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Liner Drilling: A Simple Solution to Complex Drilling Challenges

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Weatherford
Outline

• What is liner drilling?
• Why liner drilling?
• Liner drilling applications
• Liner drilling systems
• Engineering considerations
• Case histories
• Summary
What is Liner Drilling?

- Liner replaces the conventional BHA*.
- Provides hydraulic energy to bit.
- Provides mechanical force to the bit.
- **Liner drills and cases well in single trip**

*Bottom Hole Assembly*
Liner System Basics

• Casing string set below the wellhead.
• Can be set on bottom
• Can be hung off with liner hanger assembly.
• Many configurations to meet well demands.
• Cemented or uncemented.
Liner drilling is very similar to conventional drilling methods in that the liner **is the BHA**.

Liner drilling **success** is determined by how the liner BHA and wellbore **are managed**.
Why Liner Drilling?

• Get liner to total depth
• Mitigate:
  – Losses
  – Wellbore instability
  – Depletion
  – Pressure transition intervals
• Keep every foot drilled
• No rig modifications
• One trip to drill and case
Non-Retrievable Liner Drilling Systems

- Simplest and most common
- Ability to cement when reaching total depth (TD)
- Inability to change direction
- Cased-hole logs

![Diagram of Liner Hanger/Packer assembly, Float Collar, Stabilizer, Casing Bit, Centralizer, Annular Casing Packer (ACP)](Courtesy Weatherford)
Retrievable Liner Drilling Systems

- Directional drilling capability
- Logging while drilling
- Multiple trip capability
- Unable to cement when reaching TD

Diagram labels:
- Setting Tool
- Inner Tool String
- Liner String
- Pilot BHA for Directional Control
- Reamer Bit for Hole Enlargement

Courtesy Baker Hughes
Connection Design for Liner Drilling

- Proven in liner drilling or casing drilling applications
- High resistance to compression, bending, and tensile loads
- High resistance to cyclic fatigue
- High torsional resistance
- Economic considerations
- Ensure connection integrity
Liner Drilling Systems
Design Considerations

- Directional control requirement?
- Hanger and/or packer requirement?
- How will these affect liner drilling operation?
  - Hydraulic bypass area?
  - Setting sequence?
- Is hanger setting system pressure balanced?
Liner Drilling Float Equipment

- Float collars (multiple valves)
- Poppet-valve float collar preferred
- Shoe-track requirement dictates spacing
Centralizers and Stabilizers for Liner Drilling

• Solid body centralizers with non-welded blades
• Thermal spray centralizers for tight clearances
• Centralizer and stabilizer subs
Drilling Fluid and Cementing Design

- Lost circulation material compatibility
- Cementing wiper plug system
- Single- or multi-stage cementing
- Mechanical - or RFID*-enabled intervention

*Radio-Frequency Identification
Drillable PDC* Casing Bits for Liner Drilling

*Polycrystalline Diamond Compact

Aluminum and Steel Construction

Steel Alloy Construction

Courtesy Weatherford

Courtesy Baker Hughes
## Liner Drilling Engineering Matrix

**Engineer Constraints**

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<th>Operating Parameters</th>
<th>Hydraulic Loading</th>
<th>Mechanical Loading</th>
<th>Torque and Drag</th>
<th>Helical Buckling</th>
<th>Cyclic Stress Fatigue</th>
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*Operations  *Weight On Bit  *Revolutions Per Minute
Objectives/Results:
• Isolate 17-ppg pressured shale and 2-ppg sand
• Conventional methods resulted in stuck pipe
• Exceed 6 1/2-in. hole conventional drilling limits
• 5 1/2-in. liner reamed and drilled-in 113 feet
• Isolated 2-ppg sand and 17-ppg shale
• Saved 3 ½-in. completion system
Objectives/Results:

- Isolate 60-ft. depleted sand with 9-7/8-in. liner
- 6.5 ppg pore pressure - catastrophic losses likely
- 9 7/8-in. liner drilled 306 feet with total losses
- 9 7/8-in. x 14-in. annulus kept full
- Isolated depleted sand
- Maintain 36° inclination over 306-ft. interval

Ref: SPE-170290
Romania Land Application

Objectives/Results:
• Isolate a salt creep interval with 7-in. liner
• Salt movement prevented liner installation
• Conventional methods resulted in 3 sidetracks
• 7-in. liner was drilled in 17 meters through salt
• 8m salt section isolated with 7-in. liner

Ref: SPE 184626
Offshore Indonesia

Objectives/Results:
- Isolate fractured lime loss interval with 7-in. liner
- Conventional methods resulted in two sidetracks
- 7-in. liner drilled in 349 feet with total losses
- 7-in. x 9-5/8-in. annulus kept full
- Maintain 67° inclination

Ref: SPE/IADC 118806
Offshore Mexico

Objectives/Results:
• Isolate unstable shale with 9 5/8-in. liner
• Multiple stuck pipe events due to shale collapse
• 9 5/8-in. liner drilled in 266 feet without losses
• Liner set in caprock overlying fractured lime
• Maintained 75° inclination

Ref: SPE/IADC 105403
Key Takeaways For Liner Drilling

- Drilling hazards can be mitigated in a single trip.
- No rig modifications are required.
- Losses are more manageable than with conventional drilling.
- **ONE TRIP TO DRILL AND CASE THE HOLE**
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