



Counter-Rotating Tandem Motor Drilling System (CRTMDS)

**Strategic Center for Natural Gas and Oil
National Energy Technology Laboratory
U.S. Department of Energy**



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DOE Project Goals

Develop Microhole Technology to Reduce Cost of E&P Down to 5000 ft. in Wellbores as Small as 3-1/2”

- > Evolutionary Advance Over Existing Technology**
- > High Penetration Rate Drilling System Suitable for drilling 3-1/2” Boreholes Using Coiled Tubing**

Specific Goals of Counter Rotating Tandem Motor Drilling System (CRTMDS)

- > Develop and Test CRTMDS**
 - Evaluation of 2-5/8” Tool for LANL
 - Design & Manufacture 3-1/2” Tool for DOE
- > Drill 3-1/2” Wellbore on Coiled Tubing**
 - High Rate of Penetration (ROP)
 - Low Weight on Bit (WOB)
 - Low Reactive Torque

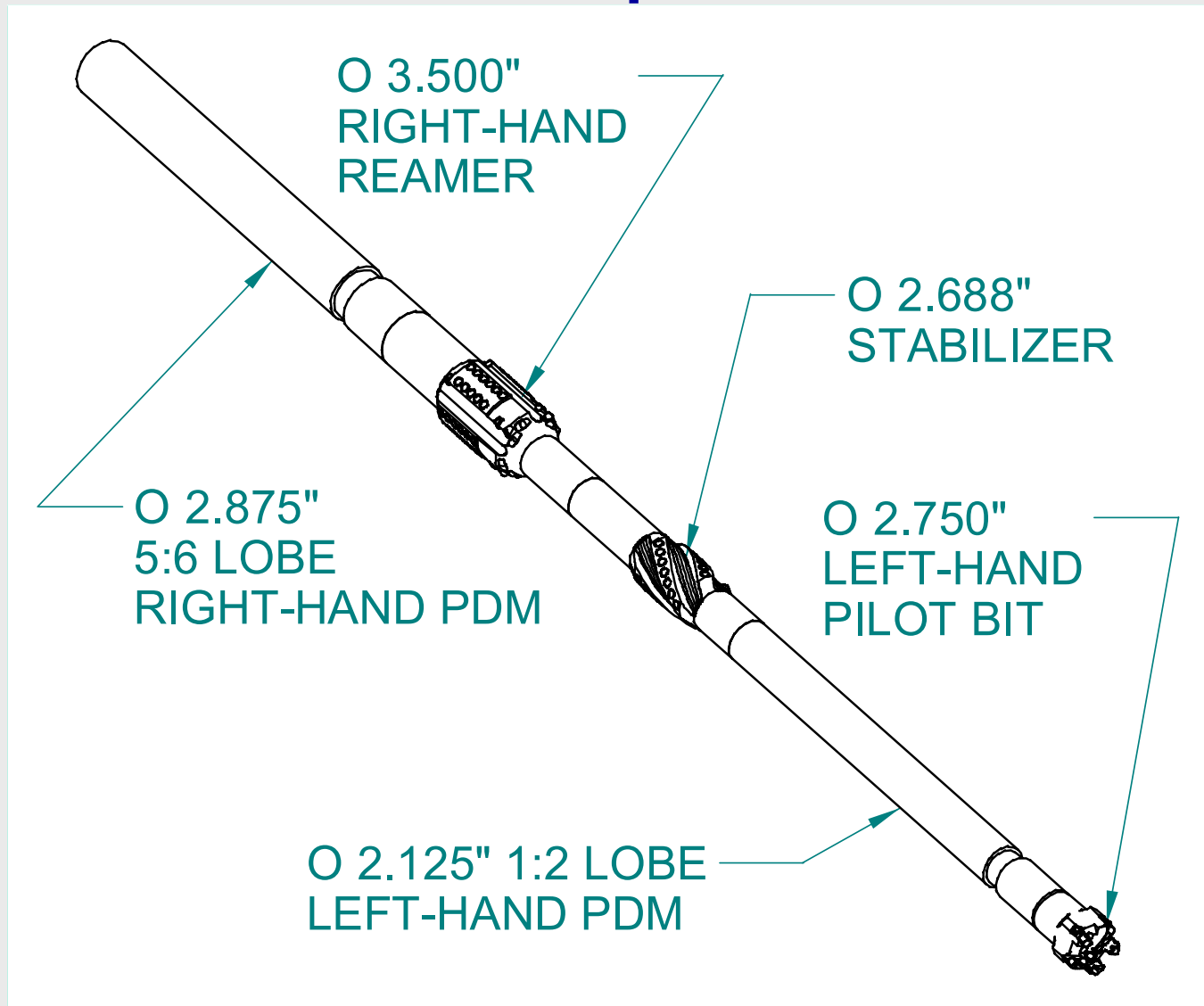
Background

- > **High ROP is normally associated with:**
 - Aggressive drill bits,
 - High rotary speed,
 - High WOB
 - High Torque
- > **Small coiled tubing units have very limited WOB and torque capabilities**
- > **CRTMDS combines a counter-rotating pilot bit and reamer to:**
 - Drill with low WOB
 - Reduce reactive torque transmitted to coiled tubing

Features of CRTMDS

- > Small diameter left-hand PDC pilot bit driven by a left-hand turning positive displacement motor (PDM) drills a small pilot hole**
