



East TX Gas Producers Association

Panola College, Carthage, TX

May 18, 2010

Multi-Stage plungers in East Texas Cotton Valley

Christian Click, Production Engineer

Chevron

Outline

- **Overview of Beckville field**
- **Current artificial lift**
- **Multi-stage versus single-stage plunger**
- **Downhole setting tool**
- **Candidate selection**
- **Issues surrounding multi stage plungers**
- **Economics**
- **Results**

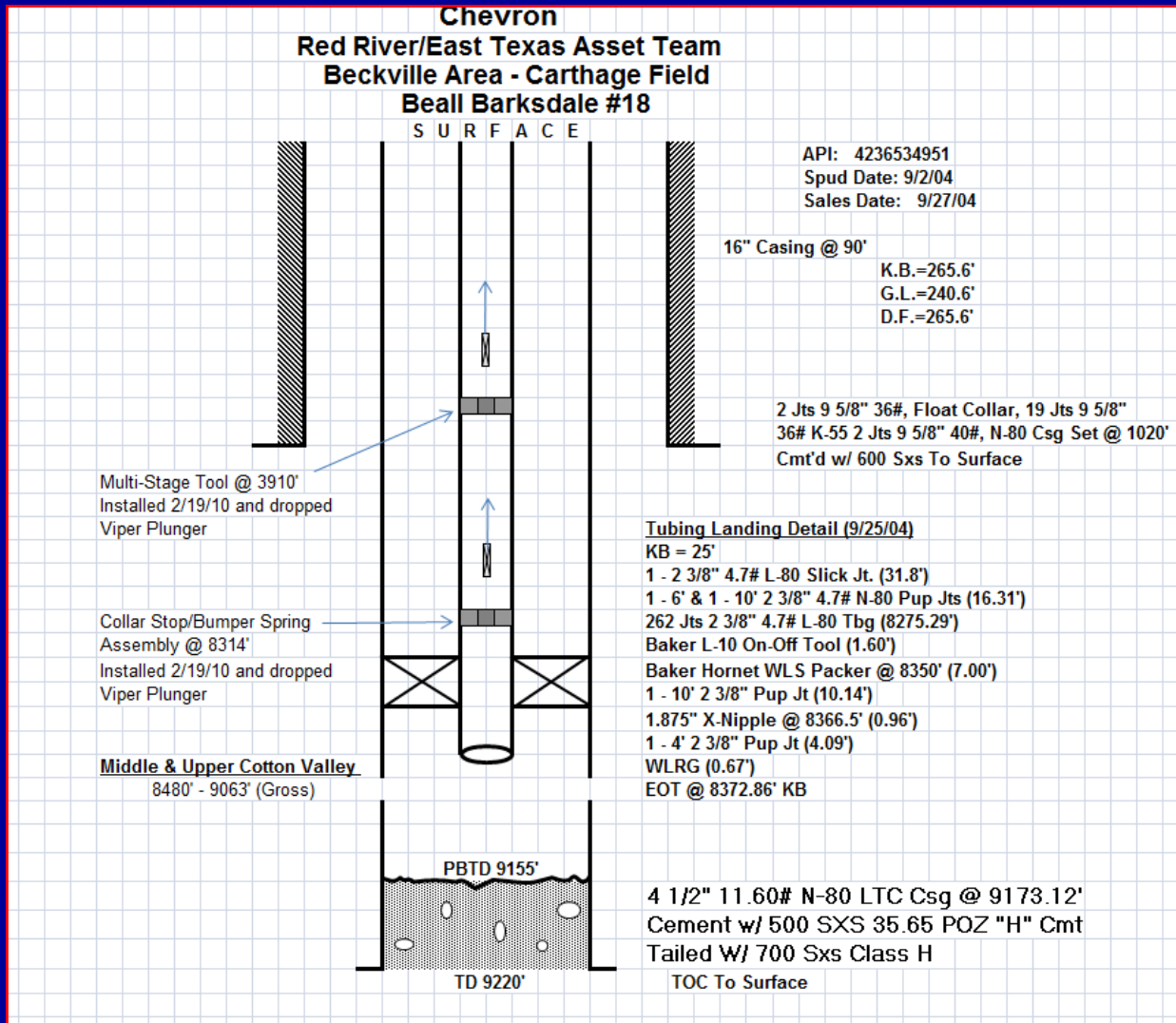
Overview of Beckville Field

- **4 producing Reservoirs**
 - **Pettit**
 - **Carbonate**
 - **Travis Peak**
 - **Tight sandstone, high perm streaks**
 - **Cotton Valley**
 - **Tight sandstone**
 - **Haynesville**
 - **Shale gas**

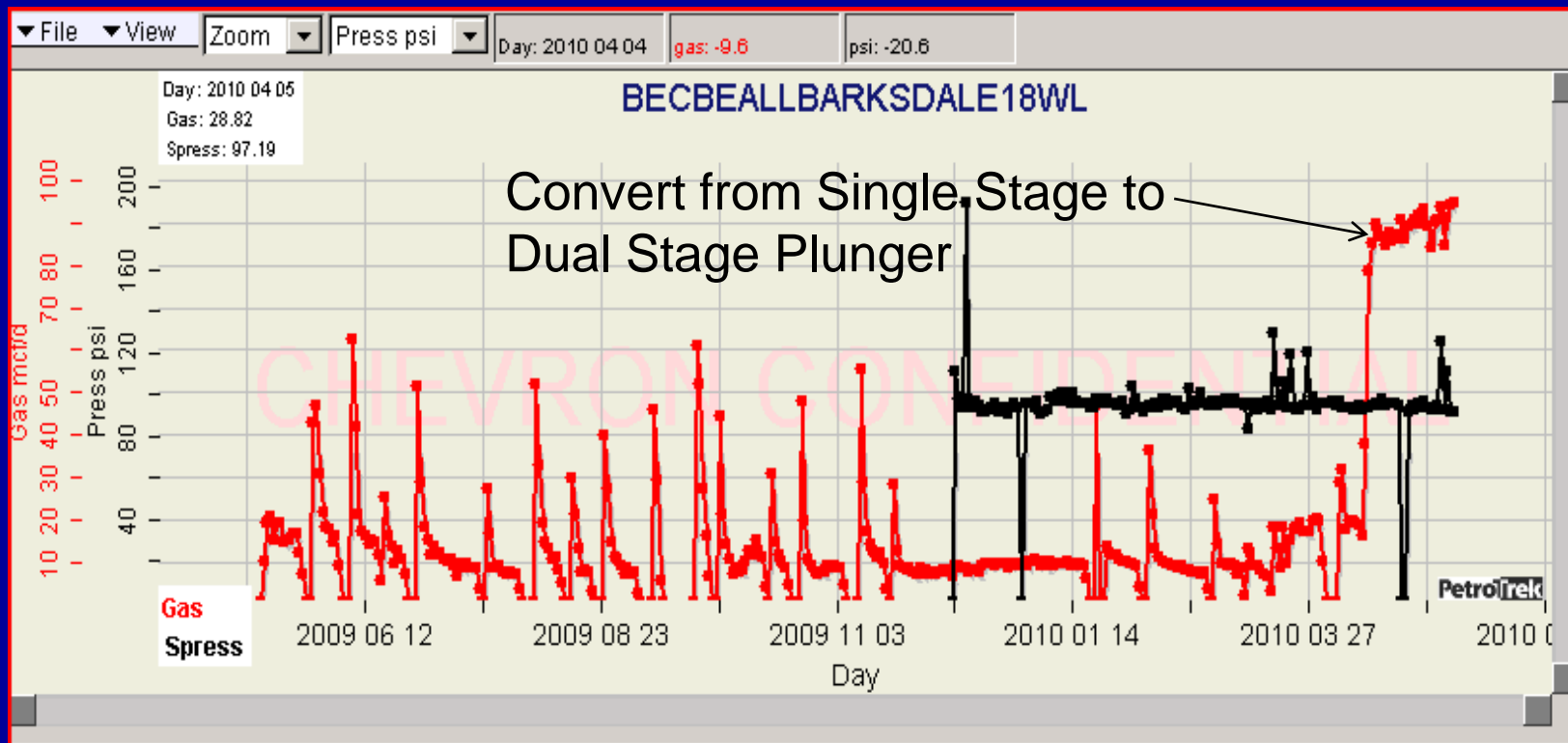
Overview of Beckville Field

- **~ 420 Wells**
 - **~364 Cotton Valley**
 - **~32 Travis Peak**
 - **~23 Pettit Wells**
 - **1 Haynesville Well**
- **Typical Completion**
 - **Packer within 100' of TOP**
 - **2-3/8" tubing string w/ on/off tool**
 - **EOT @ +/- 8500'**
 - **Twice as many 4.5" as 5.5" production casing**
 - **~1300' of net perforations down to ~ 9700-9800'**

