SPE/IADC
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Well Collision Avoidance Management and Principles

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also referred to as ISCWSA

Introduction – Well Collision Avoidance

- Not a new subject, but
- Current guidance
  - Disparate
  - Company specific
  - Occasionally contradictory
- Goal: Standardise
  - Rules
  - Process
  - Nomenclature
  - Improve efficiency
  - Reduce implementation errors
  - Input to API RP78 development

Nomenclature:

Reference Well:

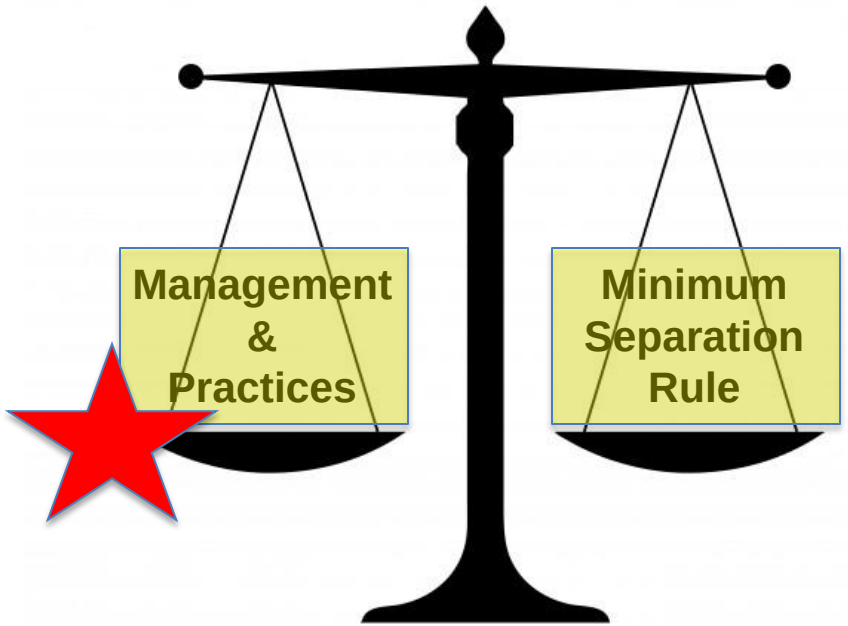
- The well being drilled

Offset Wells:

- Adjacent wells

Well Collision Avoidance

"*The adoption of a particular minimum allowable separation rule, no matter how conservative, does not ensure an acceptably low probability of collision*"



Offset Well Risk Classification

HSE Risk Well

Collision with it could result in an uncontrolled release of material:

- Hydrocarbons
- Chemical (e.g. H_2S)
- Nuclear (e.g. radioactive material)
- Biological
- Physical (e.g. geothermal)

or undermine facilities. (e.g. working mines, piles)

Does not have to be at surface:

- Sub-surface blowouts
- Sub-sea releases

Non-HSE Risk Well

Can be addressed solely in financial terms

- Temporal risks - damage after the collision
- Remediation (access and time)

Well Collision Frequency

Date	No.*	Collision Probability
1970-1980	3	1/2150
1980-1998	1	1/16330

*Offshore North Sea, GOM and Canada – uncontrolled flow to surface

- Land based drilling activity increased
- Drilling pads
- Closer well spacing
- Conductor sharing
- Additional slots
- Poorly surveyed old well stock

Why the interest?

- Unreported incidents?
- No uncontrolled flow?
- Changes in industry practices?