- > 3-1/2" PDC reamer with integral stabilizer is run in tandem and is powered by a right-hand turning PDM**
- > Premium PDC cutting inserts manufactured with advanced microwave-sintered carbide substrates**

3-1/2" CRTMDS Components



Benefits of CRTMDS

- > **Low WOB Requirement**
- > **High ROP**
- > **Counter-Acting Torques from LH Pilot and RH Reamer Result in a Net of Near Zero Reactive Torque Transmitted to the Coiled Tubing**
 - **Required for Small Diameter Coiled Tubing**

Benefits of CRTMDS

- > **Small Diameter LH Pilot Bit Drills With:**
 - Higher ROP
 - Less WOB than a Conventional Bit
- > **Pilot Bit Drills Ahead of Reamer**
 - Relieves some of the rock's compressive stress near the periphery of the hole
- > **Improved Drilling Efficiency Due to Reamer Drilling rock in an “Unconfined” State**

Benefits of CRTMDS (cont.)

- > **Enables use of higher torque PDM's**
 - Improves ROP
 - Maintains torque limitations of the coiled tubing
- > **Improved tool life and less frequent bit changes from advanced cutters**
- > **Estimated to drill as much as:**
 - 25-60% faster than conventional bits

LANL 2-5/8" Tool



2 5/8"
Reamer



Flow
Diverter



2 1/8" Bit

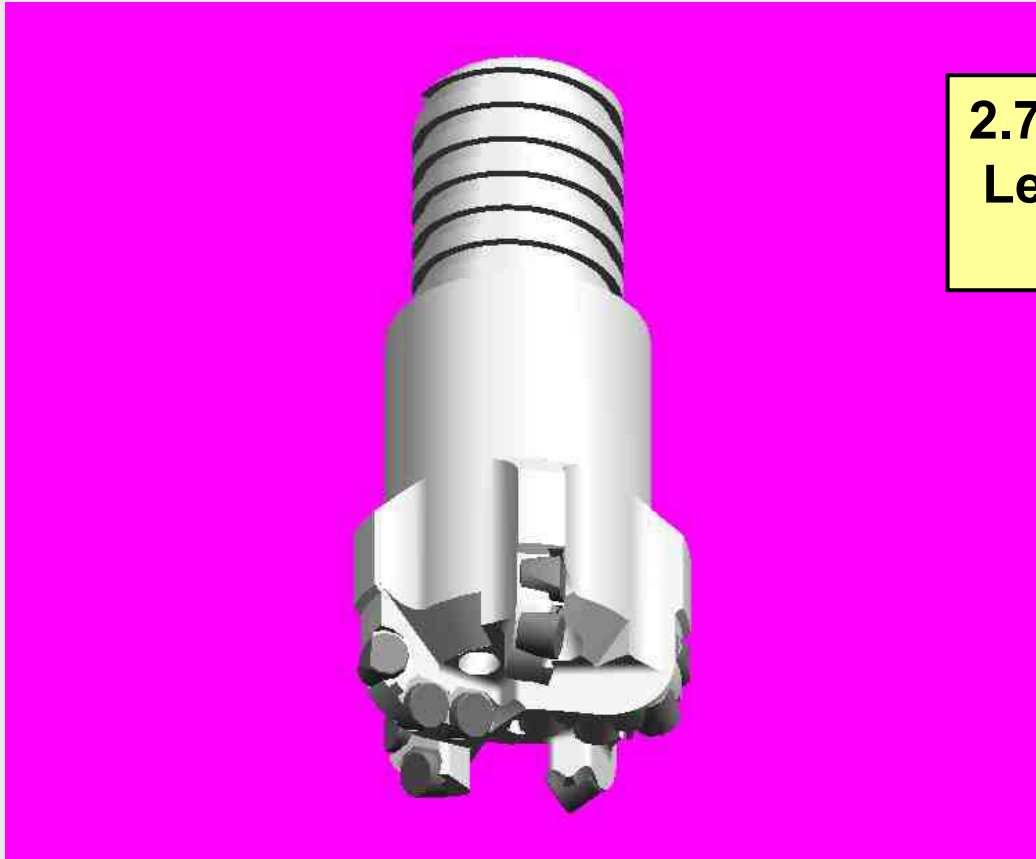
Results of LANL Evaluation (2-5/8")

