Gas Field Development - Challenges and Current Best Practices to Maximise Value

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Slim Hole Mono-bore Cemented Completion Well Design for Cost Minimization and Environmental Sustainability : Best Practices from Malaysia-Thailand Joint Development Area

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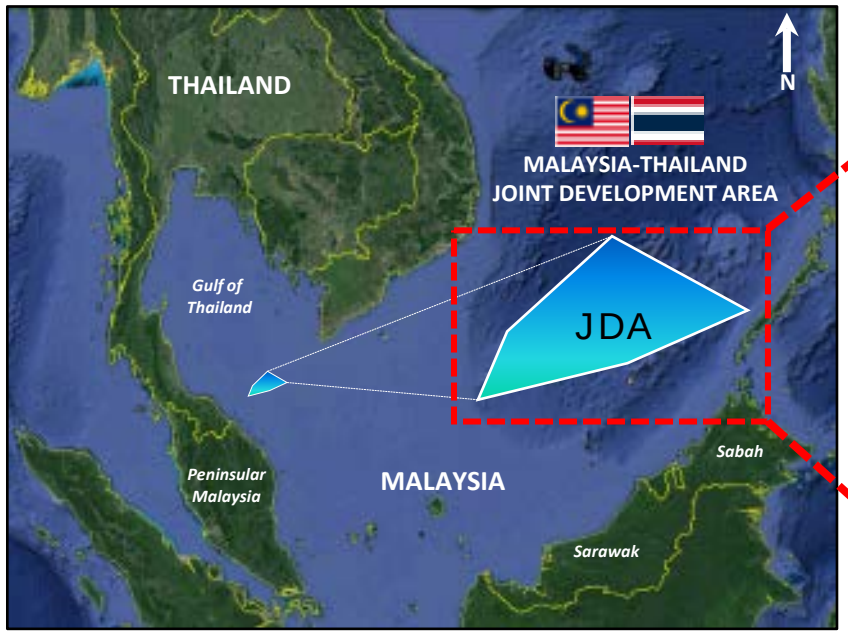
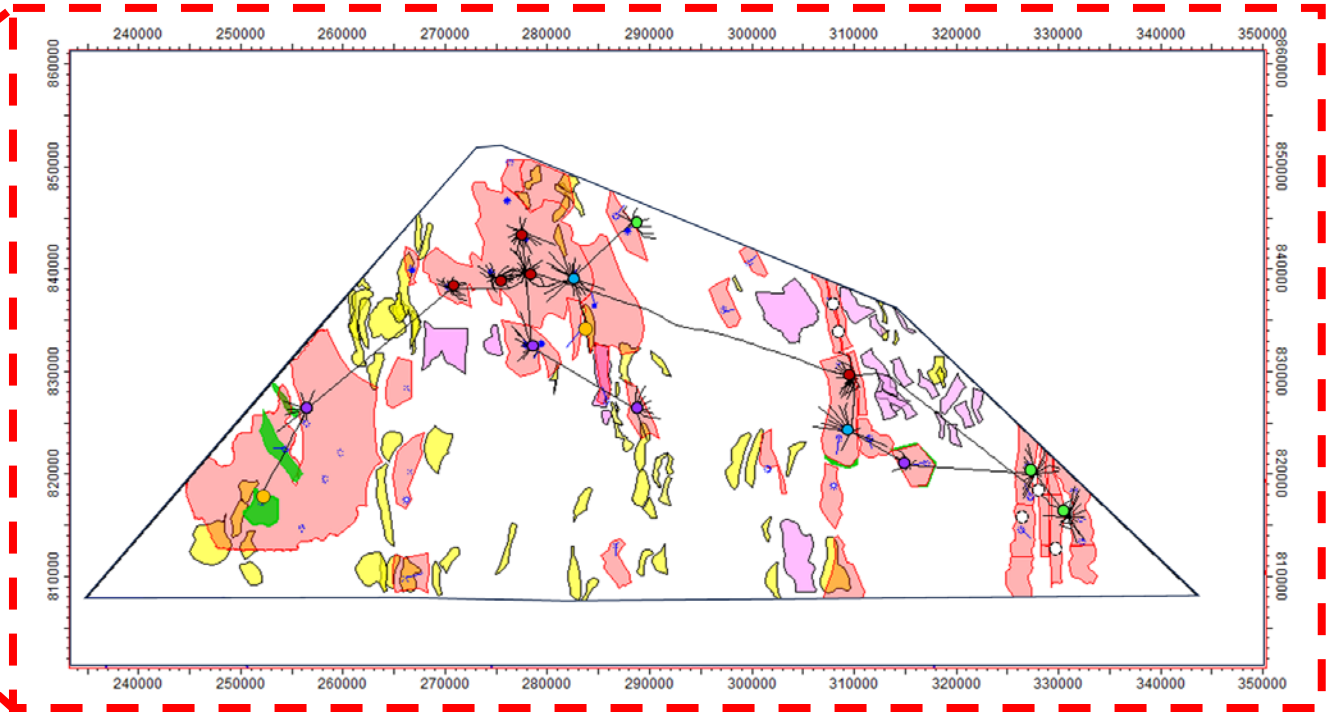
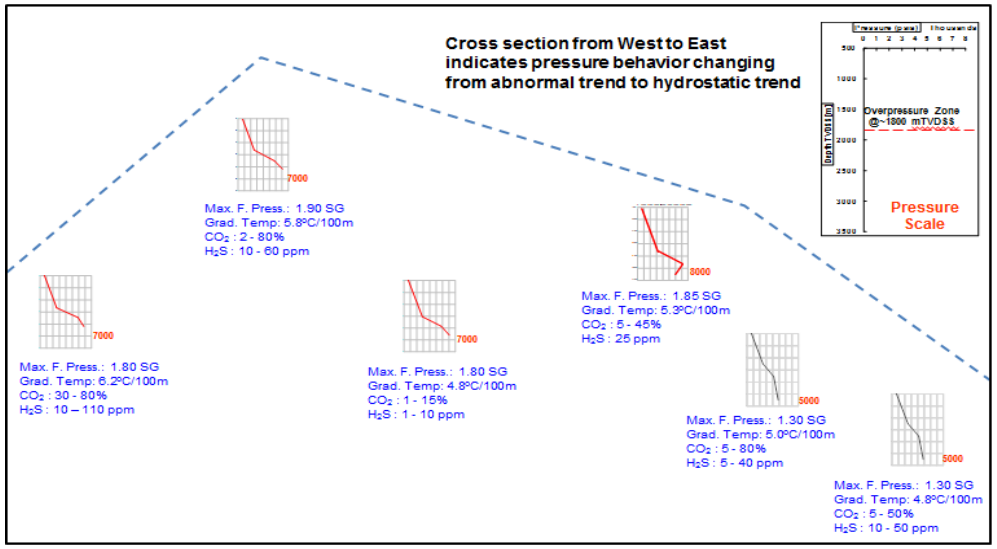
Agenda

