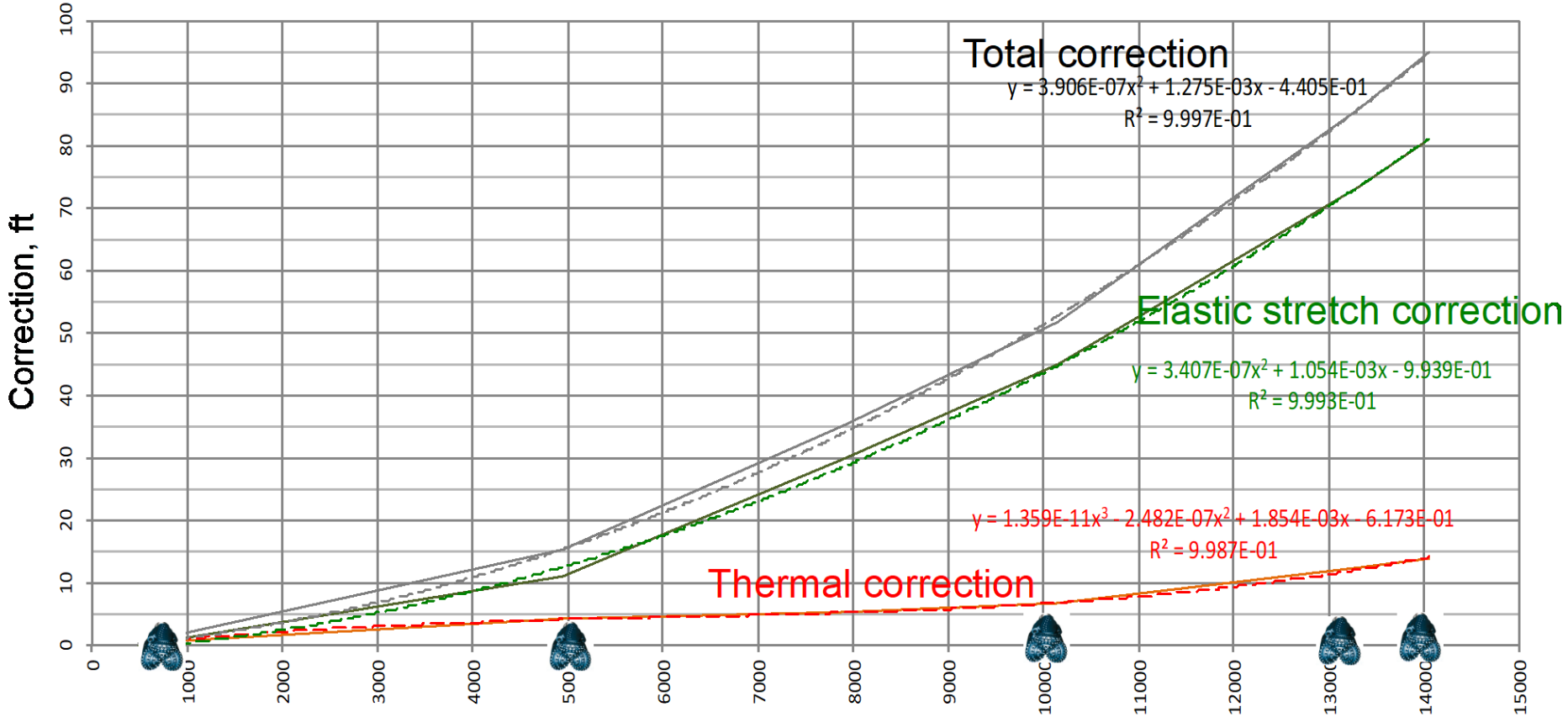
Well 1 N.Sea, 30 deg TD ~14,000 ft



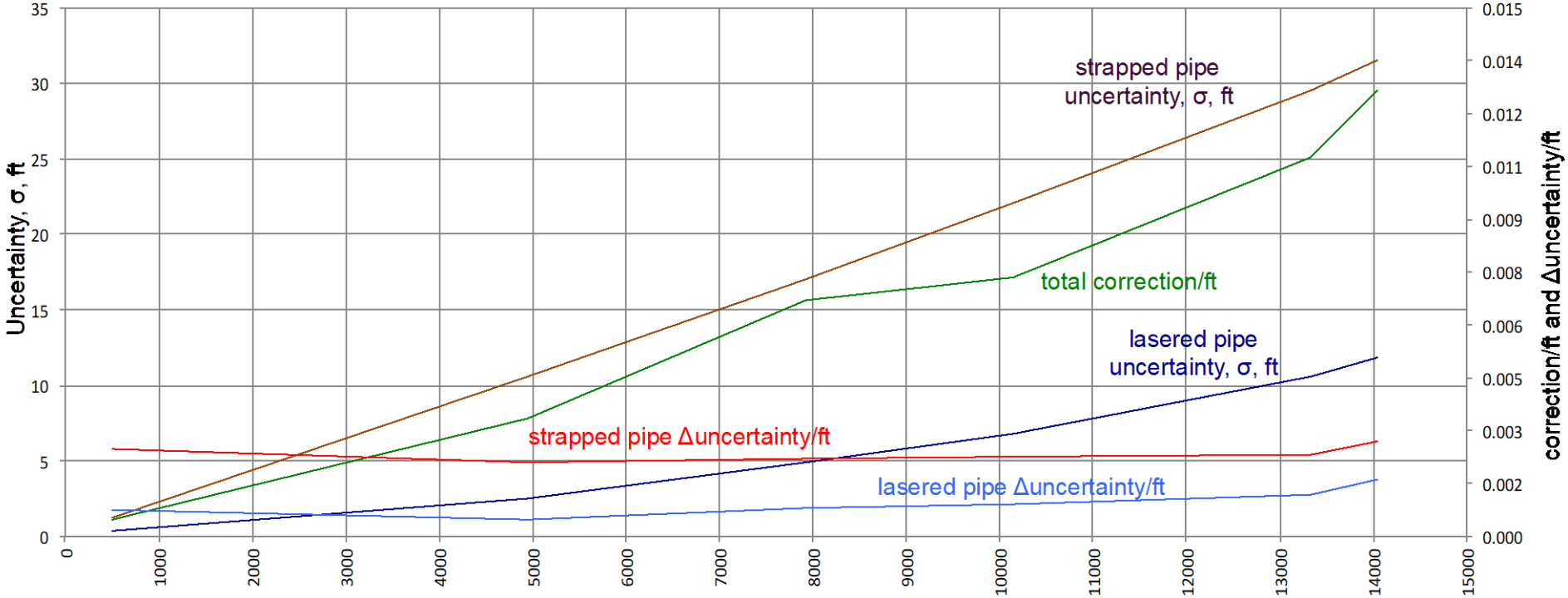
Temperature and tension regimes



