

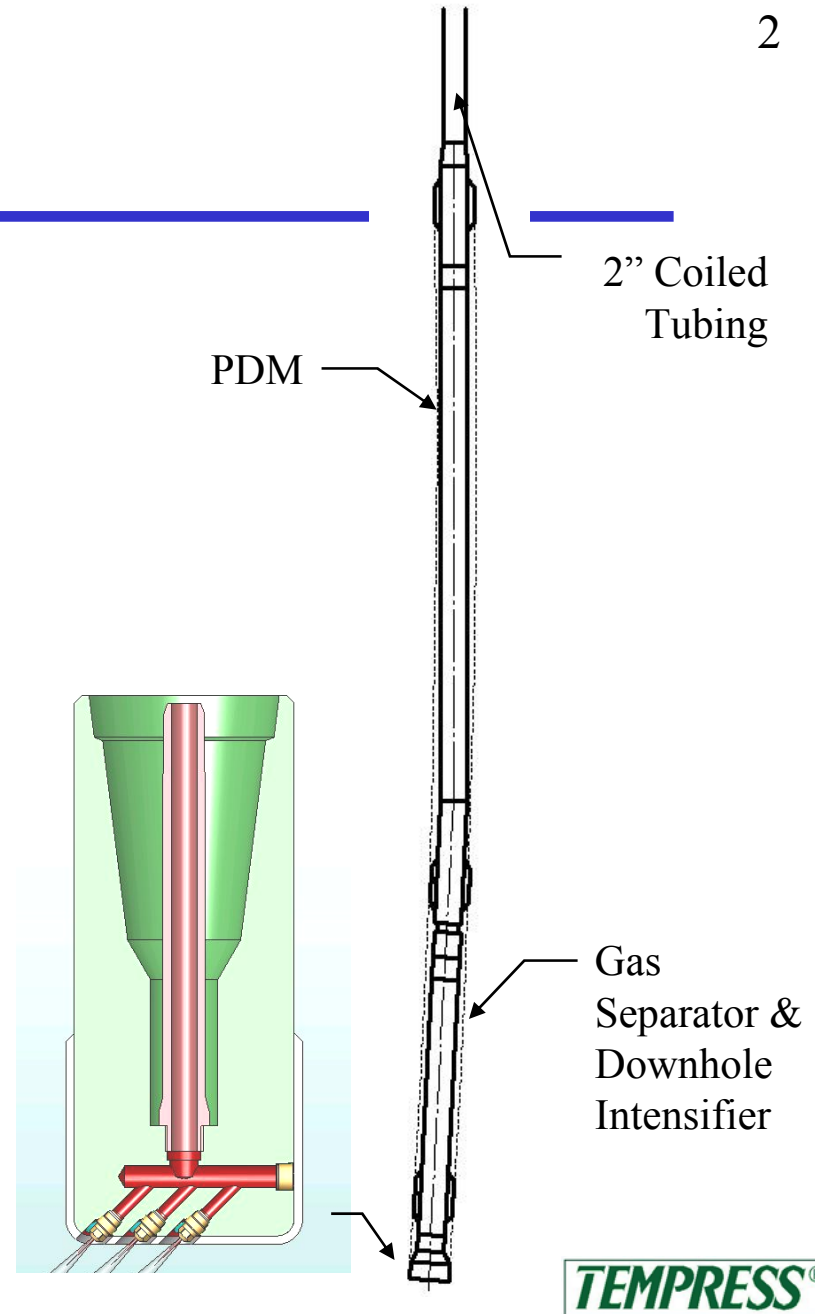


Mechanically-Assisted Jet Drilling

Presentation for
U.S. Department of Energy Microhole Program
Integration Meeting
August 17, 2005

