Oil and Gas Drilling

Presented by Jerry Davis, PE
Who Gets the Oil & Gas?

• Rule of Capture

• In Texas, You Own What is Under Your Ground

• In Oklahoma, You Retain the Right to Capture What is Under Your Ground

• From *cuius est solum eius est usque ad coelum et ad inferos* (for whosoever owns the soil, it is theirs up to the sky and down to the depths)
Who Gets the Oil & Gas?

- Subsurface Boundaries are the Same as on the Surface
- All the way to the Center of the Earth
- Also Applies to Groundwater and Game Animals
- Ownership by First “Capture”
- But, You Can’t Steal by Slant Drilling
Downside of Rule of Capture
Downside of Rule of Capture

• Overproduction

• Boom-And-Bust Cycles

• Wild Price Swings

• Pollution and Contamination
Downside of Rule of Capture
Where is the Oil & Gas?

• Petroleum Geology

• Subsurface Mapping

• Seismic Data Gathering

• 3-D Rendering Using Powerful Computers

• Well Logs
Where is the Oil & Gas?

- Located in One or More “Strata” of “Oil-Bearing Rock”
- Located Under Various People’s Land
- Permian Basin Now Sells Individual Strata
Where is the Oil & Gas?

Uses of Well logging

Well Logging Technology

Well logging involves measuring the physical properties of surrounding rocks with a sensor located in a borehole. The record of the measurements as a function of depth is called a well log.
Where is the Oil & Gas?
How Do We Get It?

• We Drill!

• But, Usually Far Deeper Than Water Wells

• And, Through a Lot of Rock Layers
The Drill Rig
The Drill Rig
The Drill Rig
The Drill Rig

• KODA Rathole

• Large Diameter “Starter Hole”

• Up to 6 Feet in Diameter, Up to 100 Feet Deep
The Drill Rig
Drill Bits
Drill Bits
Drill Bits

- Modern Bit
- Tungsten Carbide Inserts
- Polycrystalline Diamond Compact Inserts
Drill Bits
Drilling Pipe

- Typically 31 Feet Long
- Threaded at Both Ends
- Commonly Steel, But Aluminum Also Used
The Kelly

• Threaded Into Top of the “Drill String”

• Splines Lined Up in rotary Drive

• Rotates the Drilling Pipe and Bit
The Kelly
Even More Kelly
Mud

• It Just Looks Like Mud
• Lubricates Bit
• Carries Away Rock Chips
• Transmits Signals
• Prevents Blowouts/Gushers
Well Completion

1. Black vertical lines with a triangle on the bottom represent steel casing or liner section.
2. Gray hatched boxes represent cement upsets of the casing.
3. Red hatched boxes represent cement upsets of the drilling mud.
4. The drill string in the middle consists of (top to bottom) drill pipe, drill collars, and a drill bit.

20" Surface Casing
13 7/8" Intermediate Casing
9 7/8" Intermediate Casing
7 5/8" Production Casing
5" Production Liner
Perforation
Perforation
Perforation and Production
The Humble Pumpjack
Production Wells
Shipping it Out
Shipping it Out
Refining

Small molecules:
- Low boiling point
- Very volatile
- Flows easily
- Ignores easily

Large molecules:
- High boiling point
- Not very volatile
- Does not flow easily
- Does not ignite easily
Offshore Drilling
More Offshore
Well Logging
Well Logging

Electrical Well Logging
Well Logging
Well Logging

Figure 6: Generalized Neutron Logging Tool illustrates a typical neutron logging tool (Schlumberger, 2010).
Well Logging
Directional Drilling

- Slant Drilling
- More Sophisticated Steerable Drilling
- Uses Gyroscopes etc. to Know Where They Are
Directional Drilling
Directional Drilling
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Directional Drilling
Oh, Frack!
Oh, Frack!
Fracking Fluid

- 90% Water
- 9.5% Sand ("proppant")
- 0.5% Chemicals (propane, soaps, diesel, misc.)
- Uses Roughly 4 Million Gallons of Water Per Well
- Disposal?
- Earthquakes?
The Blowout
The Fire Department
The Blowout Preventer

• Cuts Drill Pipe

• Isolates Upward Flow of Oil and Gas

• Removed After Well is Completed and Under Control
Blowout Preventer
FWIW

Oil Rig Count

- Natural Gas Rigs
- Crude Oil Rigs

Oil Rigs in Operation

That's all Folks!