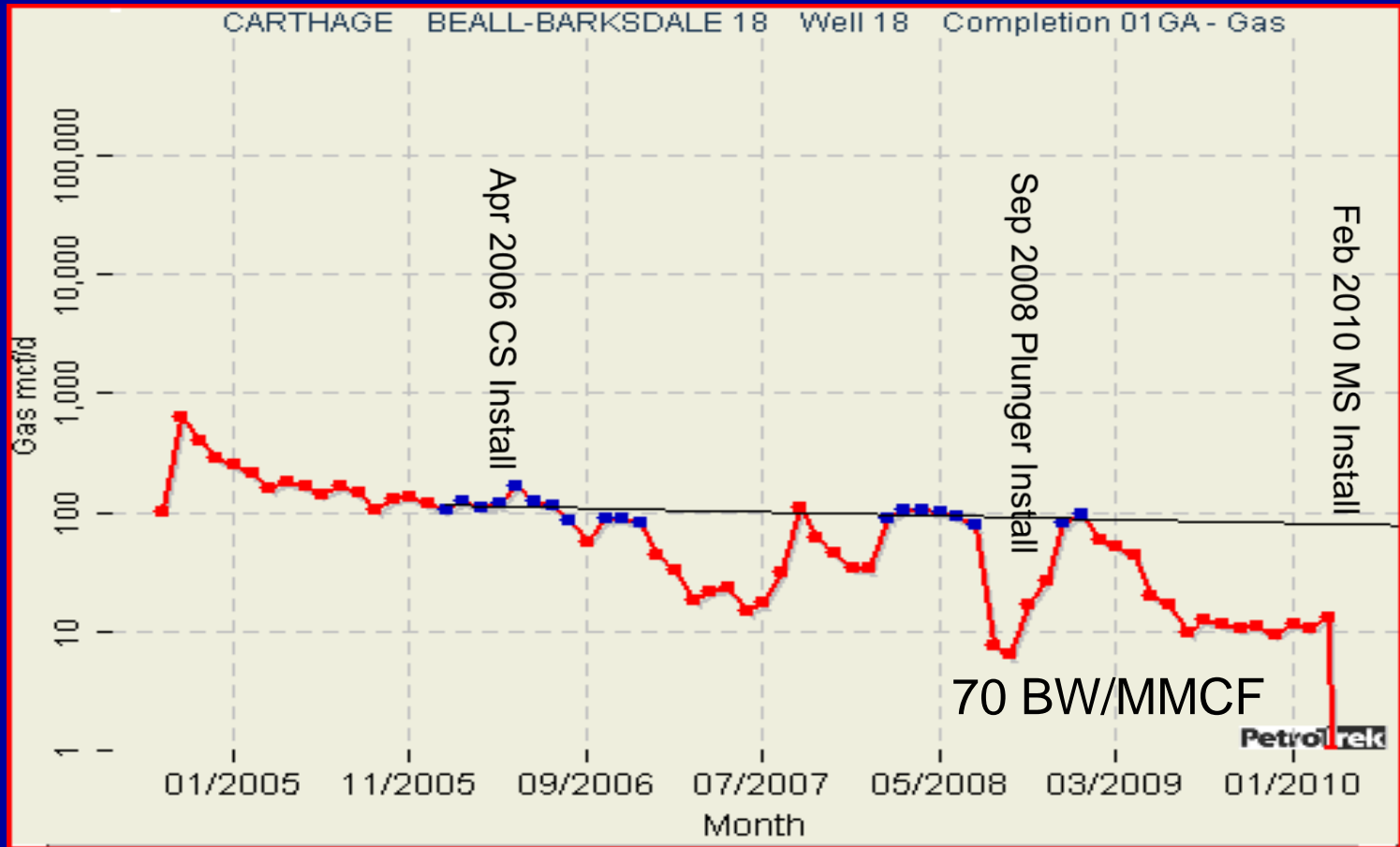
Typical Cotton Valley WBD



Beall Barksdale #18 Daily Production



Beall Barksdale #18 Monthly Allocated Production



Current Total Artificial Lift in Beckville

History

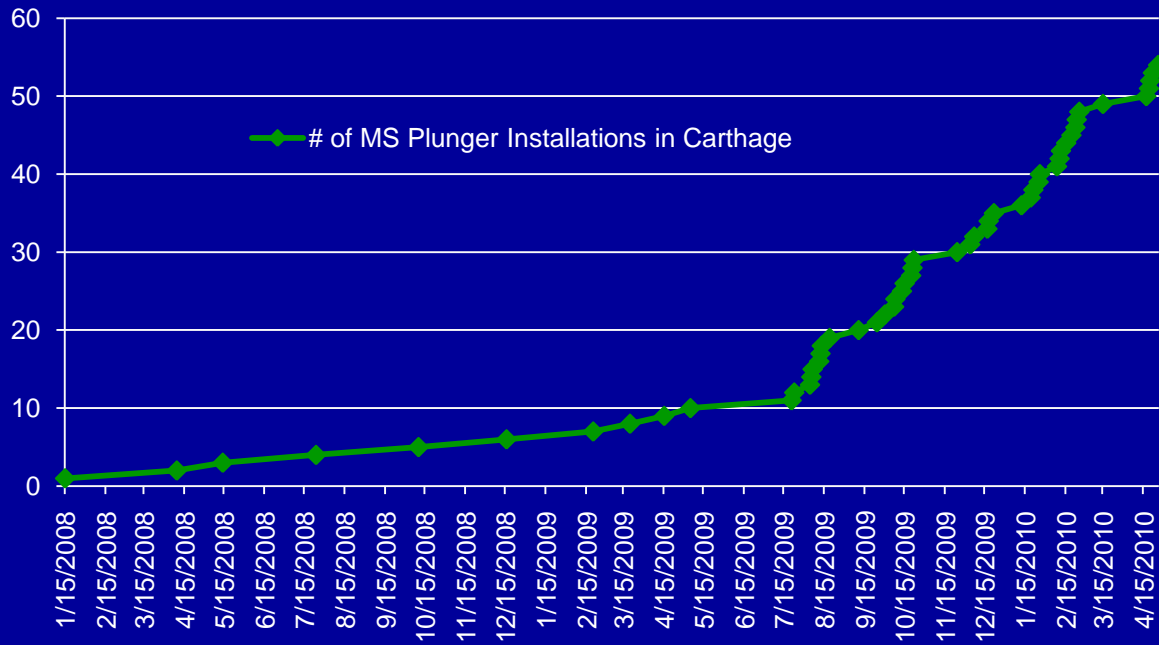
- Ran capstrings in high water yield wells (>100 BW/MMCF) and single stage plungers in low water yield wells (<100 BW/MMCF)
- 1.25" Velocity strings have been tried with little success
 - Friction effects are greater than the increase in velocity up smaller diameter pipe