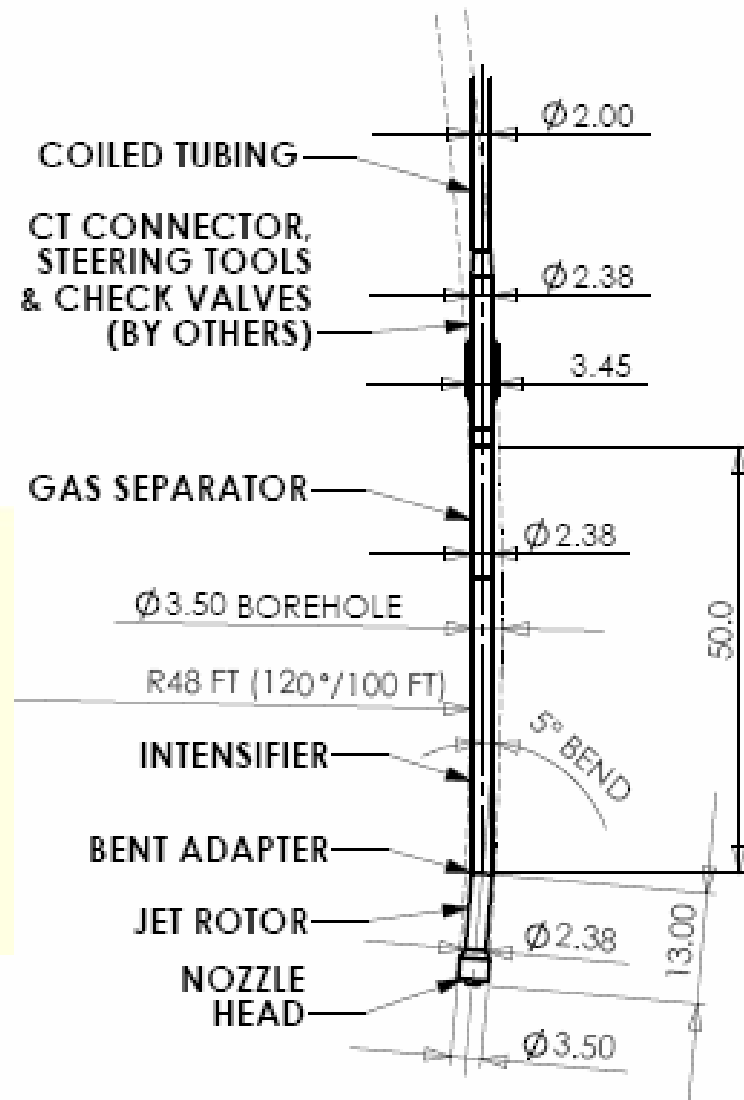
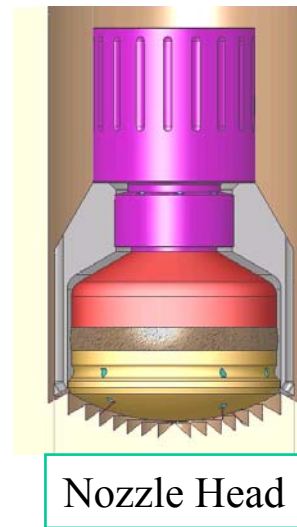
Mechanically-Assisted Jet Drilling

- ◆ Downhole motor
 - Modified for 30 MPa (4350 psi) operation
- ◆ Gas Separator
 - Removes gas from fluid
- ◆ Downhole intensifier
 - Boosts pressure from 30 to 70 MPa (4350 to 10,000 psi)
- ◆ Mechanically-assisted jet bit
 - Gas-shrouded fluid jets cut the rock for fast drilling
 - Diamond cutters for hard rock stringers