Well Collision Example

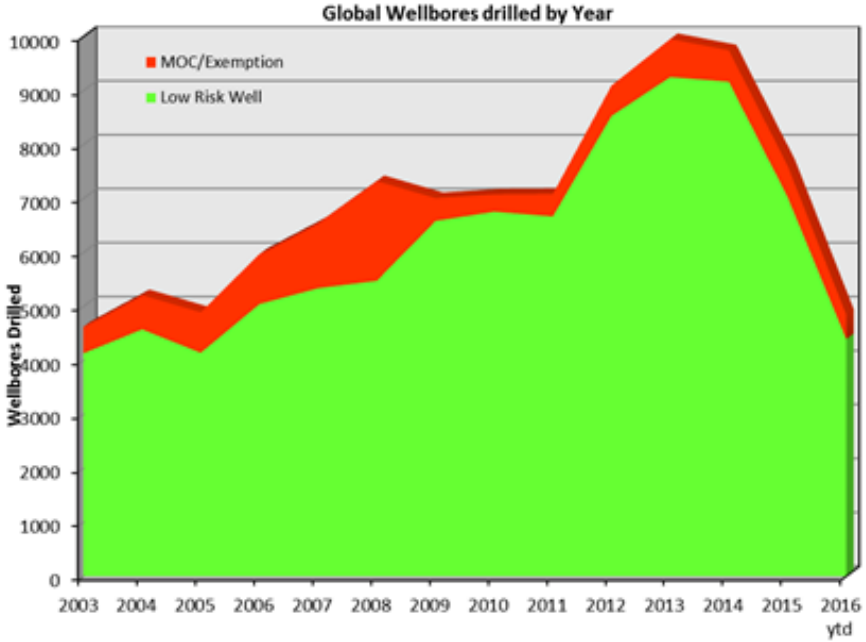
Case	Description	Cause	Avoiding Action
18*	*Offshore:* Whilst drilling a fast ROP top hole section with a recognised collision risk, the well built angle faster expected. The first few MWD s failed QA\QC due to suspected interference. The rig crew rejected them entirely and continued to drill blind. They drilled into an offset well causing a kick, throwing the drillstring out of the hole. When investigated, plotting the rejected MWD surveys showed the well heading straight towards the offset …	Failure to plot, and manage s	Adhere to required practices, after each survey and project ahead.

Human Factors
Risk habituation?

- Collisions are still relatively rare
- But less so than indicated
- Major influence is well density
- Industry trends ... added care

* One of 19 HSE and Non-HSE incidents recorded over the last 15 years

Leading Indicators

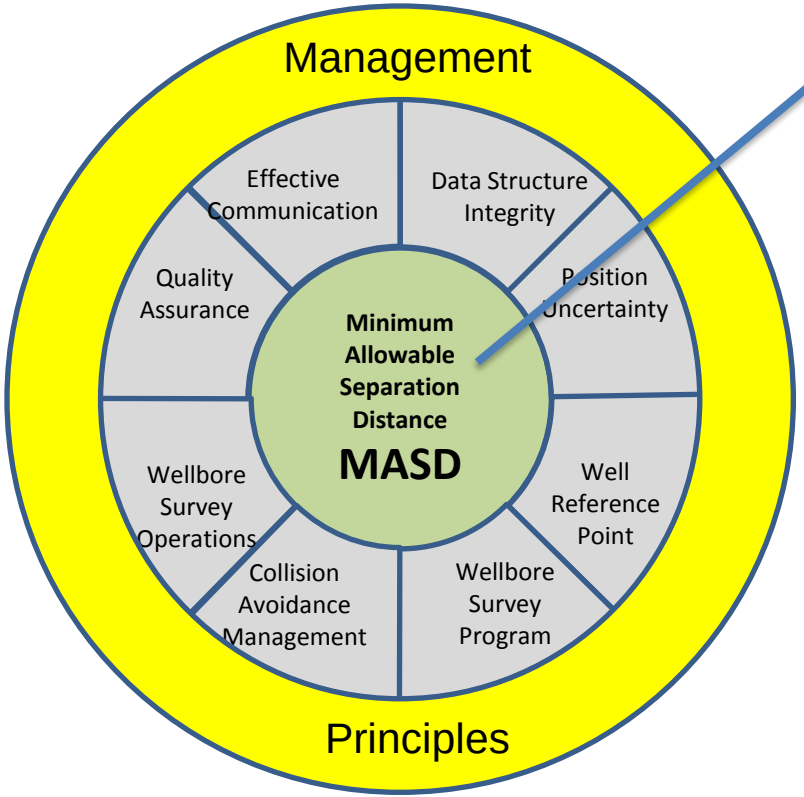


Poedjono et. al. 2009

% of wells for which exemptions are required

Helps detect “weak signals”

