



**Vortex *FLOW***™

Customer Case Study

Natural Gas Liquids recovery:

March, 2011

# Vortex Tools

The addition of a Vortex tool to a flow-line or gathering line maintains a two-phase flow of liquids and gases, with the liquids traveling close to the wall of the pipe.

The organized flow developed with the Vortex tool prevents liquids from dropping out at low points in the line and maintains two-phase flow throughout the gathering line.

This organized Vortex flow permits the economic recovery of NGLs with recovery rates of five times that recovered through pigging.

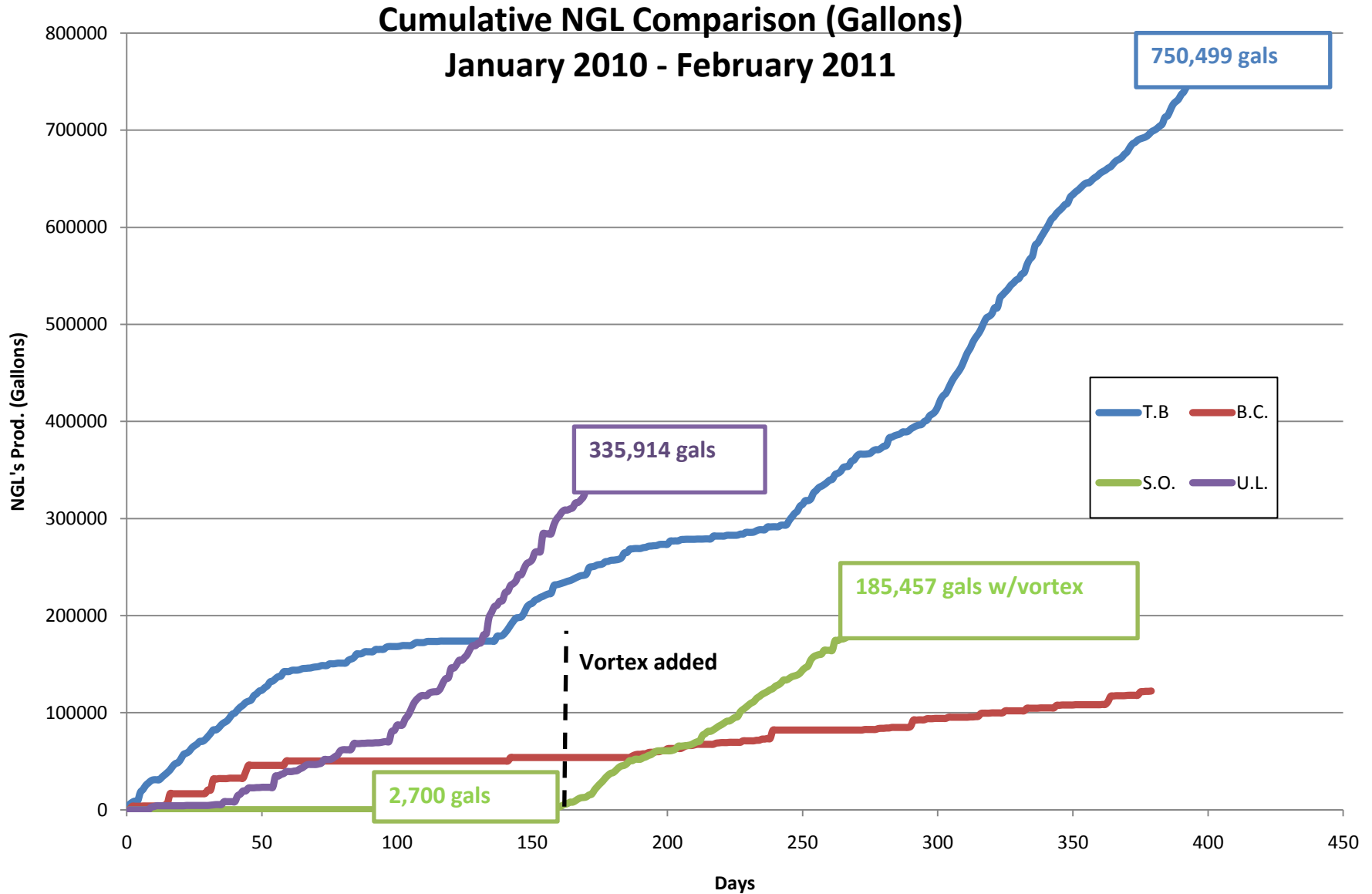
# Customer Experience with Vortex

“In one year, not counting any propane produced prior to the Vortex installation, we have produced 1,205,447 gals. of propane.”

“The addition of the Vortex tools has also helped to prevent freeze-ups in the past two months.”

Customer quotation: March 4, 2011

# East Texas: NGL Case Study



# The science behind Vortex tools



As a stream of gases and liquids enters the flow modifying device, it is forced by a “bluff body” in the