Chapter 3

COMPLETION

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How do completion requirements determine which horizontal drilling system to use?

How do I design a high rate, low maintenance, trouble-free, economical completion?

Who is the Completions Engineer?

In a vertical well:

It's the person who picks perfs in a cased vertical well.

The stimulation requirements are predetermined except for quantites to be pumped.

Who is the Completions Engineer?

In a horizontal well:

It's the person who determines:

- Well bore stability from rock properties
- Flow rates stimulated and unstimulated
- Withdrawal points considering compartments and barriers
- Tubular requirements

Who is the Completions Engineer?

Determines hole stability, for example:
“Will an open hole completion work or do we need a slotted liner?”

Williams Mid-Continent choose slotted liners in the Hartshorne CBM in the Arkoma Basin.

Who is the Completions Engineer?

Determines cased and cemented liner like Devon on their 1000th horizontal well in the Barnett Shale.

http://www.wcmessenger.com/news/news/EEAkAlkpuFhSbCGike.php

Who is the Completions Engineer?

Decides well must be frac’ d

- Completed accordingly
- Cemented casing, perfed and stimulated
- Open hole with stack frac type system, external packers with opening sleeves

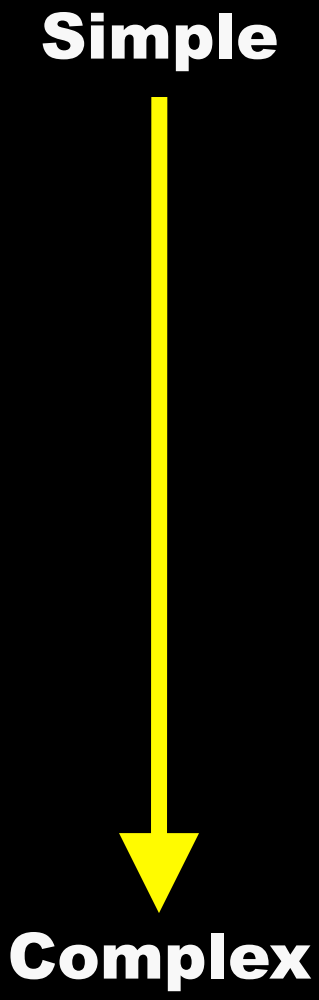
Who is the Completions Engineer?

Determines how the well will be pumped

- In the vertical
  Back pressure on reservoir based on radius of curvature
- The tangent
  Above reservoir some distance and loss of drawdown
- In the lateral
  Maximum drawdown

Completion Strategy

- Open Hole
- Slotted Liner
- Pre-packed Screen
- Gravel Pack
- External Casing Packers
- Cemented Casing



Completion Strategy

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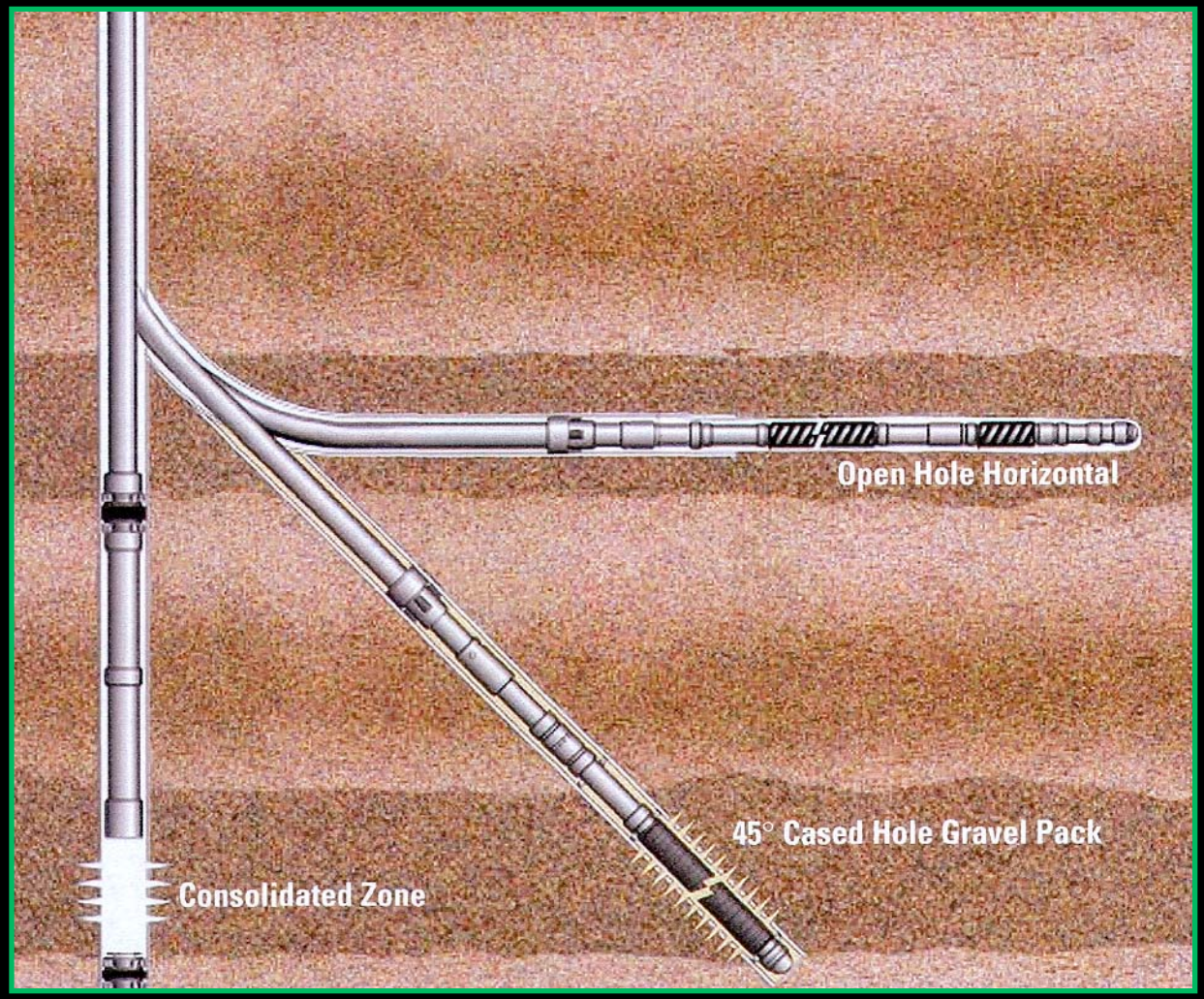
Completion Strategy