Current

- 125 Single Stage Plungers
- 114 Capstrings
 - Capstrings have been very effective but have started to fail @ <100 mcf/d
 - In turn, we have pulled many capstrings
- 45 Multi-stage (MS) plungers in Beckville with 7 Pending
 - 4 are 2 7/8" slimhole installations with 1 more pending
 - 10 MS Plungers in Deadwood Field (3 are 2 7/8" slimholes)
- 34 Pumping Units in Pettit & Travis Peak
- 98 Wells W/O Artificial Lift
- 4 Wells on Gas Lift
- Potential ESP install in a horizontal CV well with high water production

Carthage MS Plunger Installations vs Time

of MS Plunger Installations in Carthage vs Time



Mechanics of Single Stage versus Dual Stage plunger

• Similarities

- Both have lubricator to catch plunger at surface
- Both tools use f-type stop to set tool
 - Retracted when RIH and expand when pull up and set in collar
 - Beat down to set seals
- Both have shut-in and after-flow time settings
- Both are retrieved and set via slickline
- Both take time to get proper SI/BU time settings
 - Every well requires different amount of time for SI to cycle plunger due to fluid yields, production rates, pressures, etc.
 - After-flow time depends on how long SI time is
 - If SI time is short, after flow time is long because well can cycle easily
 - If SI time is long, after flow time is short to prevent even longer SI times to trip the plunger

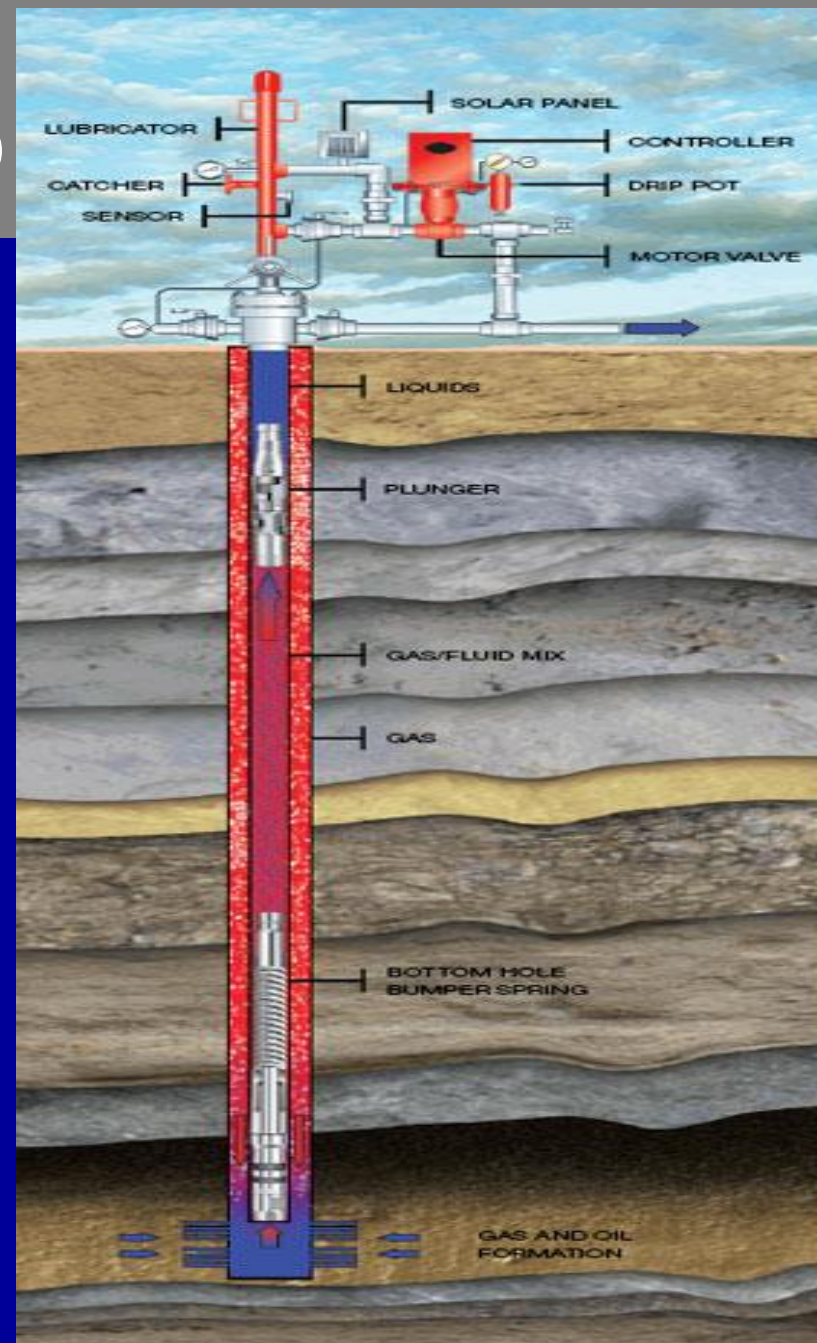
Mechanics of Single Stage versus Dual Stage plunger

• Differences

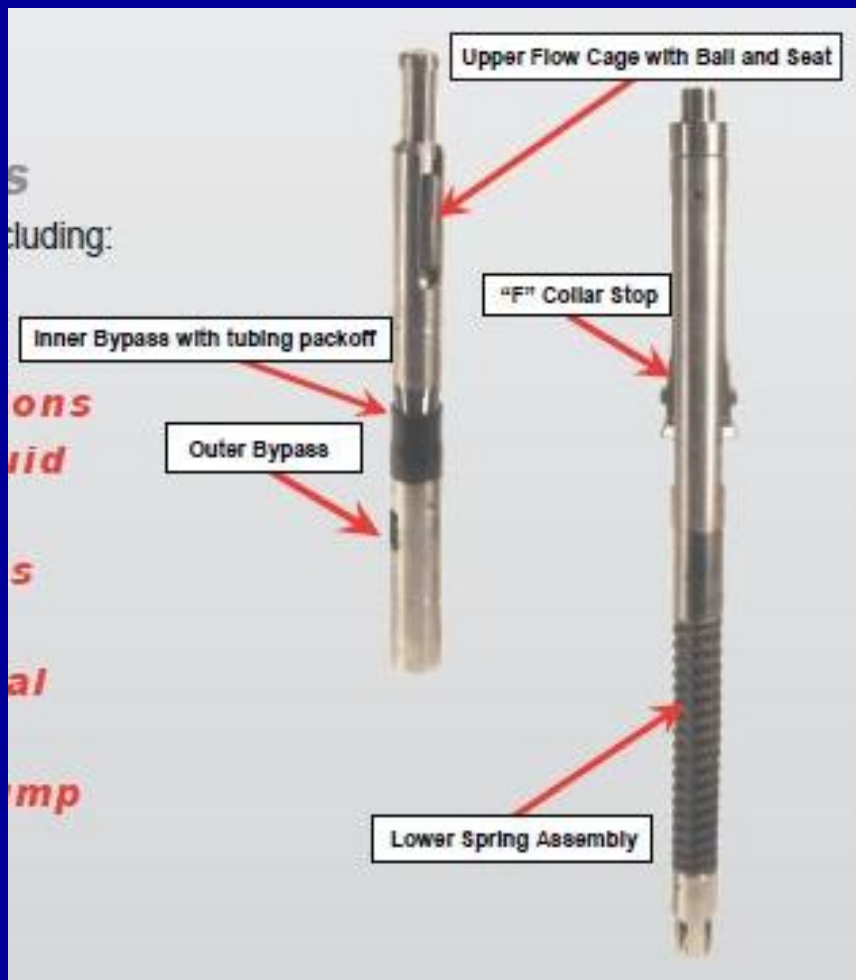
- **Operational limits**
- **Dual stage has a multi-stage setting tool halfway between the bottom collar stop/bumper spring and the surface**
- **More junk in the hole = more severe fishing operations**
 - **6 month PMs have prevented any issues**
- **Operational settings take more time to perfect**
 - **Operators are not as familiar with the settings**
 - **More dynamic = more variables**
 - **Necessary time for both plungers to hit bottom to get adequate fluid movement**
 - **Bottom plunger will drop slower due to fluid in tubing**

Plunger Surface Setup

www.pcsplungerlift.com



Multistage Plunger Tool



www.ipsadvantage.com

Candidate Selection

- Well Tests
- Water yields
 - Single Stage:
 - Up to 150 bbl/mmscfd (avg=70-120)
 - Dual Stage:
 - Up to 300 bbl/mmscfd (avg=150-180)
 - We feel that we have not tested the upper limits of water yields
- Rates
 - The wells are typically loaded or in slug flow
 - Not often installed in wells before loading issues
 - ~50-80 mcf/d

Candidate Selection Contd.