flow stream to spin rapidly. The high angular acceleration slings the heavier liquid towards the pipe wall. As this spinning flow moves through the device, the configuration allows the spin angle to relax to a very efficient value.

This efficient helix-angle will propagate very long distances. The consequence of the liquid moving (like the rifling on a gun barrel) is that the no-flow boundary at the edge of the central gas flow is moving, resulting in a lower differential velocity between the bulk flow and the outer edge of the flow, which yields a lower shear force and a lower pressure drop due to friction.

A second benefit is provided by eliminating the slip between liquid droplets in the flow and the gas stream. Removing this slip force reduces the amount of work the gas must do as it moves – reducing the total pressure drop.

Source: David Simpson, P.E. Muleshoe Engineering.

# East Texas: NGL Case Study

Data gathered from four different gathering systems

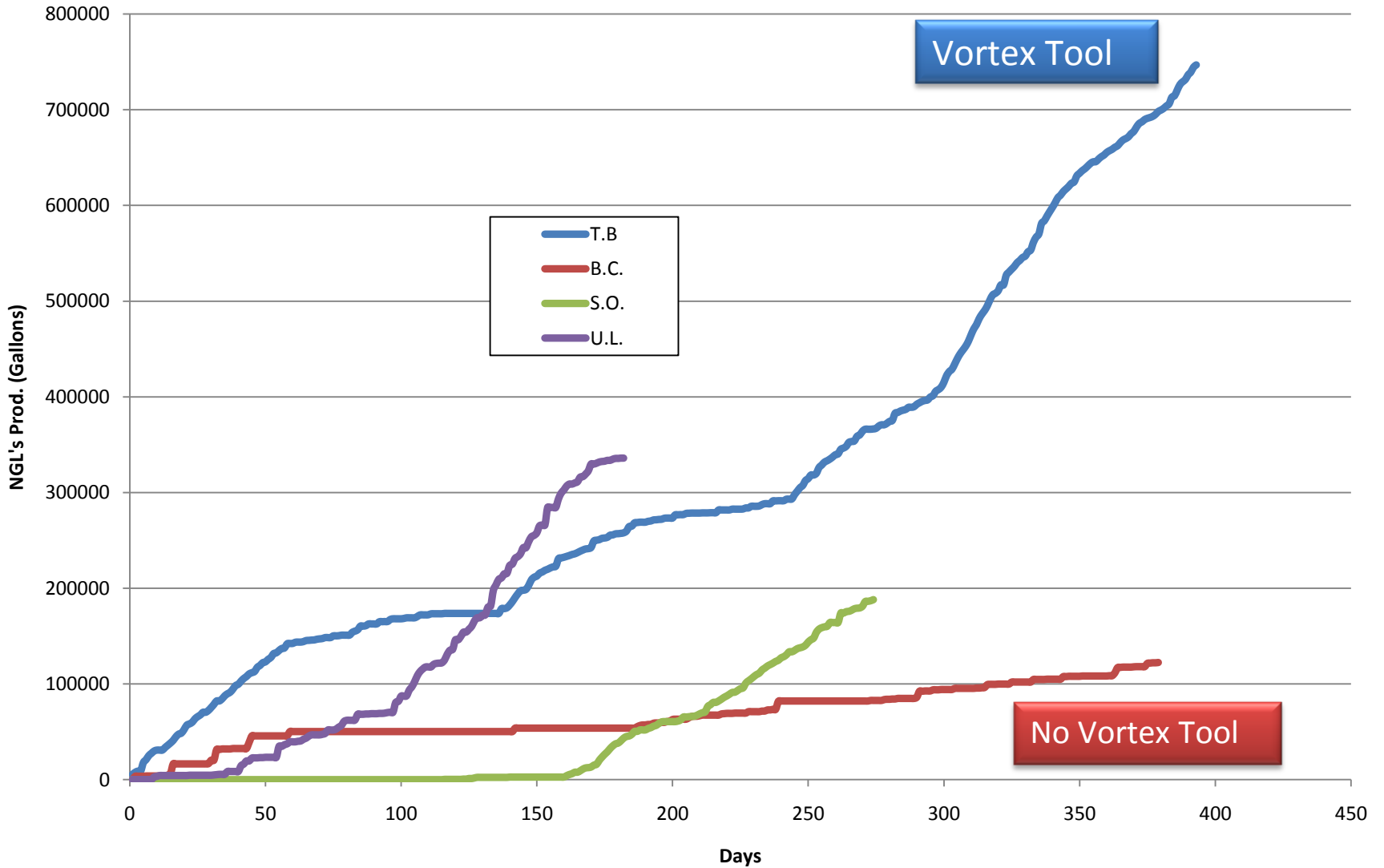
Each gathering system combined gas and NGL production from several wells