BAKER HUGHES

Completion

- Gas or oil well?
- Flowing well or artificial lift required?

Completion

- Reservoir Bottom Hole Pressure is KEY!
- You need confidence in BHP (fluid level) measurements!

Completion

- Estimate your anticipated production rates.
- Tubing size dictates casing/hole size, basically the entire well design.

Rock Mechanics/Hole Stability

It is *extremely* important to understand rock stability!

While drilling:
Vertical hole stability is NOT equal to horizontal hole stability!

While producing:
ALL exposed rock types must be stable!

Formation Damage

Overbalanced = Probable Formation Damage

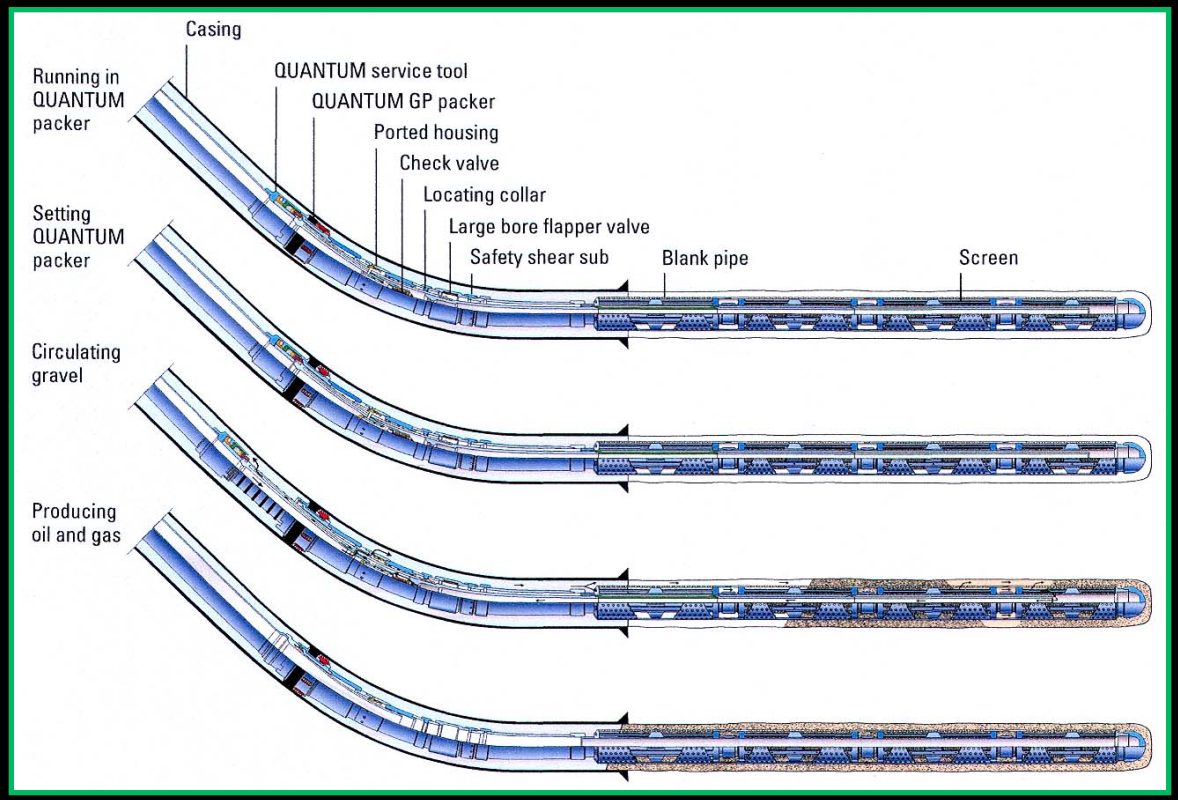
Underbalanced = Minimal Formation Damage

Pre-packed Screen/Slotted Liner

Needed in unstable, unconsolidated formations not requiring gravel packing

Gravel Pack

Required in unconsolidated formations for optimum production



Schlumberger

External Casing Packers

For Zonal Isolation:

- Slotted Liners
- Perforating

Cemented Casing

Required for

- Wells with vertical permeability barriers needing stimulation
- Fluid isolation of gas/oil/water

Acid Clean Ups

- Carbonates – OK
- Avoid sand reservoirs – hole stability issues

Frac Stimulation

Control of frac initiation point.

Must Have It Right

Some horizontal wells = $1,500,000

Horizontal Fracs = $1,000,000

Completion Conclusion

- Hole stability
- Reservoir BHP
- Artificial lift system
- Clean up
- Stimulation

The completion drives the bus!