- > **September 2005 Field Test**
 - RMOTC near Casper, WY
 - 1" CT Unit (1650 ft) with 5000 psi Capability
- > **High ROP**
 - 2-5/8" CRTMDS Averaged 82 ft/hr
 - Conventional 2-5/8" PDC Bits Average 10-30 ft/hr
- > **Fast Drilling with Low Weight (~700 lbs.)**
- > **Low Vibration of CT at Surface**
 - Possible Indication of Low Reactive Torque
- > **Top Sub of Left-hand PDM Backed Off**
 - Testing Halted After Drilling 130 ft in 1.58 hours

Design Changes Based on LANL Evaluation

- > Ratio of Pilot Bit Size and Reamer Size Resulted in Good Drilling Performance**
 - 2-5/8" LANL Tool has 2-1/8" Pilot and 2-5/8" Reamer (0.81 Ratio)**
 - For 3-1/2" CRTMDS Change Pilot Bit Size from 2-1/4" to 2-3/4" (0.79 Ratio)**
- > 2-3/4" Pilot Bit Allows for Larger LH PDM**
 - Left-hand PDM Size Increased from 1-11/16" to 2-1/8"**
- > Right-hand PDM Size Changed**
 - Increased from 2-3/8" to 2-7/8"**
- > Modify Connections to Prevent Backing Off**

2-3/4" Left Hand Pilot Bit



**2.750" PDC Pilot Bit
Left Hand Rotation
800 RPM Net**

**At 45 gpm, the 2-7/8" PDM and right-handed reamer will rotate at 200 rpm.
the left-hand 2-1/8" PDM will rotate at about 1000 rpm to the left.**