Each well tied in to the gathering system at the NGL tank

Data reviewed from two gathering systems; one with Vortex and one without Vortex

# Vortex or No Vortex?

## Cumulative NGL Comparison (Gallons)



# NGL volume: Vortex vv Pigging

## T.B. Gathering System - Vortex

13 months production data

- 750,499 gallons of NGLs recovered with Vortex
- \$122,200 cost for tank and Vortex tools and ongoing pigging of lateral lines \*

\$1,072,141 in NGL revenues

\$949,941 in net revenues

777.37% ROI – year 1

## B.C. Gathering System - Pigging

13 months production data

- 131,734 gallons of NGLs recovered with pigging
- \$107,200 cost for tank and ongoing pigging of flow and lateral lines

\$188,191 in NGL revenues

\$80,991 in net revenues

75.55% ROI – year 1

\* Customer kept a weekly pigging schedule on laterals.

# Summary – Vortex or Pigging?

T.B. Gathering system (with Vortex) collected 750,499 gallons of NGLs with a value of \$1,072,141 over a 13-month period.

B.C. Gathering system (no Vortex) collected 131,734 gallons of NGLs with a value of \$188,191 over the same 13-month period

Addition of Vortex generated a 469.7% increase in NGL revenues.

# Summary analysis – NGLs



- Flow lines with Vortex produce substantially more NGLs than lines without Vortex.
- In summer - lines with Vortex average 131.1 gallons/mmcf compared to 76.44 gallons/mmcf on lines without Vortex.
- In winter - lines with Vortex average 379.26 gallons/mmcf compared to 131.04 gallons/mmcf on lines without Vortex.

# Summary

The addition of Vortex to the target gathering lines has shown a significant and sustained increase in the recovery of natural gas liquids with a nominal BTU loss on the gas.

The ROI on the addition of the Vortex tools is impressive with net additional cash-flow after costs of equipment and installation and ongoing operational costs starting in month 2.

# Summary

Customer investment in Vortex tools and associated installation (tanks and piping) totals \$350,631.

Customer revenues from Vortex tools from 1,297,811 gallons of NGL's (\$60/barrel average) is \$1,854,016.

Profit on investment = \$1,503,340

ROI (year 1) = 428.77%