- Swab Tests
- Maximum water recoveries (pulling from bottom)
 - Single Stage:
 - 3-4 bbl/run
 - Multi Stage
 - 4-5 bbl/run
 - This is a dramatic difference considering a MS plunger will run about every hour which can equate to a minimum of an extra 24 bbl/day of unloading
- Minimum Tail Gas Pressures
 - Single Stage:
 - Down to ~150 psi
 - Dual Stage
 - Down to ~70 psi
 - If we have a low tail gas we like to see a 1 hr. pressure buildup to ~ 300 psi
 - We have quite a large population of wells that fall into the <150 psi tail gas category which is why the MS plunger is such a great application for our field

Operating Conditions

- Shut in times Required

- **Single Stage**

- **Conventional**

- Typically 1 hour- up to 1 hr 45 min

- **Flow through (i.e. 2 piece, pacemaker)**

- 20 min. average

- Largely depends on needed time for buildup to cycle plunger

- **Dual Stage**

- **Conventional**

- $\frac{1}{2}$ the time of single stage conventional= ~30-45 min

- **Flow through**

- We have not tried flow through MS plungers

Issues with MS Plungers

- **Paraffin**

- Plunger will help keep tubing clean but takes a small friction bite to turn into a fishing job

- **Sand**

- **Single stage**

- Viper plunger can handle some sand due to spiral shape of plunger with grooves that prevent sand buildup when plunger is running

- **Dual Stage**

- We are reluctant to install a MS in a sandy well, but have some running w/ Viper Plungers
 - Inability to determine if bottom-most plunger is tripping
 - Plunger control only records arrival time of upper plunger

- **SCADA control issues**

- Operators aren't able to make adjustments when they don't have communication to the plunger screen

- **2-7/8" slimhole**

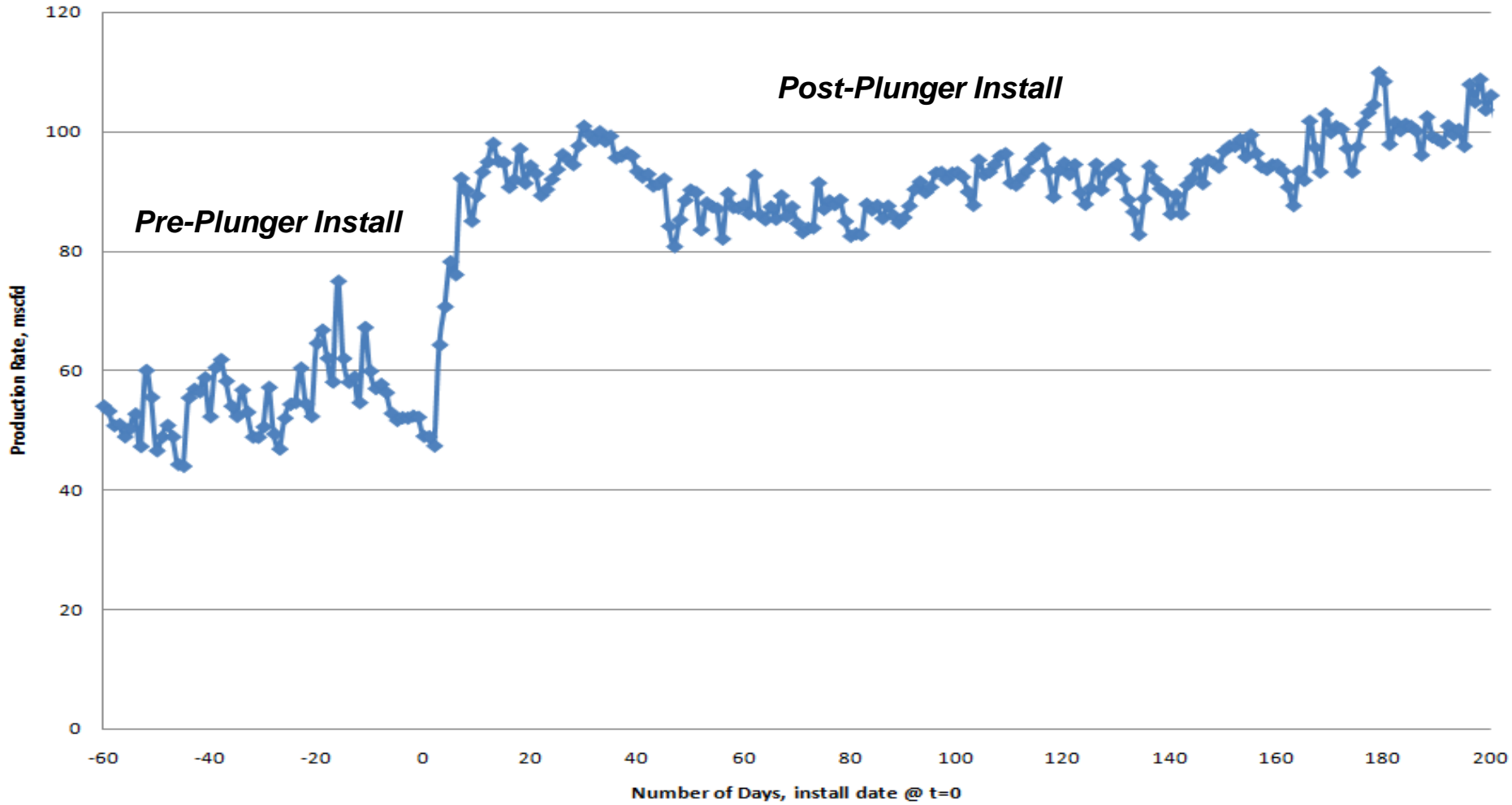
- Deadwood has seen good results with 3 installations
- Beckville has 4 installations w/ mixed results (1 is outstanding)
 - Slimhole installations require a much higher tail gas pressure to get the needed velocity to trip a plunger with a larger surface area