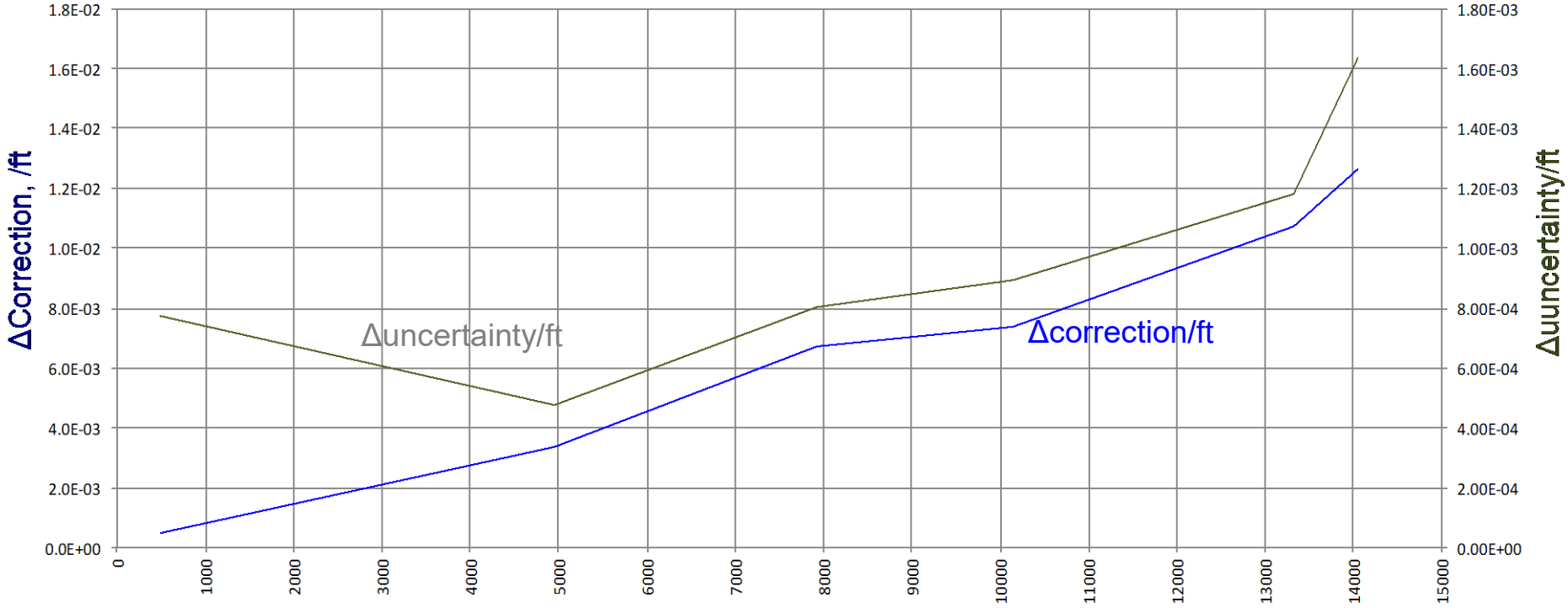
Well 1 DwpD Corrections



Well 1 DwpD Correction and Uncertainty

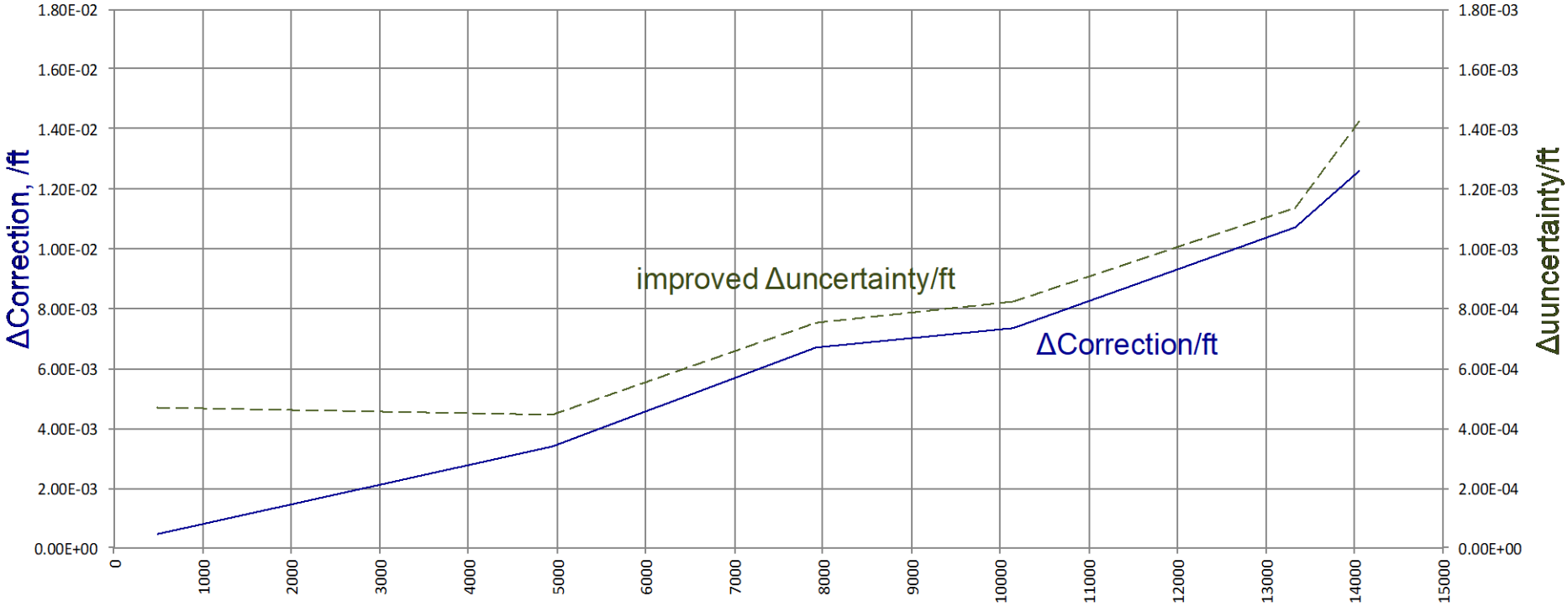


