Coiled Tubing Deployable 3-1/2” Expandable Tubular System

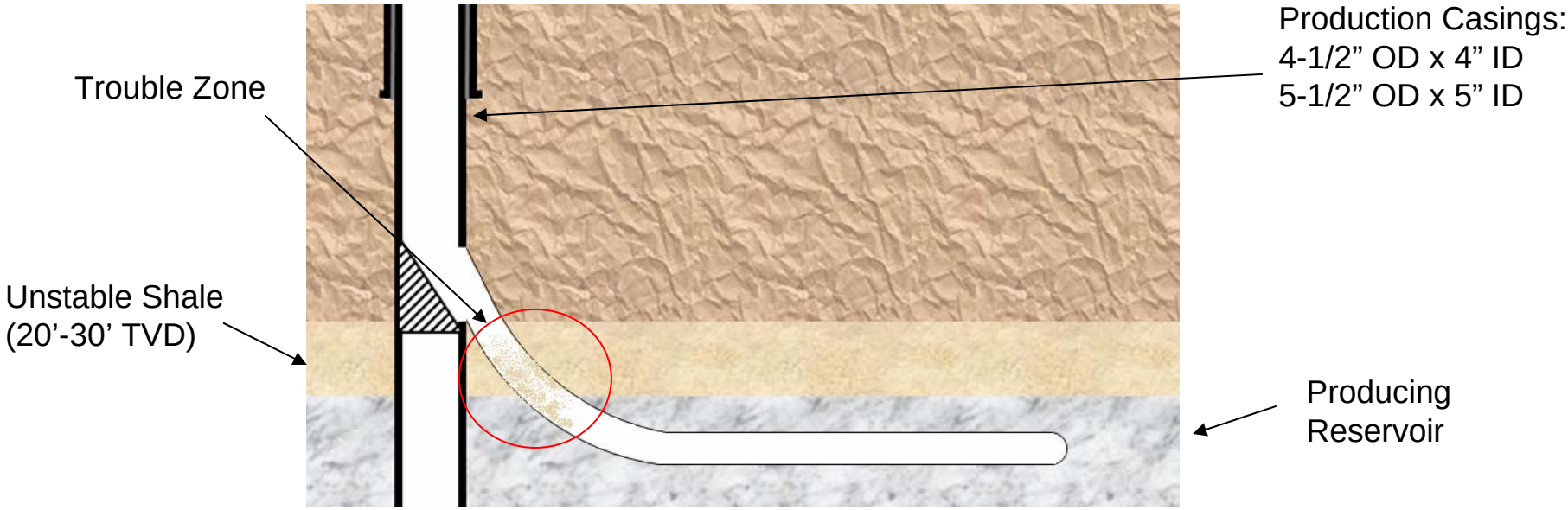
Alex Caccialupi, Mohawk Energy

In Collaboration with BP

April 25, 2007

Problem Description

- BP is sidetracking wells in the Anadarko Basin [300 wells] to unlock existing reserves
- Major problem: casing off an unstable shale interval (100-300ft) exiting the window to allow running of the well completion tools.
- The system has to provide a 3.75” DD after expansion, working through an existing 3.90” milled window.