1. Introduction
2. Challenges for an Economic Development
3. Slimhole Monobore concept
4. Critical Design Considerations
5. Key takeaway

Introduction



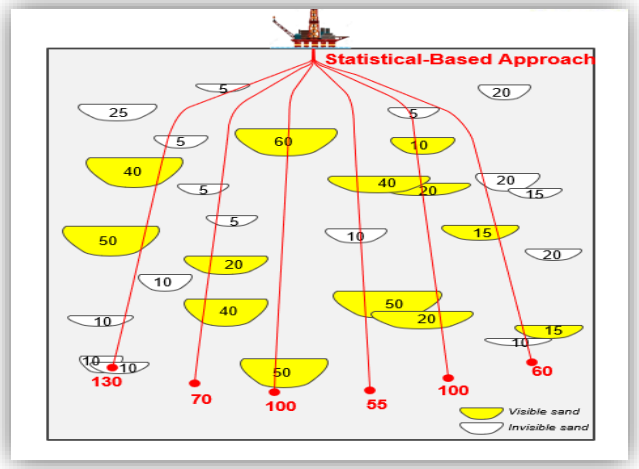


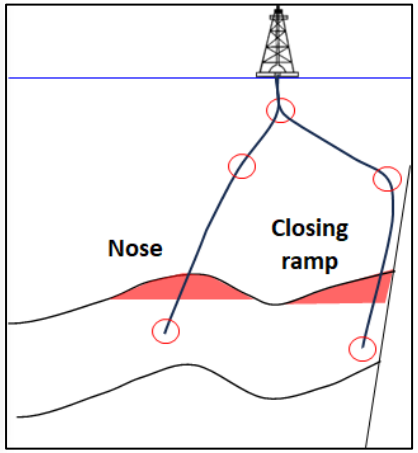


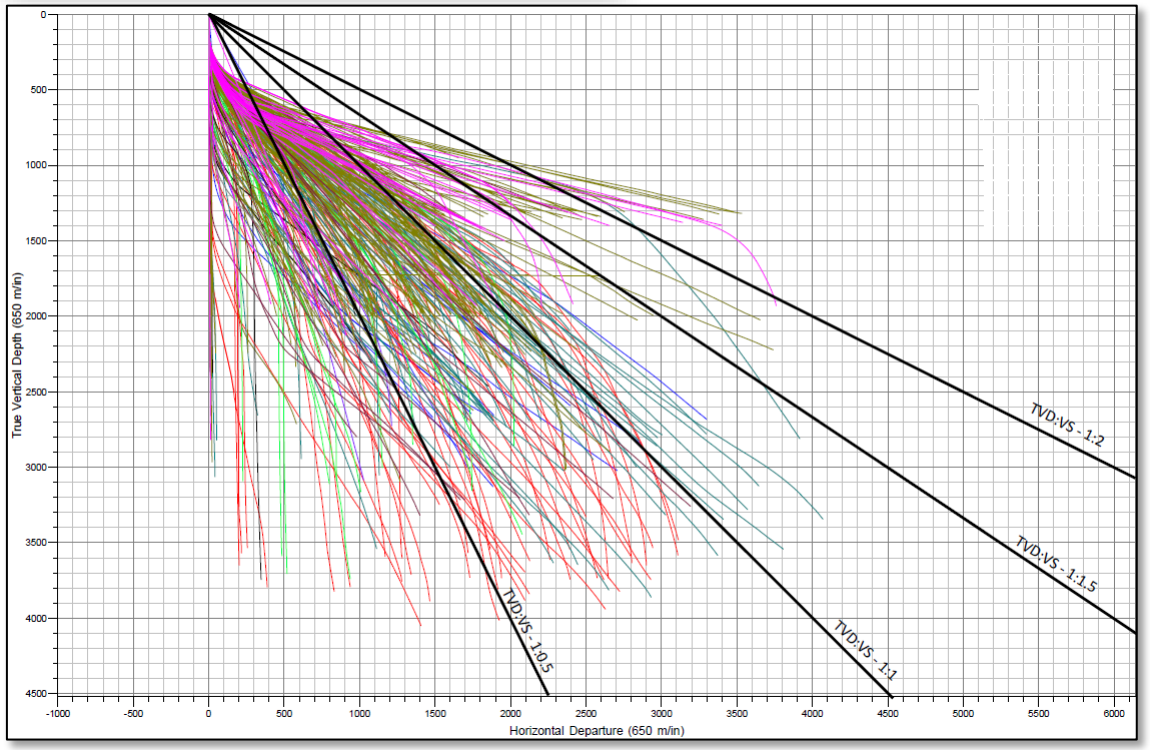
Subsurface Conditions

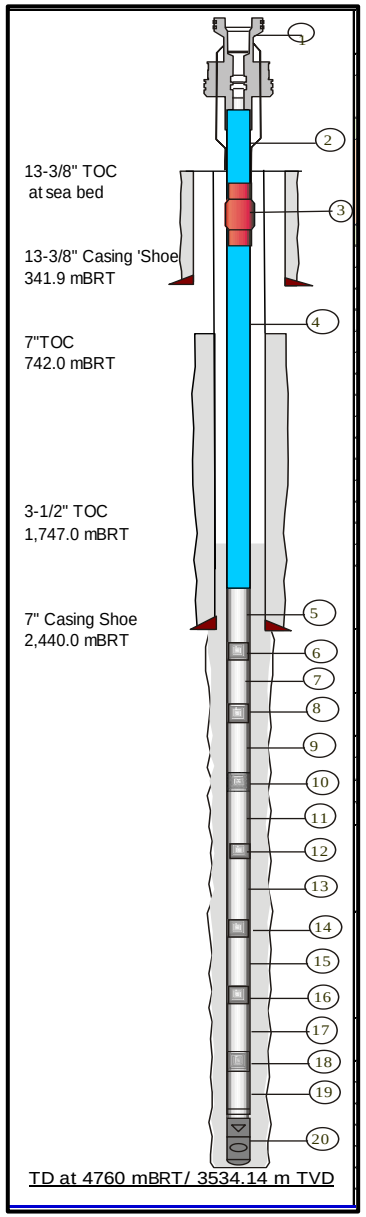
- High PP (~1.90 SG EMW), Ultra High Temperature (>200°C)