Well 1 Δcorrection and Δuncertainty



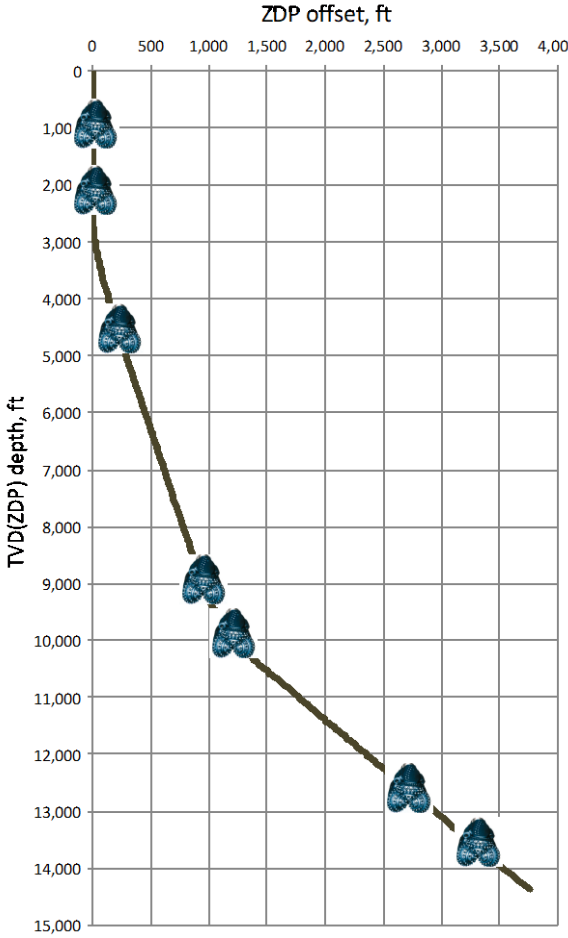
The uncertainty is determined per way-point.