Problem Description – The Unstable Shale

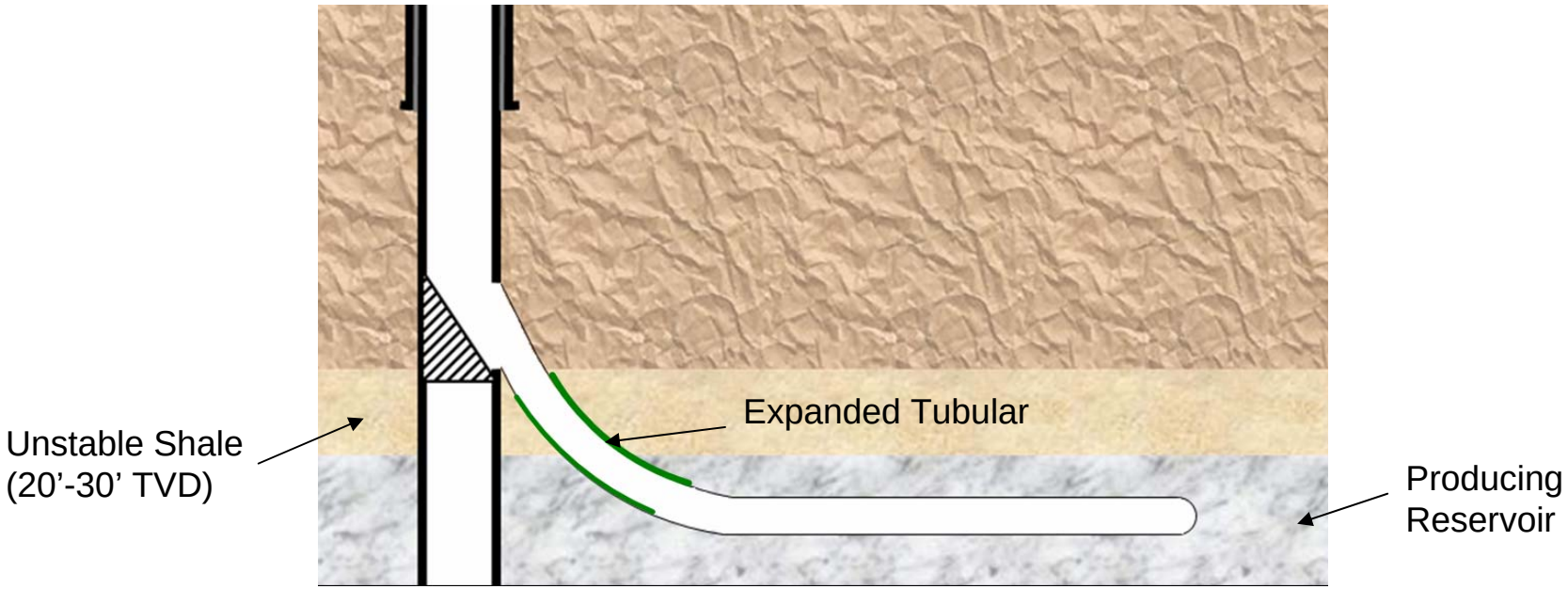
- Unstable Shale: requires >8.5ppg mud weight to control
- Depleted Reservoir: requires <6.0ppg ECD to circulate
- Mechanical isolation of shale needed

Solution

Setting an open hole clad expandable across the trouble zone

Requirements:

- 100-300ft of expanded tubular length
- DLS of up to 45 deg/100ft
- Pass through a 3.90” milled window
- Provide 3.75” Post Expansion Drift ID



Major Challenges

- Tubular system
  - 30% expansion ratio
- Expansion Tool
  - Extreme Dog-Leg severity (up to 45deg/100ft)
  - Very small diameters (within 3” ID)
  - Extreme expansion forces
  - Pass through a 3.90” window and provide 3.75” DD after expansion
  - CT limitations

Tubular System Selection

3-1/2” CT Option

Pro:

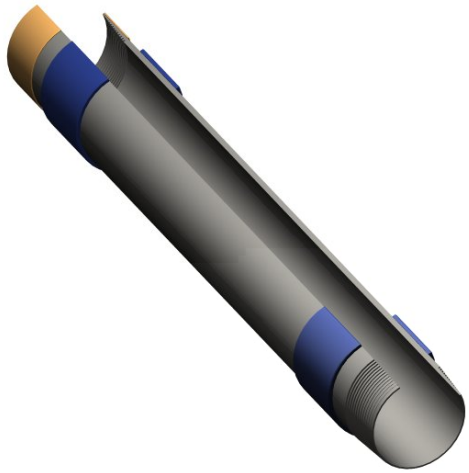
- No connectors needed

Cons:

- Special Equipment
- Difficult Logistics

- Un-economical

40-ft Pipe Joint Option



Pros:

- Standard Equipment
- Rig-Friendly Operation
- Standard Transport

- Economical

3-1/2-in-OD Tubular System - Pipe

- Proprietary MTX-60 Tubular
  - Ultra High Ductility
  - Ultra High Fracture Toughness
- Pre-Expansion: 3.5” OD x 2.992” ID
- Post-Expansion: 4.34”OD x 3.87” ID
- Expansion ratio: ~30%
- Expansion Force: ~60,000 lbf
- Tested up to 66%

3-1/2-in-OD Tubular – Damage Tolerance

- Damage Simulation
- .035” deep slot
- 1.50” long slot
- .25” un-expanded wall

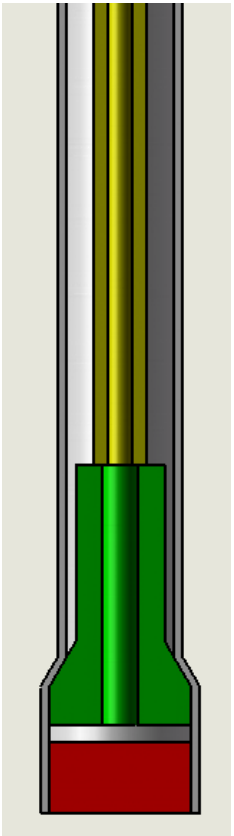
- 32% Expansion
- No fracture

3-1/2-in-OD Tubular System - Connectors

- Proprietary designed connectors on .250” wall thickness
- Full FE analysis of loading conditions
- Protected during run-in
- Tested to ~30% expansion with Mohawk’s MLC-300 ID lubrication system

