Practical Field Application of the Mysterious Dynamic Kill

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The DYNAMIC KILL

• 1ˢᵗ Published by Blount/Soeiinah (Mobil)
• 1978 Dynamic Kill – Arun Field Indonesia
  – Flowing an estimated 300 MMscf/d [8.6Mm³/d]
• Identified the Additional Effect of ECD
  – Turbulent Feature of Water
• Has been used extensively, whether known or not
• We are here to learn HOW to do it RIGHT
What is this about?

• We are not here to learn about all of the robust programs available to you
• We are here to learn how to KILL PLAIN and SIMPLE
• Problem with all SOFTWARE is…

INPUT

Garbage In/Garbage Out
What is IT (DK)?

• Increase FBHP to SBHP via
  – Increasing hydrostatic head in the flow path
  – Increase ECD via Friction of kill fluids
  – Not Fracture the formation during the Kill
  – Maintaining CONSTANT BHP once well is dead

We are essentially weighting up the gas!

Flow Rate = C \times (SBHP^2 - FBHP^2)
Inflow Performance Relationship

Flowrate (MMscf/d)

FBHP (psig)

Well Dead

Pore Pressure

AOF
Bottom Hole Pressure

DP
CP
Static BHP
Bottom Hole Pressure

Flowing BHP

DP
Increasing the BHP

![Graph showing the relationship between Kill Fluid Volume (bbl) and BHP (psi)]

- **SBHP**: 3000 psi
- **FBHP**: 1500 psi
- **Kill Rate (BPM)**: 29.0
- **Mud Density (ppg)**: 13.5
When is the Right Time for a Dynamic Kill?
When to USE

• **Anytime**
  • There are no negatives on when to use
  • Limitation on tubulars (Pump Pressure)

• **When you SHOULD always use DK**
  – No surface pressure control
    • Shallow Gas
    • Surface Blowout
  • No ability to choke well back
  • Worried about breaking down formation
    – And Having a Surface Broach
Diverted Well
Underground Blowout
The Dynamic Kill Pyramid

Control Parameters

Kill Fluid Density

Injection Depth

Kill Fluid Rate

Wellbore Geometry

Blowout Flowrates

The Kill

Kill Fluid Volume

Blowout Constraints
The Kill Pyramid

Control Parameters

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Blowout Constraints
Est. Flow Rate - Gas

Gas Flowrate Estimated from Flame Height

GPSA (Sec 5-18)
Est. Flow Rate - Oil

Oil Flowrate Estimated from Flame Height

Hasemi and Tojunga
Diverted Well
Sensitivities

12 ppg Mud Kill Rates

Kill Rate (BPM) vs FBHP

- 30 MMscf/d
- 20 MMscf/d
- 15 MMscf/d
- 10 MMscf/d

Δ42 BPM
The Kill Pyramid

- Kill Fluid Rate
- Wellbore Geometry
- Blowout Flowrates
- Kill Fluid Density
- Injection Depth
- Kill Fluid Volume
Thresholds – Fixed Kill Rate

Sensitivity - Fixed Kill Rate of 64 BPM

Kill Volume (bbl) vs. Kill Mud Density (ppg)
Thresholds – Fixed Density

Sensitivity - Fixed Density of 13.5 ppg (1.62 SG)
Thresholds – Fixed Volume

Sensitivity - Fixed Mud Volume of 2 Hole Volumes

Kill Rate (BPM) vs. Kill Mud Density (ppg)
Changing the Rules

Inflow Performance

- Reservoir Performance
- 7" x 4-1/2" Annular Performance
- 7" Casing Performance
- 7" x 3-1/2 Annular Performance

Flowrate (MMscf/d)

Pressure (psi)

300 PSI @ 6 BPM
7000 PSI @ 22 BPM
Kill Fluid

– Water
  • Goes into Turbulence Quickly
  • Cheap & Usually Plentiful
  • Less Polluting
  • High Fluid Leak-Off
  • Can Increase Flow Path Area

– Drilling Mud
  • Great Fluid Leak-Off Properties
  • Can use Higher Densities (Pro/Con)
  • Does not go into Turbulence as Quickly
After Kill

• Water as Kill Fluid
  – Displace Water w/ Kill Weight Mud
    • Use Weight/Wait method
    • ECD’s must be corrected for water-mud transition

• Monitor wellbore
  – Cement or other remedial operations
Real World Rules

• 40% more HHP/pump rate capacity than simulated
  – Don’t confuse HHP w/ Rate
• 100% more kill fluid volume than required
• Enough fuel for double the anticipated pumping time
• Start the dynamic kill job in the morning
• All data acquisition into a central control cabin (BPM, Pressure, Coms, Video, BHP)
• Only one person making the calls
Kill Spread

Frac Spread
7600 HP

2000 HP

1600 HP

2000 HP
Surface Intervention
THE End
Any Questions?