Well 1 Investing in accuracy

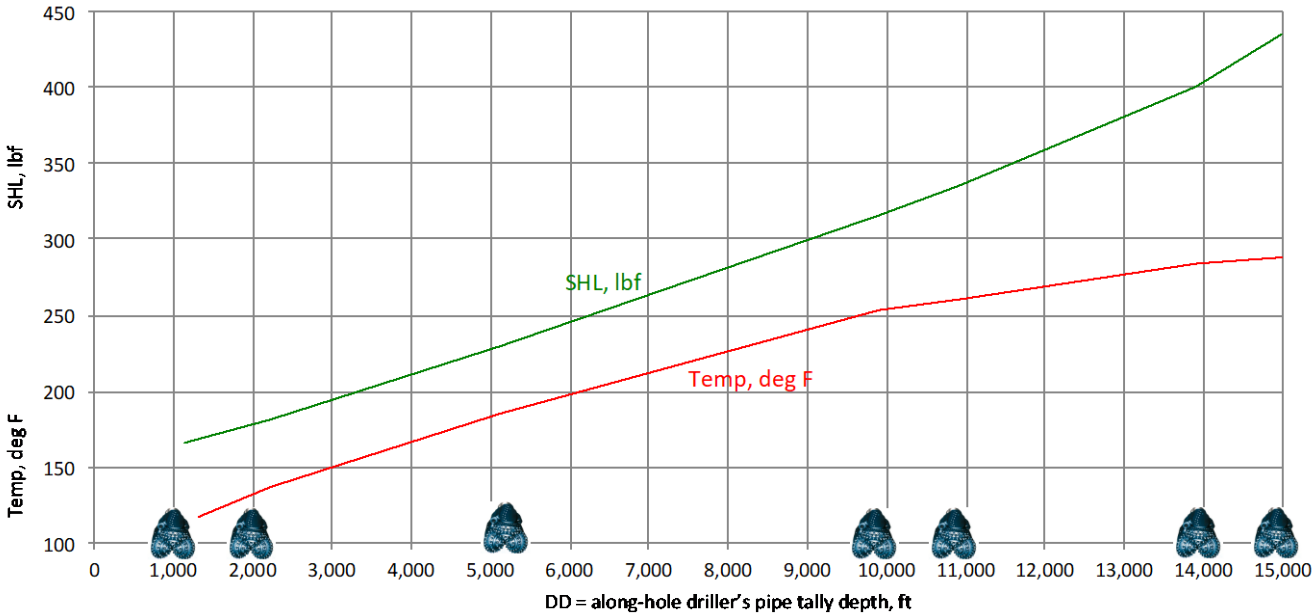


The uncertainty is improved through improved measurement accuracy.