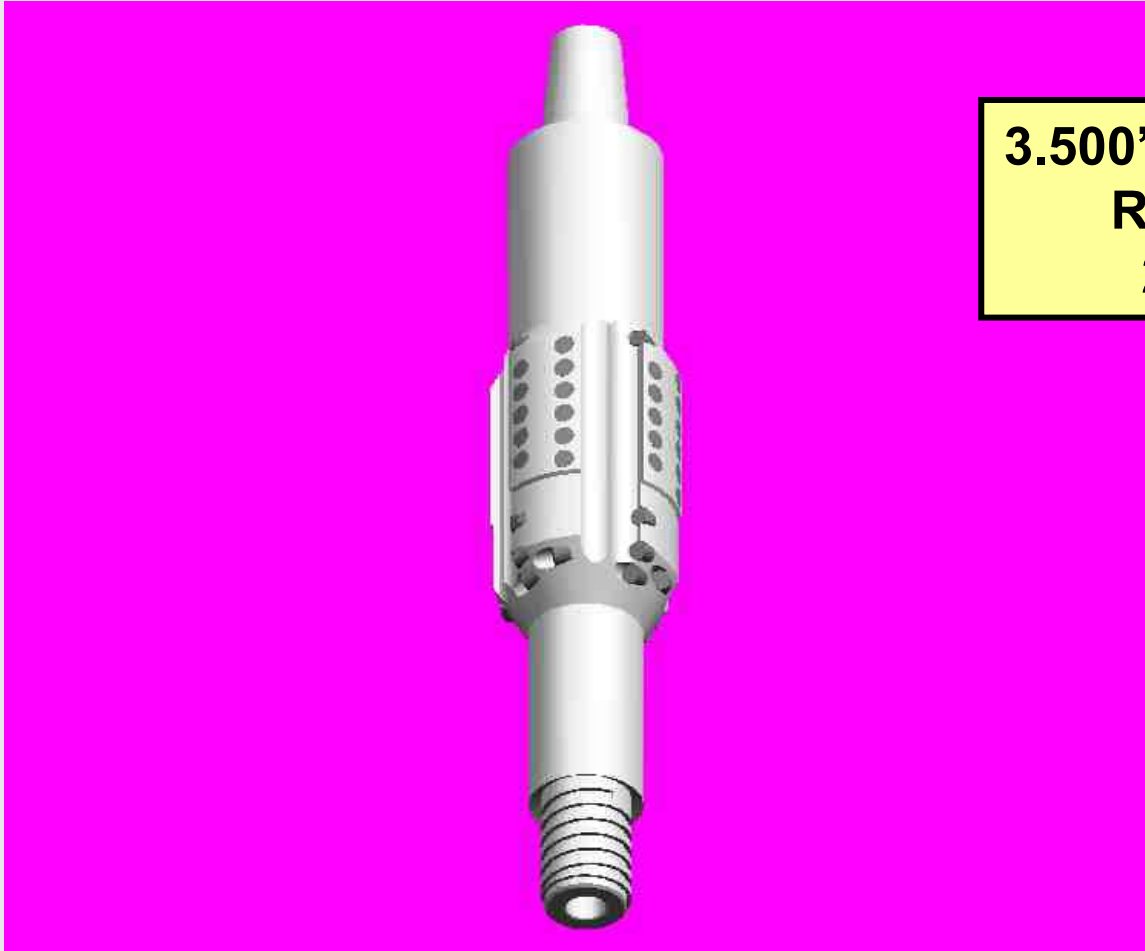
Spiral Stabilizer



**2.688" Spiral Stabilizer
Right Hand**

**Used Primarily to Guide
Reamer**

3-1/2" Right Hand Reamer



**3.500" PDC Reamer
Right Hand
200 RPM**

Progress Update

- > **Similar, Smaller 2-5/8" Tool was Built and Evaluated for LANL at RMOTC**
 - **ROP 2X - 8X Faster than 2-5/8" PDC Bits**
- > **DOE Approves 3-1/2" CRTMDS Prototype**
- > **2-1/8" Left-hand PDM - Completed**
- > **2-3/4" Left-hand PDC Pilot Bit - Completed**
- > **2-11/16" Stabilizer - Completed**
- > **3-1/2" PDC Reamer - Completed**

Future Plans

- > **Field Test Scheduled for August 30, 2006 at GTI-Catoosa Test Facility near Tulsa, OK**
- > **Evaluation of Field Test Results with Recommended Improvements**
- > **Implement Drill System Improvements (as allowed)**
- > **Field Test at GTI Catoosa Test Facility**
- > **Tech Transfer and Final Report**

CRTMDS Project Schedule			
	Feb	X	Concept Development
	Mar	X	
	Apr	X	
	May	X	Detailed Design
	Jun	X	
2005	Jul	X	
	Aug	X	NPTO and Integration Meeting, LANL Tool Test
	Sep	X	LANL Data Analysis - CRTMDS Design Mods if Req'd
	Oct	X	Go/No Go for CRTMDS Fabrication
	Nov	X	Tool Fabrication Begins
	Dec	X	
	Jan	X	
	Feb	X	
2006	Mar	X	
	Apr	X	
	May	X	
	Jun	X	
	Jul	X	
	Aug		Testing and Evaluation Begins at GTI Catoosa Facility
	Sep		Technical Presentation
	Oct		Journal Article
	Nov		
	Dec		
2007	Jan		Gas TIPS Article
	Feb		
	Mar		
	Apr		Final Report, Workshops, Review with DOE