Expenses

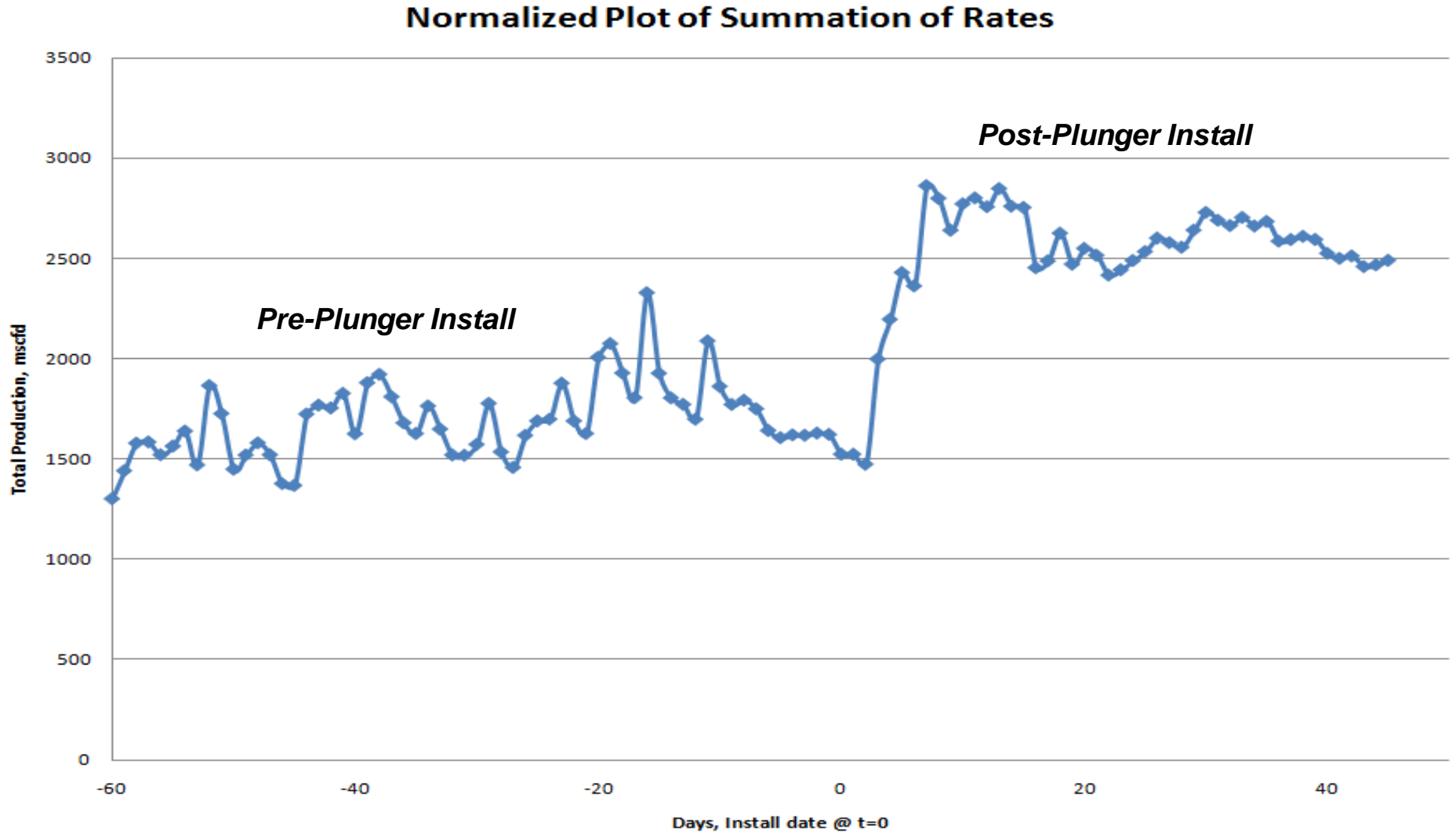
- **Installation Cost**
 - **Single stage (assuming lubricator install, SCADA and downhole reconfiguration)**
 - **\$20,000**
 - **MS Plunger (New Installation)**
 - **\$22,000**
- **Majority of MS plunger installations have been new installs**
 - **Multi stage install completed in conjunction with maintenance pull**
 - **Typically on wells w/ low flow rates that will not cycle a single stage plunger**
 - **Conversion cost <\$5000**
- **OPEX**
 - **Routine PM & Operator time**
 - **\$55/Day for Single Stage & \$66/Day for Dual Stage**

Normalized MS Plunger Chart

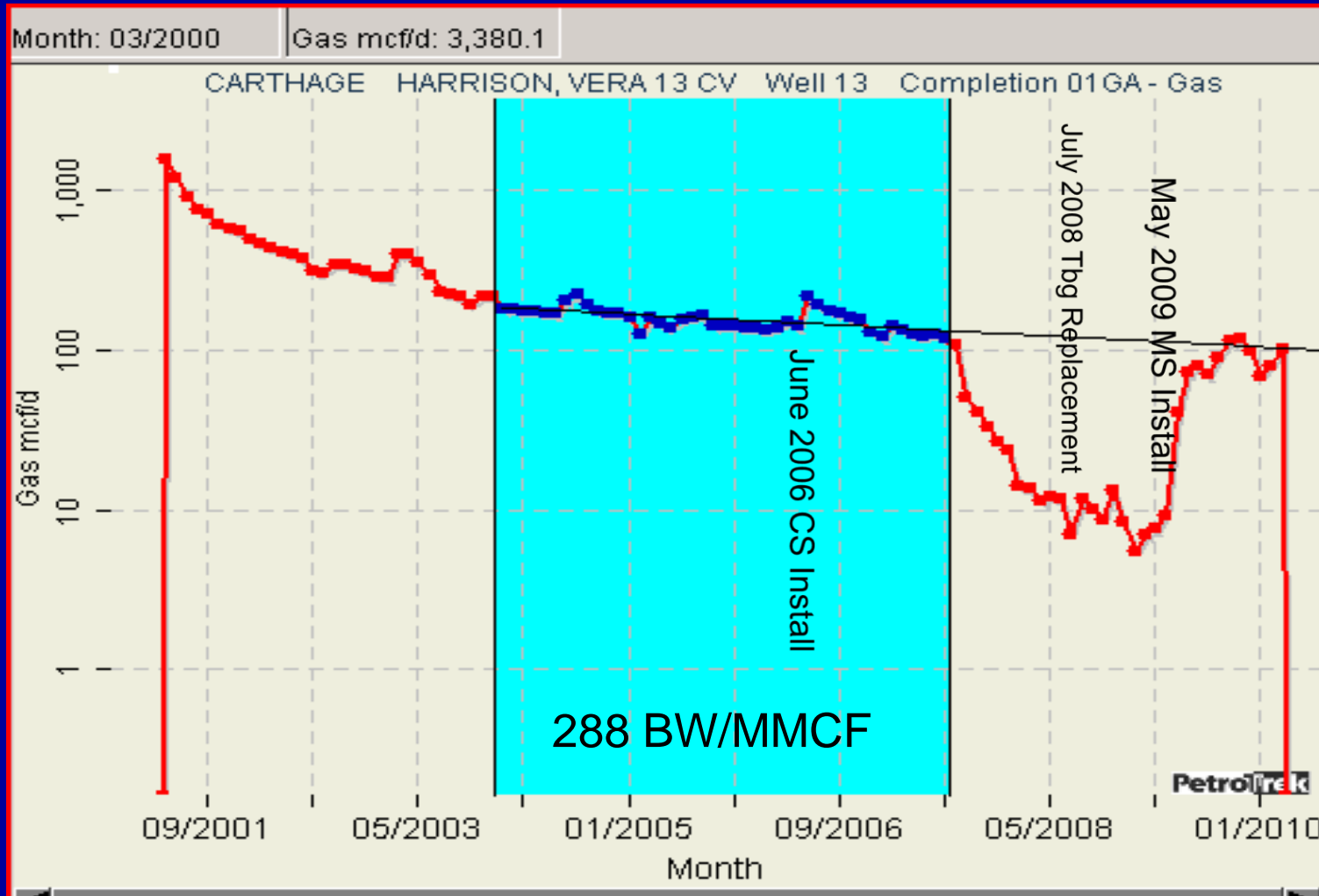
Normalized Production Plot of 31 MS Installs