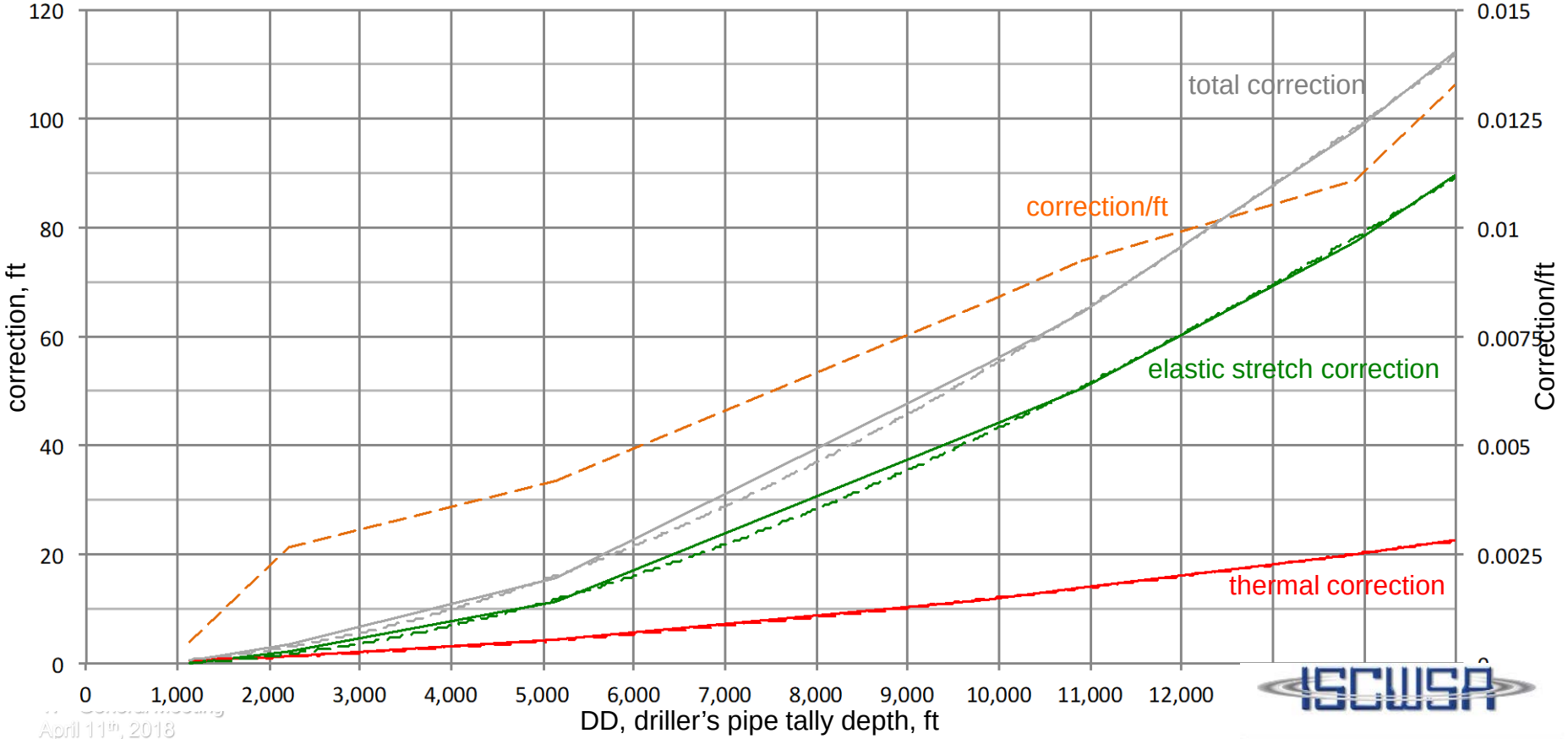
Well 2 N.Sea 15 & 30 deg TD ~15,000 ft



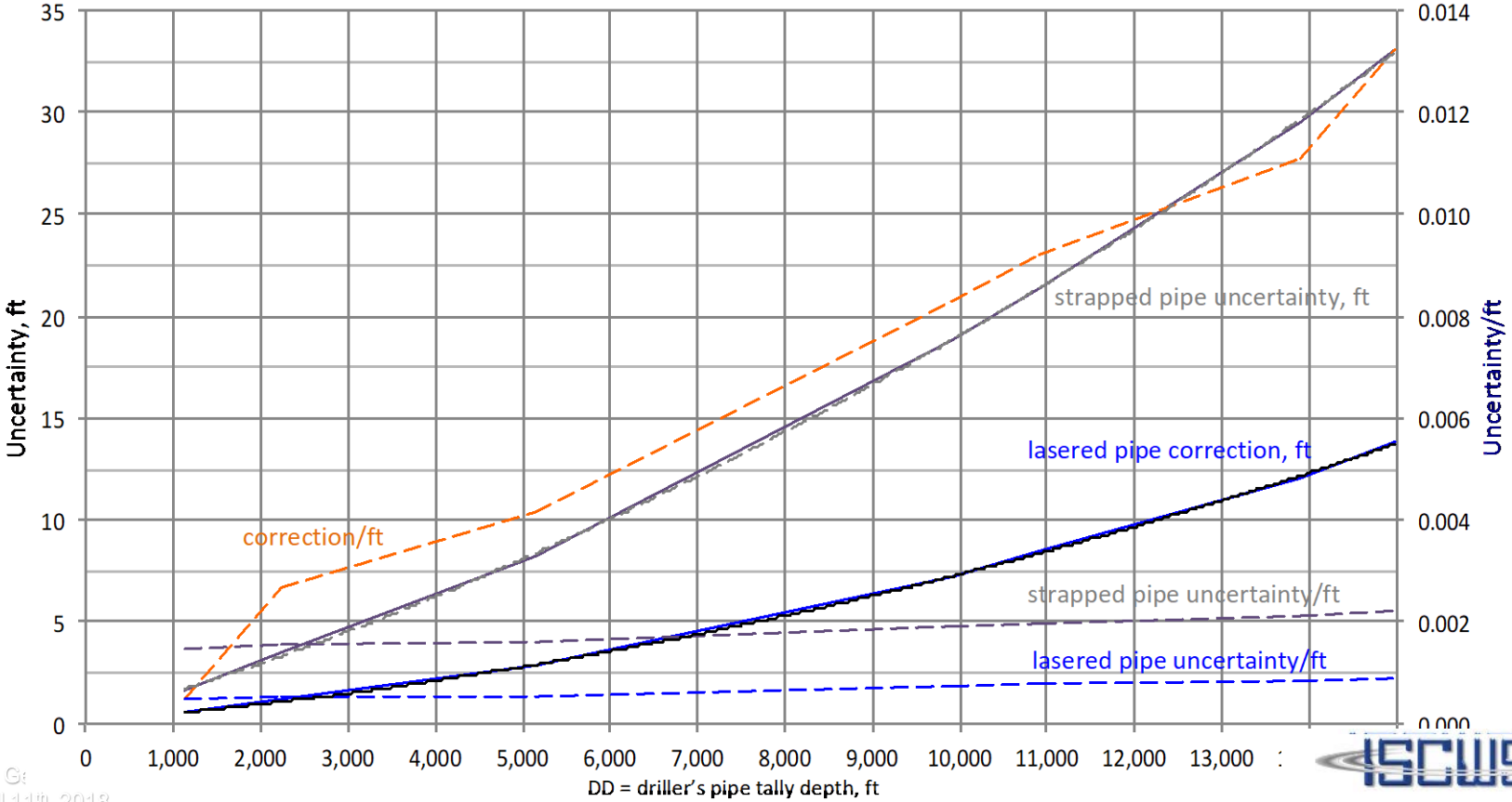
Temperature and tension regimes



Well 2 DwpD Corrections



Well 2 DwpD Correction and Uncertainty



Accuracy Expectations ?

1 : 1,000 The easiest ?

5 : 10,000 Believe it ?

2 : 10,000 Takes effort !

using strapped pipe – at best !!