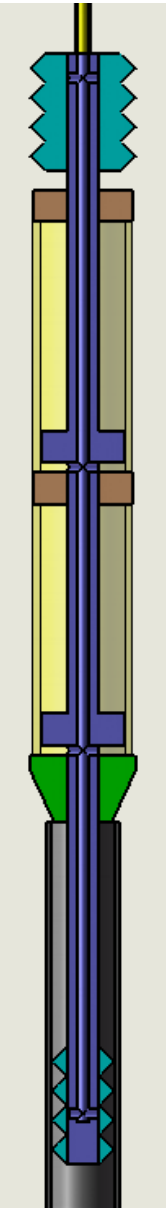
Expansion System Selection

Conventional Hydraulic Launcher



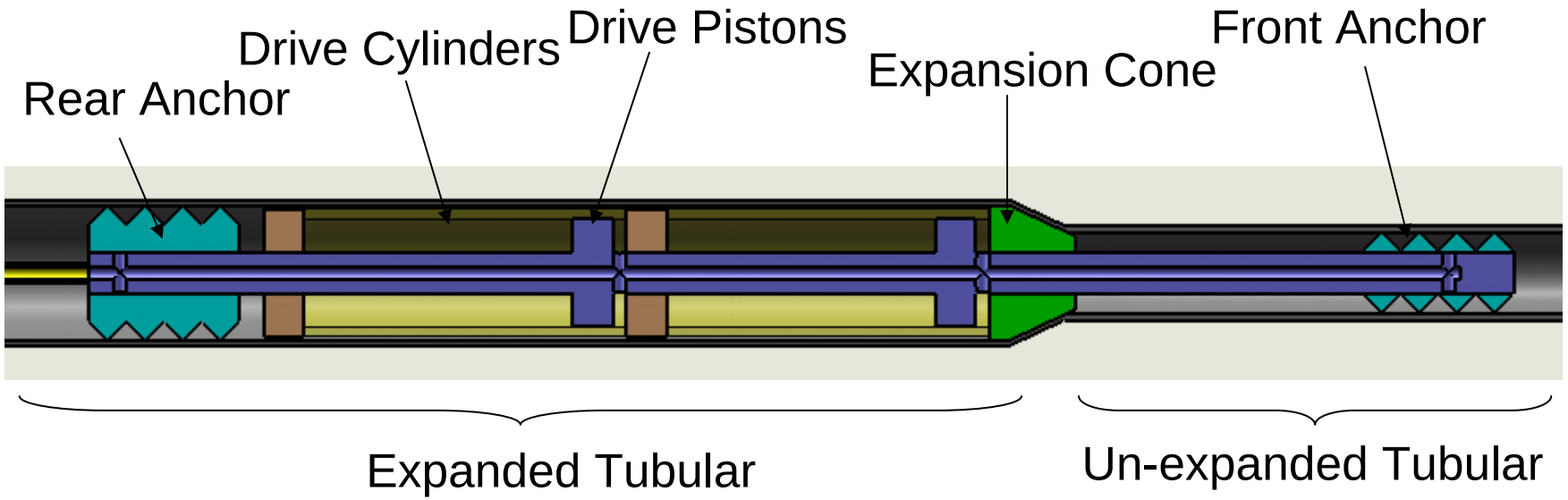
- Hydraulic Constraint: Burst of expanded pipe is lower than expansion pressure needed
- Geometrical Constraint:
  - Drift required: 3.75”
  - Launcher Needed: 4.25”
  - Window Restriction: 3.90”

Tractor-Driven Expansion System:



- 3.85” Expansion Cone provides 3.75” DD after expansion
- Offers Contingency capability
- No Drill out trip required

Expansion Tool - Working Concept



- Tractor-driven expansion system
- Expansion force created by pressurizing pistons.
- Anchors provide reaction force needed for expansion
- Tool is reset by lowering Coiled Tubing
- Expansion ratio: ~**30%**