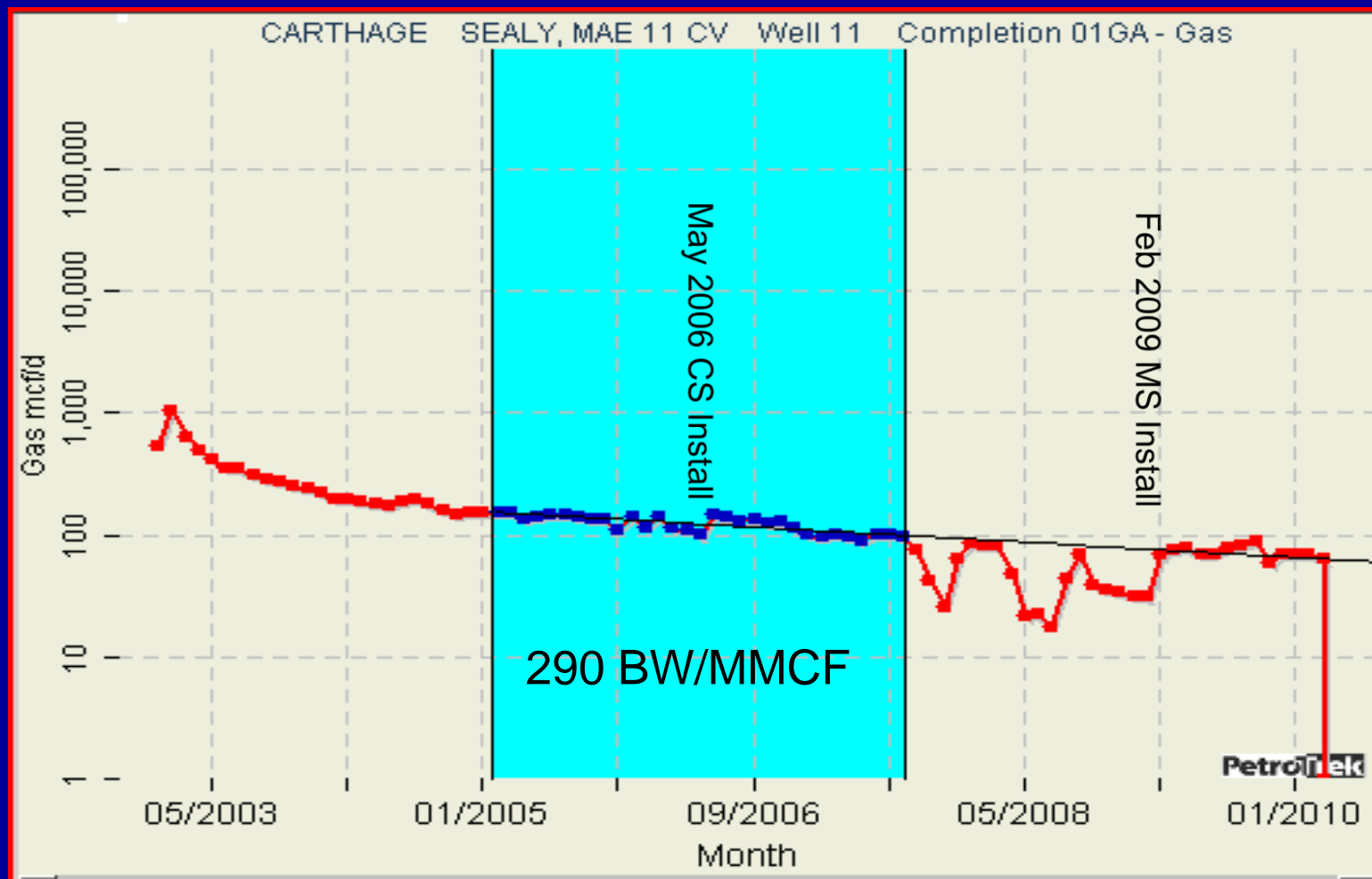
Normalized Production Sum of Plunger Installs