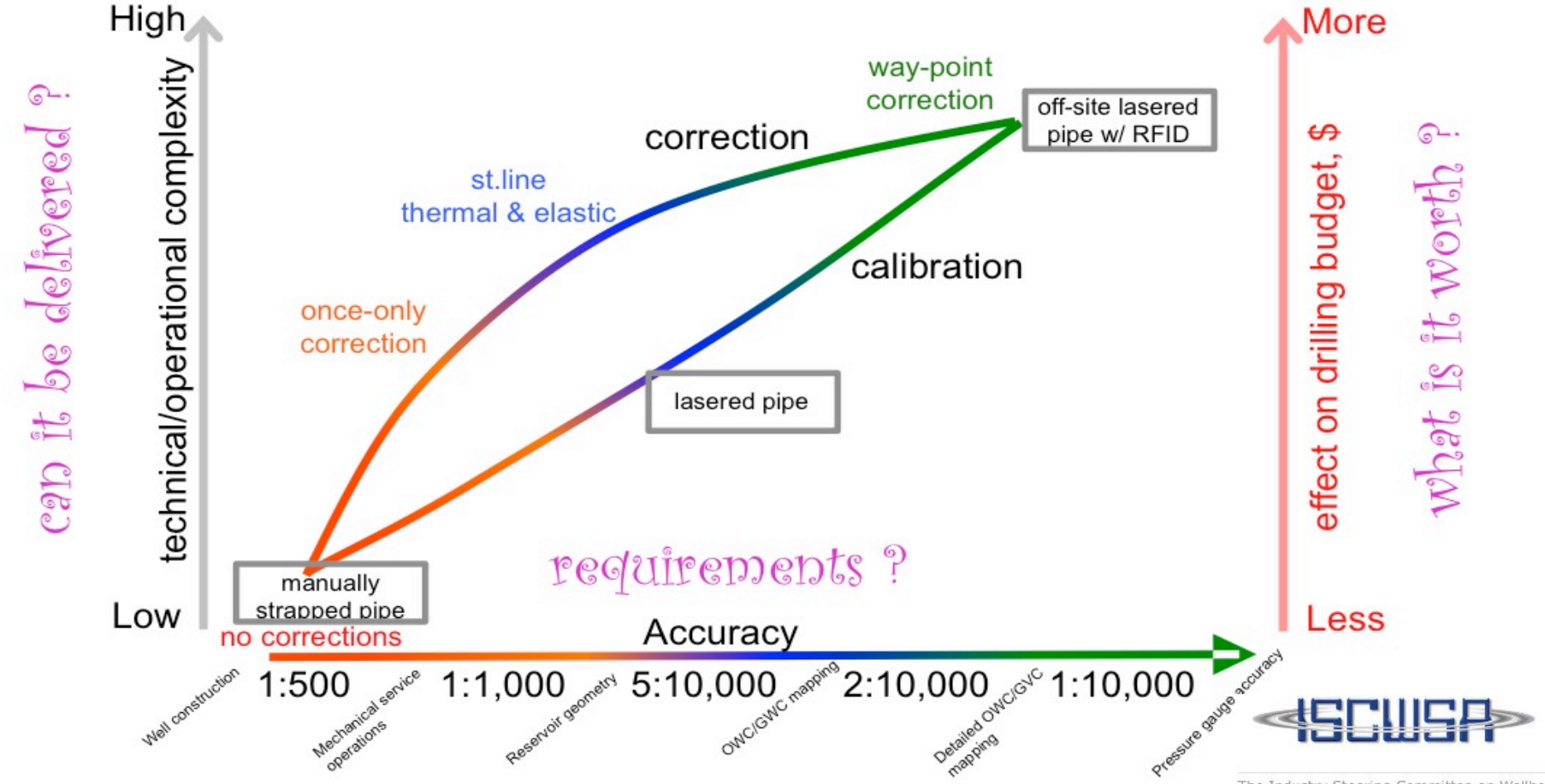
lasered drill pipe w/ corrections

off-site lasered drill pipe w/ way-point corrections

= mentioned by Reistle & Sikes,1938

~ equivalent to the best wireline accuracy !!

The Value Model



Conclusions of Understanding Depth And Uncertainty

- Depth is an issue
- Understand assumptions and expectations
- Drilling depth is a measurement
- Calibration and correction must be done seriously
- Way-point method and uncertainty is an option
- First field test results show that it works
- Consider the value model