- Soft to very hard and abrasive formations (>25 ksi)
- Depleted zones, ballooning and losses
- High CO2 and H2S

Challenges for an Economic Development



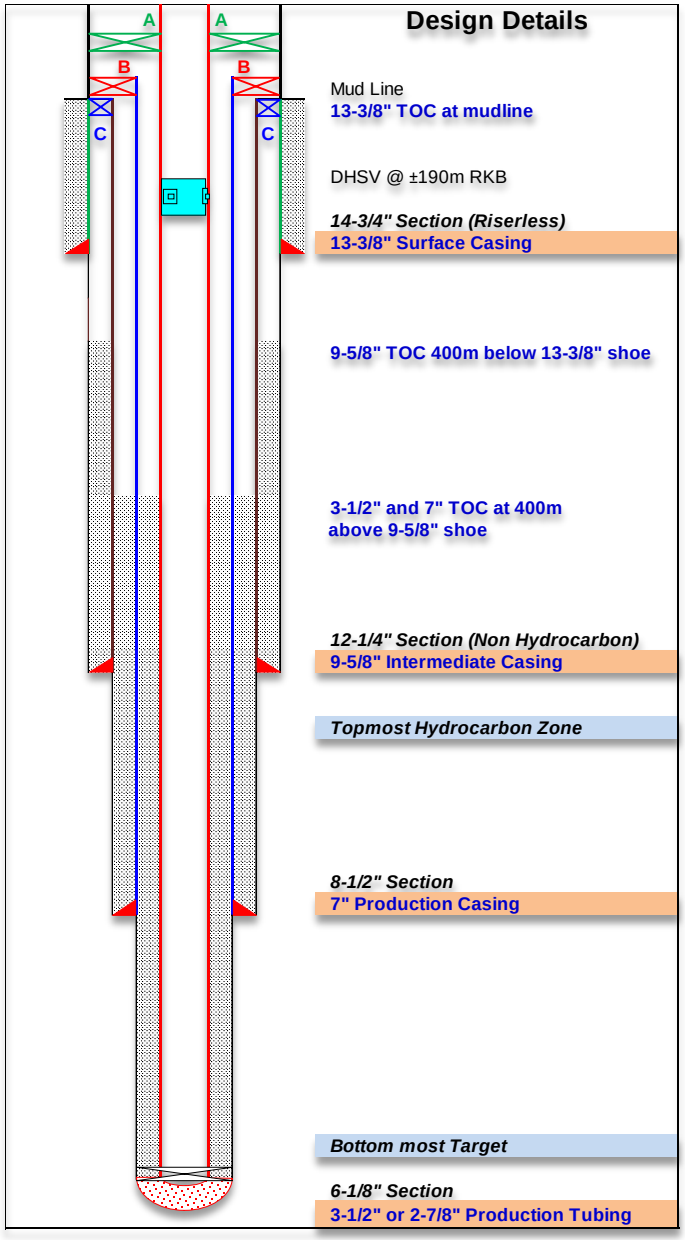






- Statistical-based approach
- Visible and invisible sands
- Lower reserves per well
- Require higher number of wells for complete exploitation of hydrocarbons
- Require low-cost drilling solution for economical viability