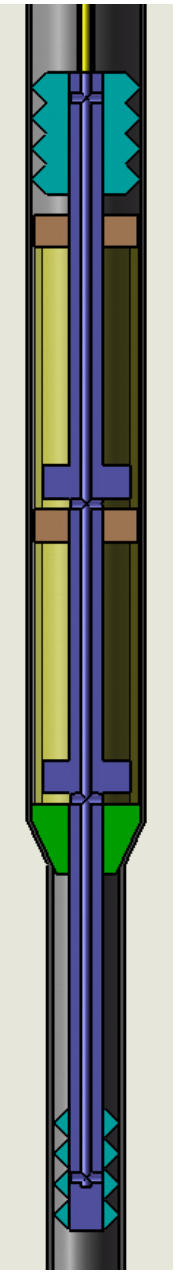
Expansion Tool - Expansion Video

Expansion Tool - Specifications

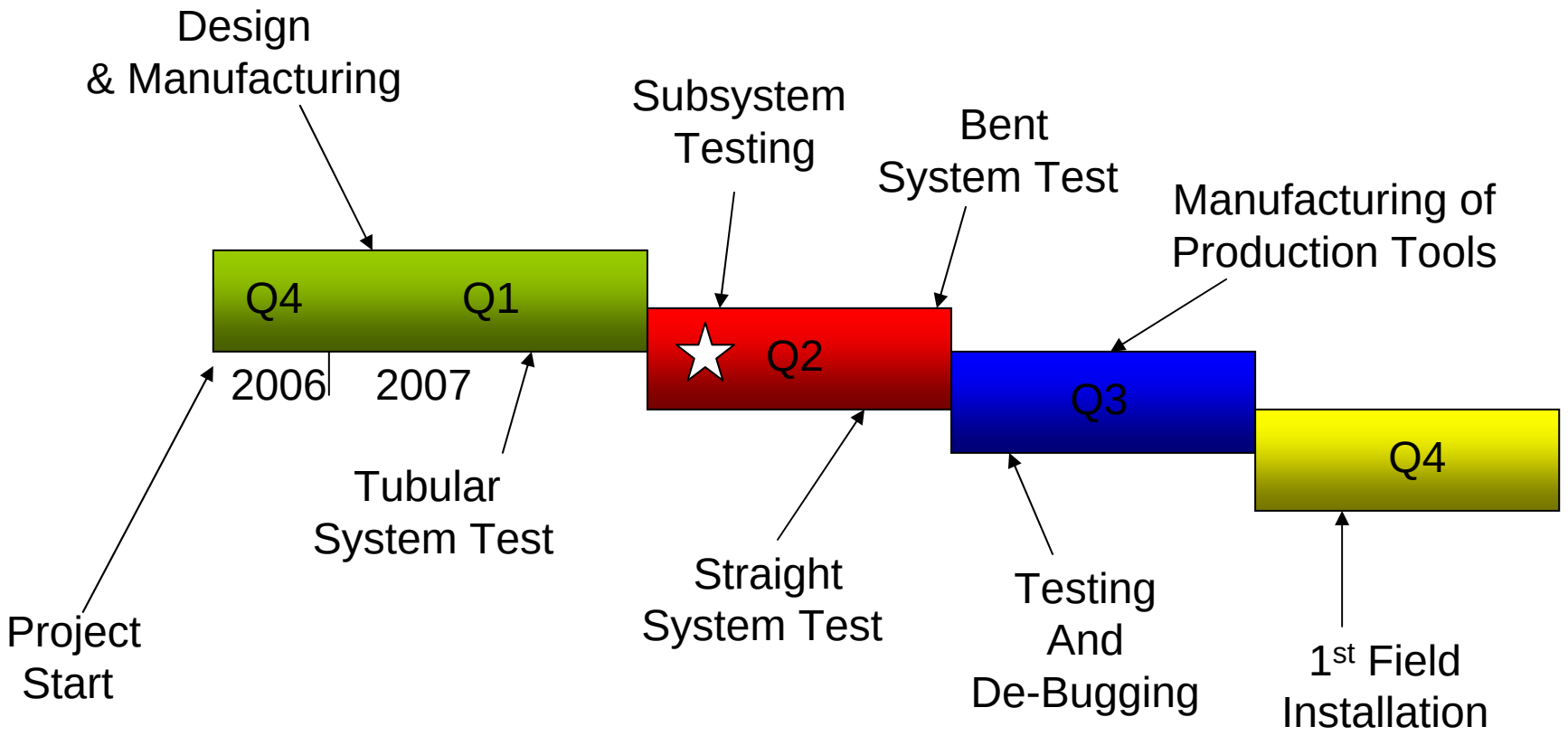
- Overall Length: 45 ft
- Max. Tool Run-in OD: 3.85 in
- Weight: ~1100 lbs
- Total Expansion Stroke: ~4 ft
- Maximum Axial Force: 160,000 lbf
- Maximum Pressure: 10,000 psi

Operational Parameters

- **Maximum DLS: 45 deg/100ft**
- Pressure: 3500-4000 psi
- Est. Expansion Time: 3 hrs/200 ft
- No drill-out trip
- Circulation capabilities



Project Status



Summary

- Joint development between BP and Mohawk Energy
- Major System Parameters:
  - 30% Expansion Ratio
  - 45 deg/100 ft DLS
  - 3.90” Window Restriction, 3.75” DD after expansion
  - CT deployable system
  - Economical System
- Unlock “stranded reserves”

THANK YOU

Mohawk Energy
3532 W TC Jester Blvd.,
Houston, TX 77018 USA

Tel.: +1 713 956 7473
Fax: +1 713 956 0310
E-mail: info@mohawkenergy.com