The Collision Avoidance Elements



Separation Factor (SF)
Dimensionless number
Critical condition SF = 1
Topic elaborated on in the 2nd paper

E	No. Cases
D	4
P	-
Well reference point	1
Wellbore survey program	-
Collision avoidance management	9
Wellbore survey operations	1
Quality assurance	-
Effective communication	3

Typical MASD Dispensations

- Effectiveness not predictable
- Energy still being put in
- Penetration always possible
- Penetration can be rapid

Acceptable mitigations are those which reliably preserve the relative well separation and so reduce the probability of well to well contact

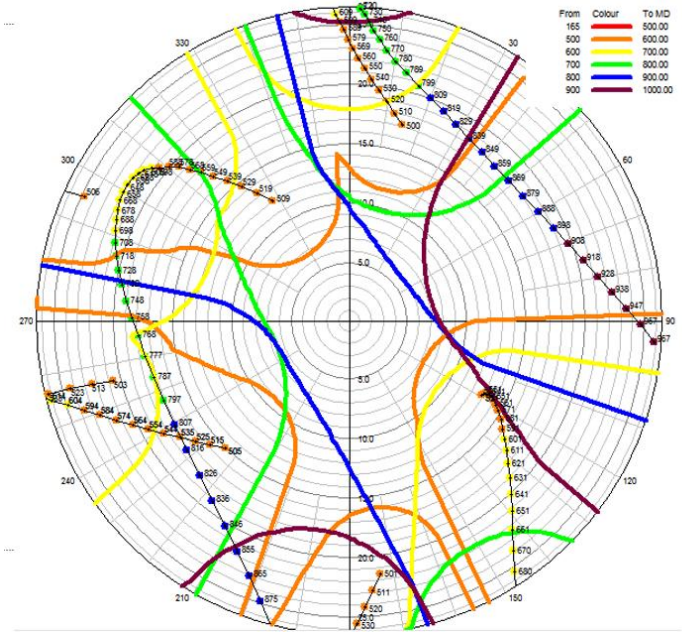
Proposed Mitigation
Multiple casing strings protecting the [illegible]
Jetting instead of drilling
Rotary drilling instead of motor drilling
Drilling with a mill-tooth bit instead of a PDC bit
Drilling with a dull or "shirt tail" bit
Drilling with low ROP
Monitoring the shakers for cement/steel
Monitoring offset wellhead vibration
Monitoring offset casing annular pressure
Low angle of incidence between wells
Soft formation

NOT ACCEPTABLE AS MITIGATIONS FOR HSE RISK WELLS

Graphical Representation of Well Separation – Travelling Cylinder

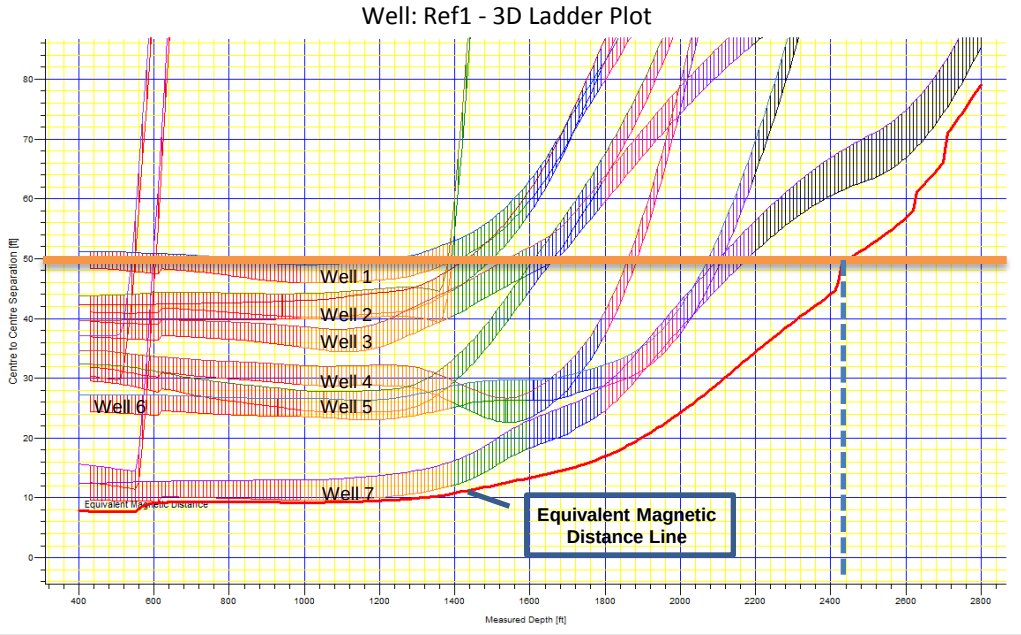
- Simplest, documented method
- Key device to show tolerances
- Support plan review and approval
- Monitor progress / project ahead
- Assess closure between wells
- Shared situational awareness