Slimhole Monobore Well Design Concept



COST MINIMIZATION

- Ultra Fast Drilling
- Flat Time reduction
- Lower material cost
- Optimize equipment utilization
- Earlier production and monetization

ENVIRONMENTAL SUSTAINABILITY

- Shorter operation time
- Lower material usage
- Less vessel frequency
- Lower fuel consumption
- Reducing overall carbon emission

Safe and fit-for-purpose design

- Minimize hole sections and hole sizes
- Seawater Drilling in non reservoir sections
- Cemented Tubing - no production casing
- Batch Drilling for repetitive operations and improvement
- Maximize Offline activities

Critical Design Considerations

PLATFORM DESIGN

- Designed for Jack-up and Tender Assist rigs
- NO Conductor
- First Casing ➔ 9-5/8” or 13-3/8”
- Supported by guide buckets till seabed

DRILLING RIG

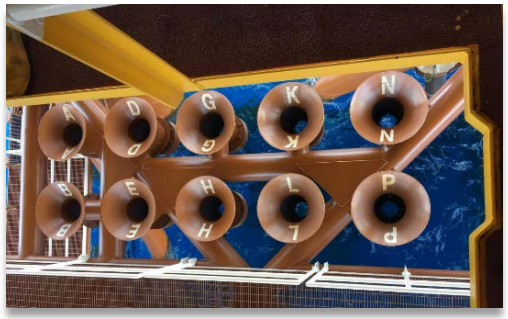
- Fully offline compliant
- Offline Activity Cantilever
- Capable to racking casing and tubing in doubles
- Knuckle boom cranes for under rig floor activities
- Separate crew for offline activities

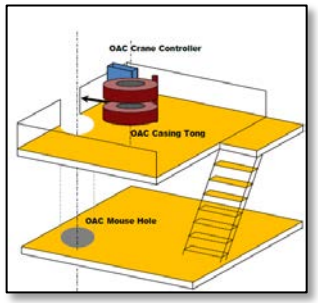
WELL DESIGN

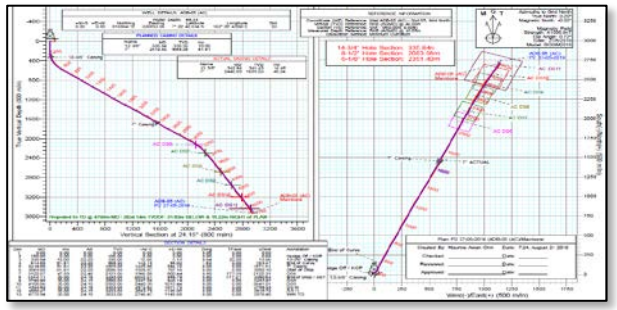
- Riserless top hole drilling
- Slimmer hole sizes, last section ➔ 6-1/8”
- No hydrocarbon zone in intermediate section
- Run casing and tubing in doubles
- Batch drilling and offline cementing

COMPLETION DESIGN

- Cemented tubing
- Carbon Steel and Chrome tubing (high CO2 & H2S)
- DHSV with control lines
- No shoe track; special wiper plugs for wiping efficiency







Key Takeaways

- ***Proven concept*** – 31 E&A and 239 development wells completed, evaluated and producing
- ***Simple*** design for ***Complex*** wells – Deep, HPHT, Extended Reach Drilling
- ***Flexibility*** – ability to ***modify*** based on well objectives
- ***Possibility*** of ***re-entry*** by P&A and full slot recovery
- ***Operational Data*** – available from ***1000s*** of wells
- Time and Cost ***benefits***
- Lower impact to ***environment*** for greater ***sustainability***
- ***Awareness*** and change of ***Mindset***
- Room for ***further Improvement***

Acknowledgements

- Malaysia Thailand Joint Authority (**MTJA**)
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- Carigali-PTTEPI Operating Company Sdn Bhd (**CPOC**)