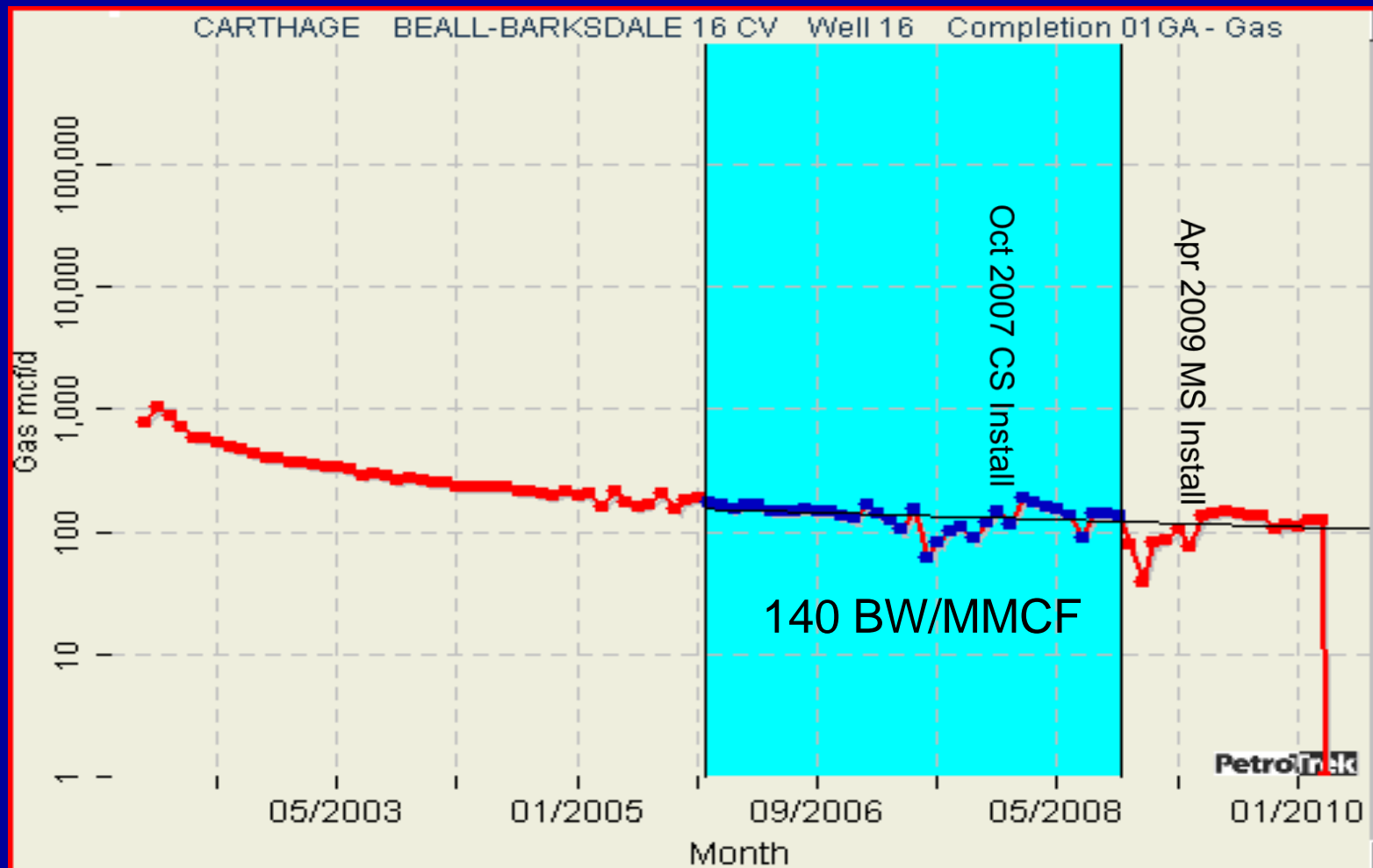
Individual Wells



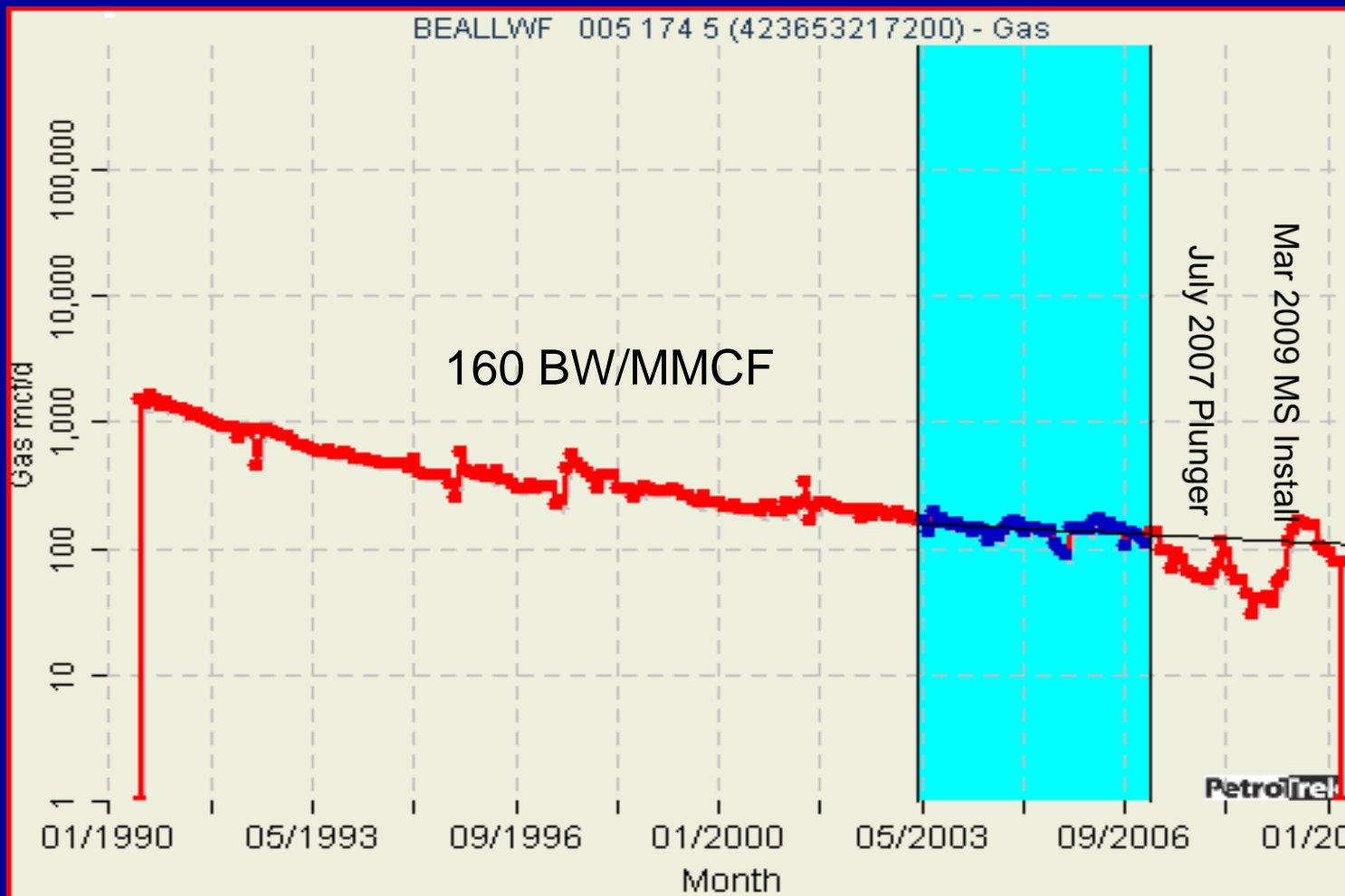
Individual Wells



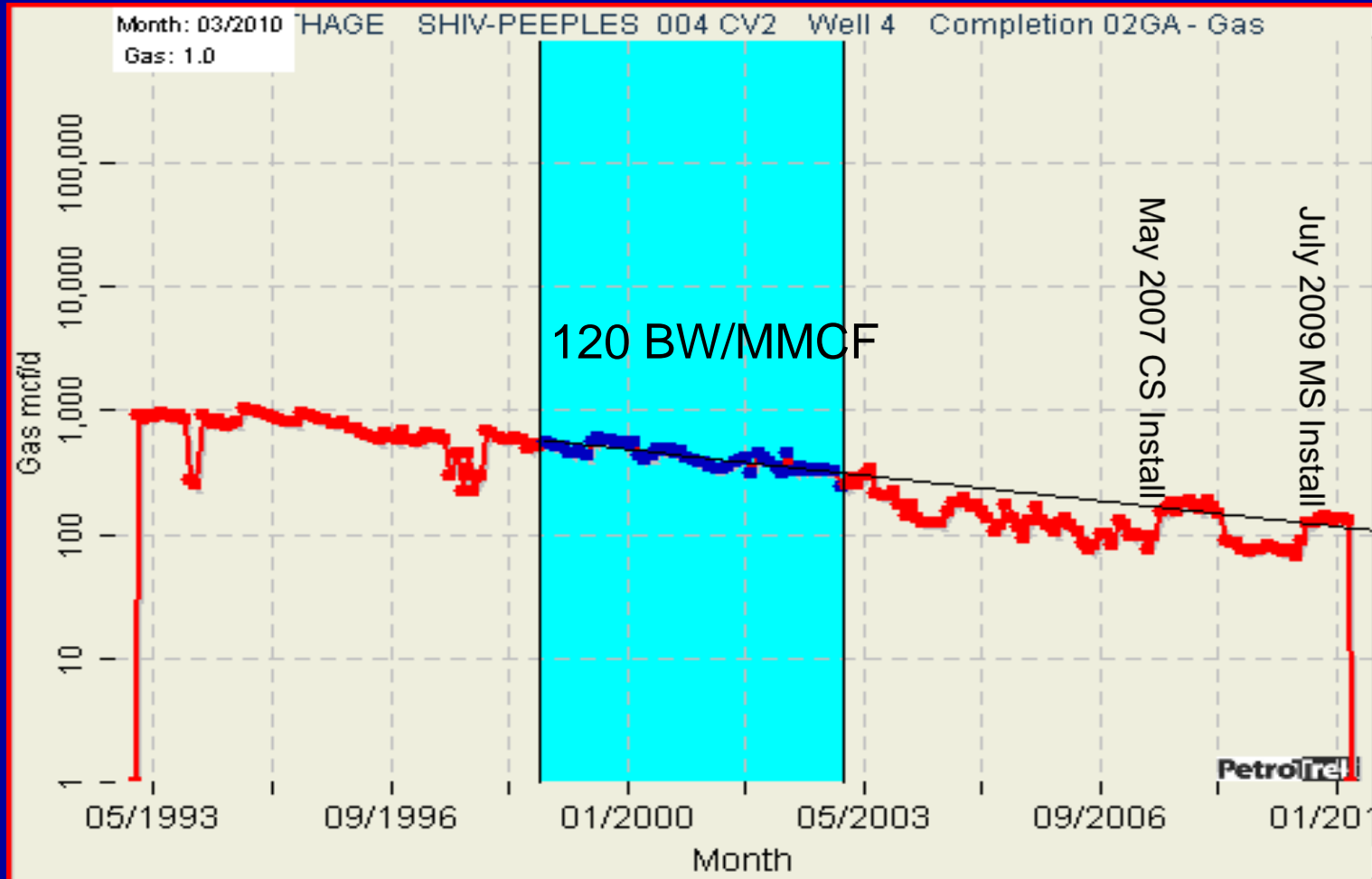
Individual Wells



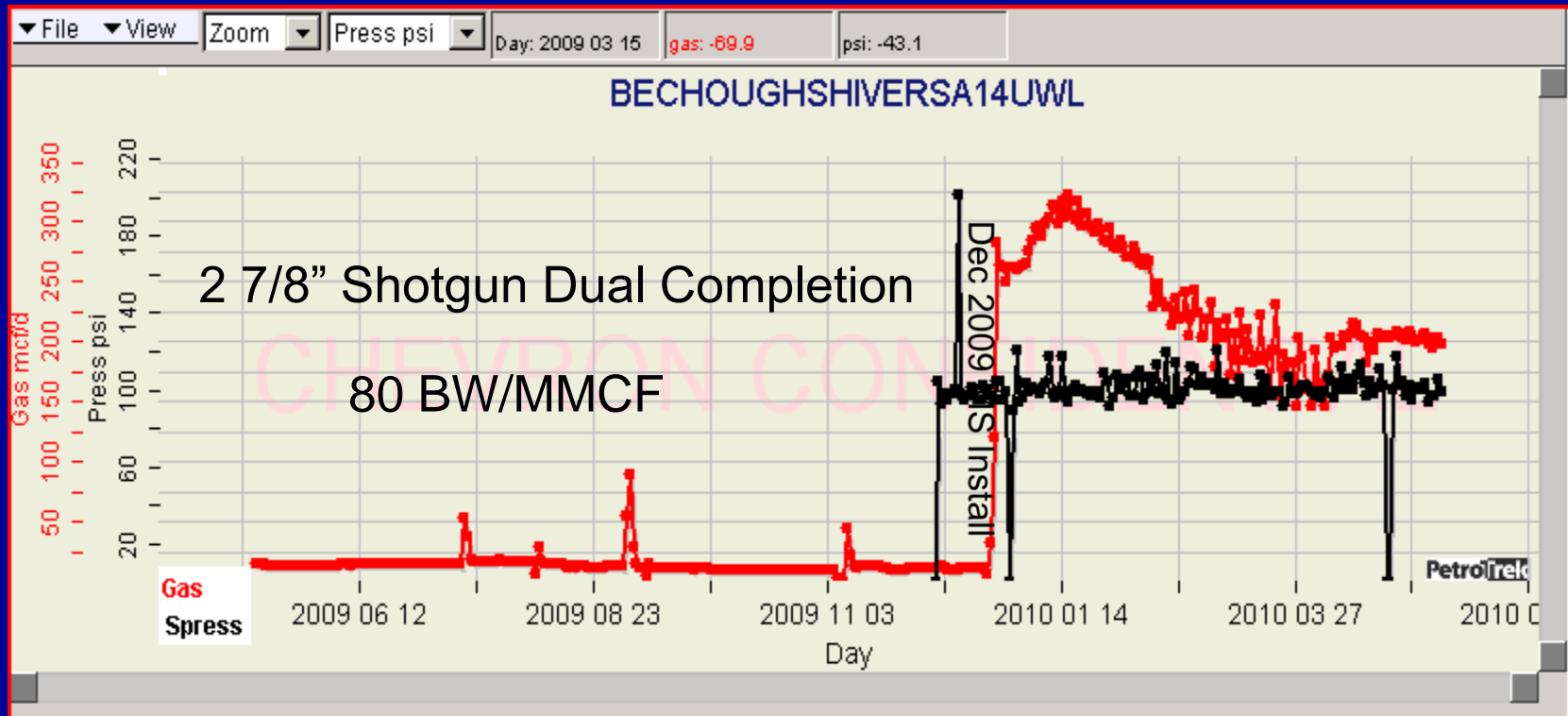
Individual Wells



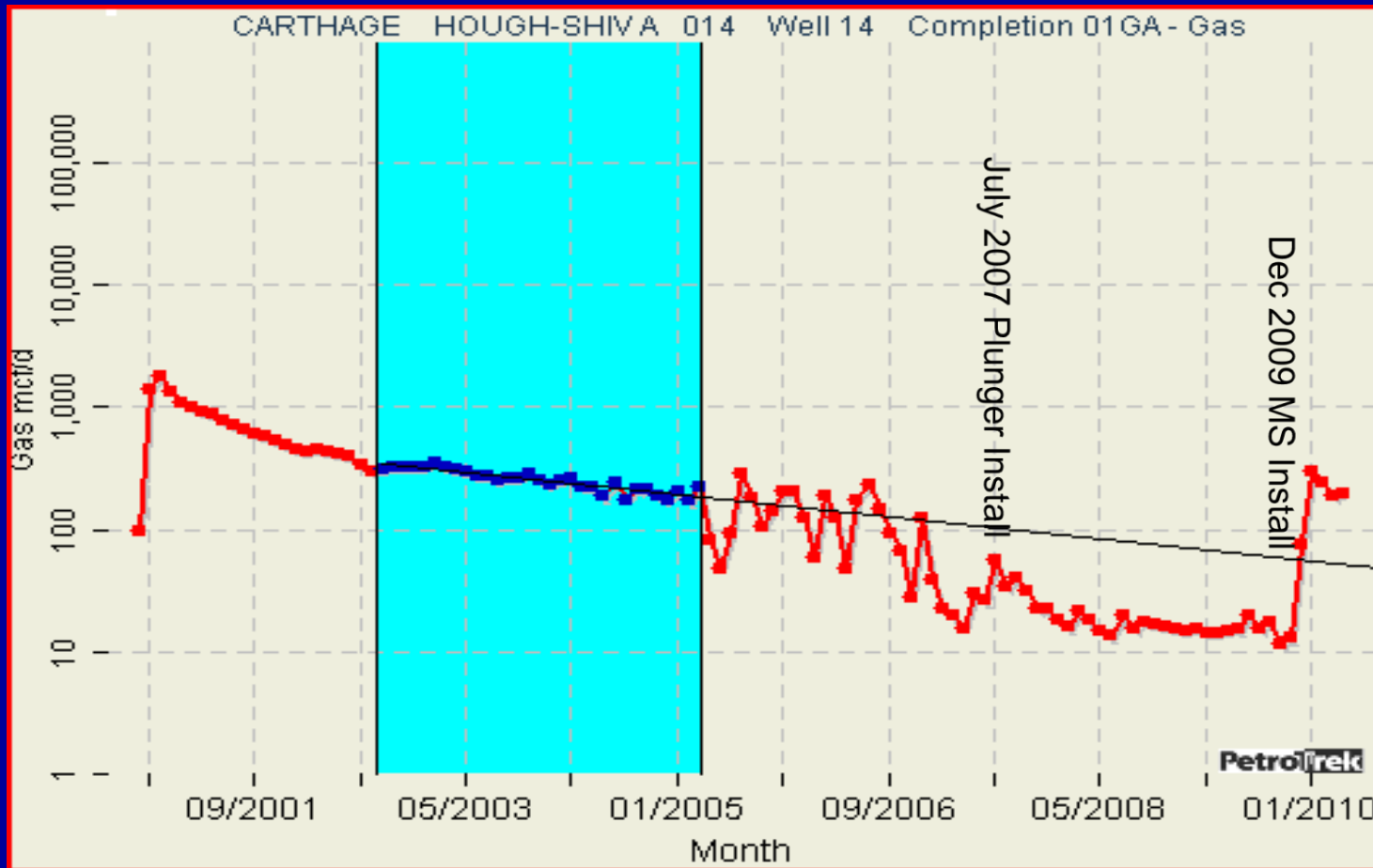
Individual Wells



Individual Wells



Hough Shivers 'A' #14U Monthly Allocated Production



Summary

- **MS Plungers have been overwhelmingly successful and economic in Beckville**
- **MS Plungers provide a lift to a percentage of wells that will not perform on capstring or single stage plungers due to low rate, pressures and high liquid yield**
- **MS plungers are commonly new installs now but as we see more single stage plungers unable to cycle with reasonable SI times they will be replaced with MS plungers**
- **MS plungers are not good candidates for sandy wells due to the inability to diagnose a problem on the bottom plunger**
- **We have not fully defined the operating range for MS plungers, but have successfully installed them in wells up to 300 BW/MMCF**
- **We have had very few problems with retrieving downhole equipment due to our 6 month PM program (Braided Line required on 2 wells)**
- **Slimhole wells have had mixed results but tests have shown that they require higher build-up pressures**