- Training essential for its use
- Scan down the OFFSET well
- Orthogonal and end-to-end cases?
- Short radius drilling?



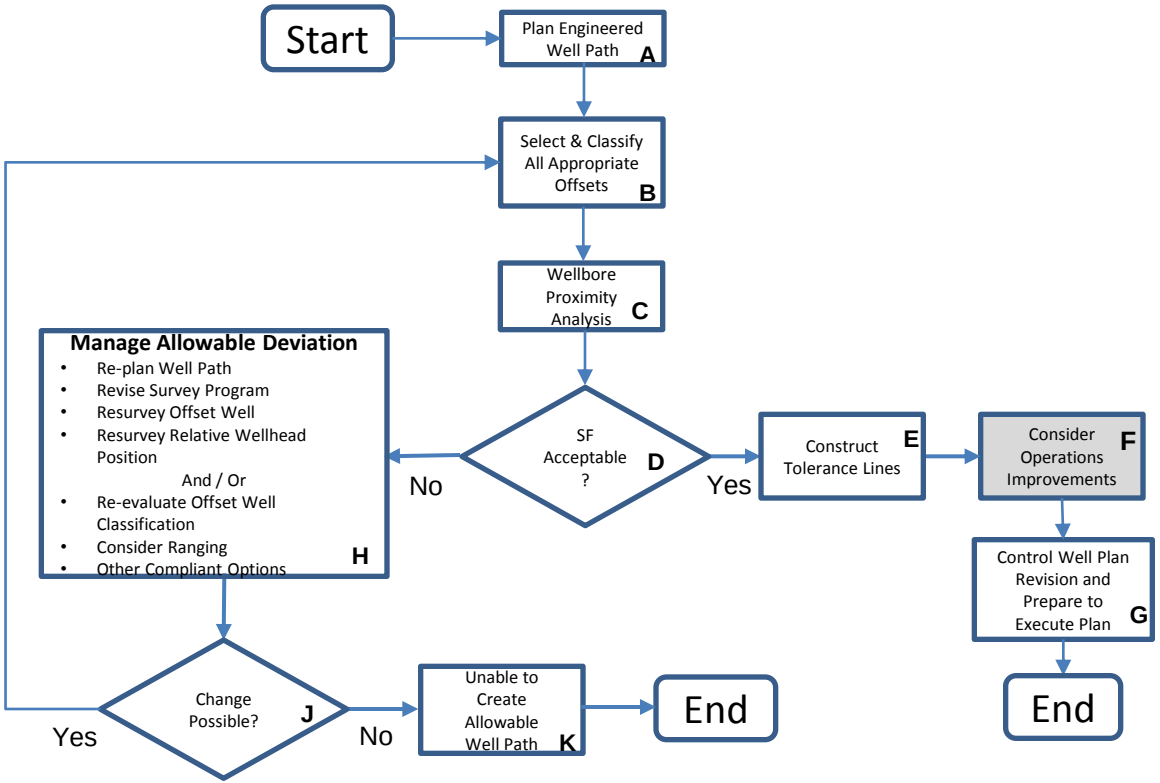
North referenced, normal plane travelling cylinder diagram