Pure Jet Drilling

- ◆ Compact BHA
- ◆ Ultra-short radius (120°/100 ft) curves

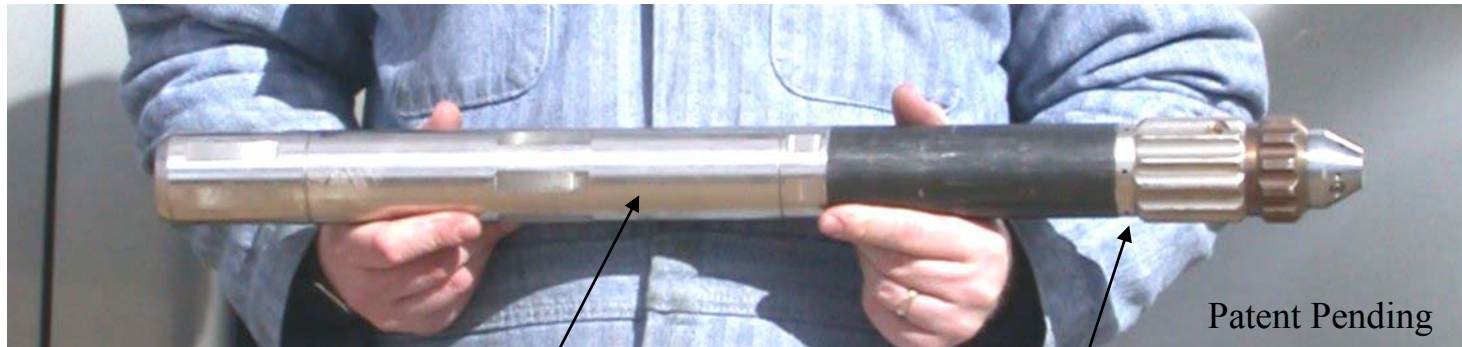


Jet Drilling Benefits

- ◆ High-Power Gas-Shrouded Jetting
 - Reduced bit weight and torque
 - Faster drilling – 5x conventional rates
 - Increased lateral reach – 25% increase
- ◆ Downhole phase separation
 - Reduced BHA vibration
 - Underbalanced motor drilling
- ◆ Compact BHA (pure jet drilling)
 - Ultra-short radius drilling at 5 to 30 m/hr
 - Limited to permeable producing formations

Prototype CT Gas Separator

- ◆ 2-inch diameter
- ◆ Under 1% gas cut from co-mingled water & nitrogen

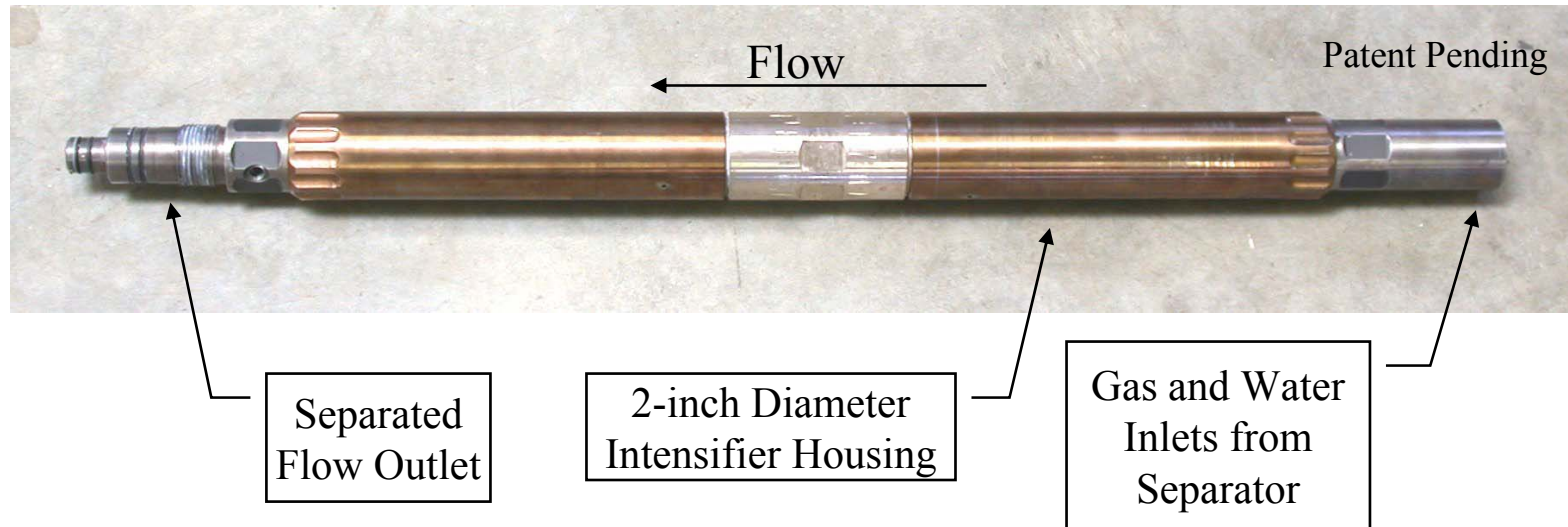


Gas
Separator

Gas-Shrouded
HydroMill™

Prototype CT Intensifier

- ◆ 2.5:1 Intensifier Ratio
- ◆ 100 MPa (14500 psi) maximum pressure output
- ◆ 2-1/8 inch diameter / 36-inch long



Integration Issues

- ◆ Hole Size
 - 89-mm (3-1/2-inch)
- ◆ Pump Capacity
 - 28 MPa (4000 psi) surface pressure
 - 100 to 200 lpm (25 to 50 gpm) fluid
 - 10-15 scmm (350-500 scfm) nitrogen
- ◆ Fluids
 - Clear fluids: water, polymer mud or solvents
 - 200 and 100 micron bag filter manifold on pump inlet
 - 175 micron downhole screen
- ◆ Coil
 - 2-inch diameter / .188-inch wall
 - 2400 m (8000 ft) maximum length
- ◆ Steering tools
 - 30 MPa (4350 psi) differential pressure