Graphical Representation of Well Separation – 3D Ladder Plot



- Shows each well's MASD
- Not direction specific
- Magnetic interference zone

Planning Phase Workflow



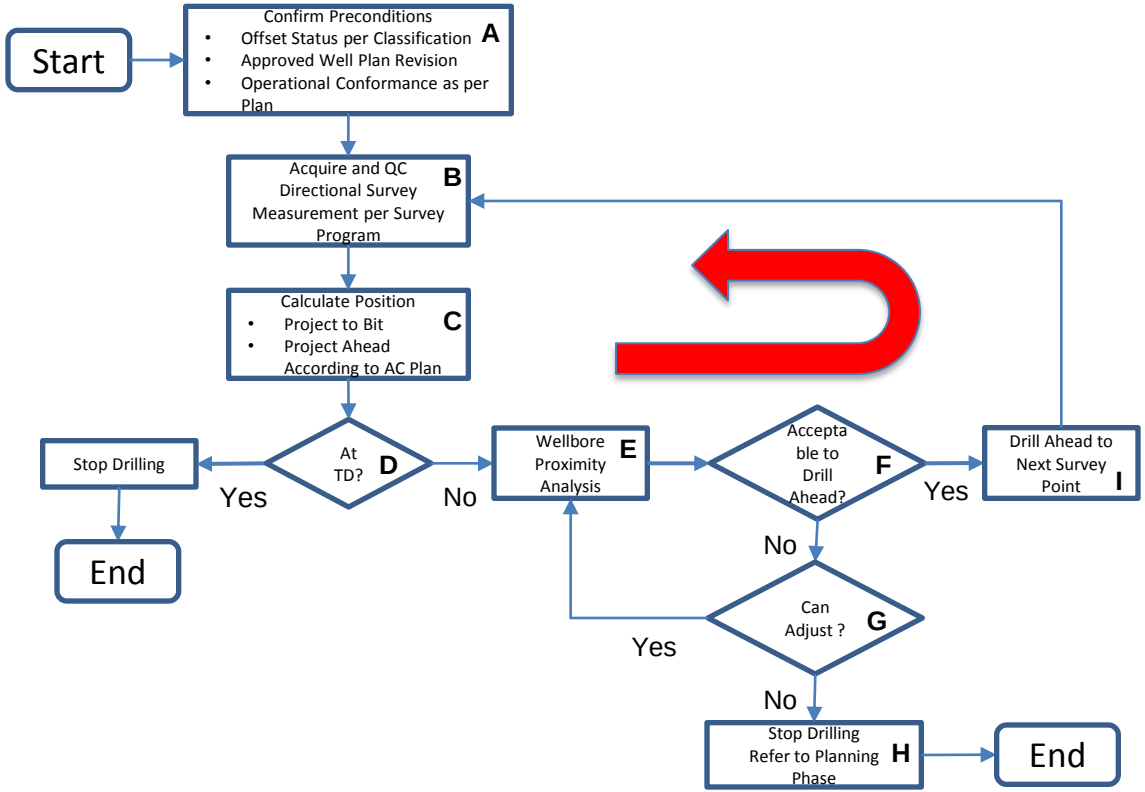
Complete set of wellbores

Offset Well Classification

Use of SSSVs

Operational improvements (F) can not alter the conditions or assumptions on which the scan is based

Execution Phase Workflow



Preconditions met

B, C, D, E, F, I Loop

Stop Drilling

Identify situations where the reference well is drilled significantly off-plan

Conclusions

- Well collisions remain an operational risk onshore and offshore
- Rigorous application of the Elements will help avoid collisions
- Collisions: Data, Collision Avoidance Management, Communication
- Risk habituation has played a significant part in a number of these
- Remediation costs for non-HSE collisions generally higher than plan
- Analysis of collisions difficult (infrequent, reluctance to share data)
- Further work: barrier management / measure well to well separation

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Acknowledgements / Questions

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