Linear Rod Pump—
A Revolutionary Sucker Rod Artificial Lift Technology

Presented By: Christopher Schmidt
Unico, Inc. Sales Manager Oil & Gas Division
Linear Rod Pump—
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About Unico, Inc.

- Drive products and systems
- Development, manufacturing, integration, and service
- Leading controls provider since 1967
- Headquartered in Franksville, Wisconsin
- Regional drive centers (Germany, UK, Venezuela, Japan, China)
- Privately owned by company employees
- Approximately 350 employees worldwide
- $75 million in annual sales
Oil and Gas Applications

- Draw works drives
- Centrifuge drives
- Drill string top drives
- Mud pump drives
- Electric submersible pumps (ESPs)
- Progressing Cavity Pumps (PCPs)
- Sucker Rod Pumps (SRPs)
- GPL® Gas-Powered Lift
- LRP™ Linear Rod Pump
- CRP™ Crank Rod Pump
- VPC™ Versatile Pump Controller
- GMC™ Global Monitoring and Control system
Background to Linear Rod Pump Concept

Large transfer presses at GM, Ford, Chrysler, Toyota, and Honda require up to 60 electronically controlled rack-and-pinion drives to achieve competitive production rates.
Linear Rod Pump Mechanical Background

- PCP to SRP conversions
- Excessive mechanical components
  - Site preparation
  - Additional installation equipment
  - Additional contractors on location
- LRP™ design evolution
  - Belt drive unit
  - Ball screw unit
  - Rack and pinion unit
**Linear Rod Pump Evaluation Projects**

- First LRP systems installed in December 2006
  - Test units (45 days)
  - Rented pick-up

- 100 LRP systems installed or pending installation

- 16 oil and gas producers installing LRP technology

- Well depths from 50 to 6,400 feet

- Production rates from 5 to 300 BPD

- Peak rod loads up to 19,300 pounds

- Over 100,000,000 cumulative LRP strokes
Typical SRP/LRP Drive Package
Operator Interface Options

Designed for ease of use in start-up, monitoring, and troubleshooting

Standard 2-line by 24-character display for easy-to-read text and graphics or optional 16-line by 40-character graphics display with charting capabilities

16-button keypad allows simple menu navigation and data entry

Password protection prevents unauthorized access to drive parameters

On-line setup instructions, prompts, warnings, bar graph displays, and logical data groupings for quick start-ups, smooth operation, and minimal downtime
Types of Pumping Units Supported
(> 12,000 ALS installed)

Crank Balanced

Beam Balanced

Reverse Mark

Mark II
Types of Pumping Units Supported
(> 12,000 ALS installed)

- Air Balanced
- Bent Beam
- Rotaflex
- Linear Rod Pump
- Crank Rod Pump
- Single Speed
  - Same upstroke and downstroke speed from a single speed source
- Dual Speed
  - Different upstroke and downstroke speeds from separate speed sources
- Optimize
  - Controller chooses optimal speed, including reduced speed soft landing prior to fluid impact.
- Speed Limiters
  - Upstroke minimum and maximum spm
  - Downstroke minimum and maximum spm
- Variable Pump Stroke
  - Ability to “tag” if operator requests
- Low Speed Operation
  - 2 SPM - 20SPM
General Control Features

- **Pump Fill Control**
  - Speed is automatically controlled to maintain target pump fill

- **Pump-Off Control**
  - Pump shuts off for a select time if unable to maintain target fill at minimum speed

- **Soft Landing**
  - Using real-time downhole dynamometer feedback, pump slows down prior to fluid impact anytime pump fill drops below the maximum setting

- **Bridle Control**
  - Pump speed is reduced if rod separates from rack, eliminating violence during reconnection
Pump Fill Control

Pump fill optimizer independently adjusts up and down stroke speeds

Single Speed Control
- pump fill monitor 60%
- pump average spm 8.0 spm
- pump rate monitor 256 bpd
- maximum rod load 21,000 lbs

Fill Optimization Control
- pump fill monitor 85-100%
- pump average spm 5.2 spm
- pump rate monitor 270 bpd
- maximum rod load 19,500 lbs
Soft Landing

Speed Reduction Prior to Fluid Impact
Variable Speed Drive Control Advantage – Compressor Down
LRP Mechanical Design

- Rod clamp
- Rack gear
- Mechanism enclosure
- Pinion gear and shaft
- Gear box
- Oil bath
- Polished rod
- AC induction motor
- Mounting frame
LRP Ease of Delivery and Changeover
LRP Installation Methods
LRP Standoff Installation and Removal
LRP Stuffing Box and Tubing Mounts
Red River Ranch, Stonewall, Colorado
Linear Rod Pump Installation

- Red River Resources is located on the Red River Ranch
- Red River Ranch is located south of Stonewall, Colorado, near an old town of Tercio
- Tercio was an old mining town in the early 1900s
- Road to the top is via steep switchbacks (difficult for delivery of equipment, winter and summer)
Red River Ranch, Stonewall, Colorado
Linear Rod Pump Installation

- Red River has more than 30 Unico drives installed on progressing cavity pumps and small Churchill pumping units.
- Once the CBM wells are pumping below 100 BPD, they require a new artificial lift method.
- Historically PCPs have been replaced by conventional pumping units.
Red River Ranch, Stonewall, Colorado
Linear Rod Pump Installation

Well 13-4, current location of the Linear Rod Pump, prior to LRP installation
Red River Ranch, Stonewall, Colorado
Linear Rod Pump Installation

Workover rig used to pull PCP and install the Linear Rod Pump
Red River Ranch, Stonewall, Colorado
Linear Rod Pump Installation

Installing the LRP standoff and “working” the LRP into place
Red River Ranch, Stonewall, Colorado
Linear Rod Pump Installation

Setting the LRP on the well
Tightening the rod clamp
Filling the LRP with oil and hugging her for good luck
Red River Ranch, Stonewall, Colorado
Linear Rod Pump Installation

- Clean installation
- One sensor and motor cables
Red River Ranch, Stonewall, Colorado
Linear Rod Pump Installation

When location is clean and LRP is painted (camouflaged), LRP blends into the landscape.
Linear Rod Pump with Center Pivot
Linear Rod Pump with Unico Gas Powered Lift
Lake Maracaibo Installation (LRP + GPL)
Farmington, NM
Typical Sucker-Rod Pump Installation

- Reducing foot print on location and site preparation
- No exposed moving parts on LRP
- Reduced installation costs—Dugan Production
LRP versus Conventional Pumping Units
Linear Rod Pumps
56 Inch Stroke LRP for 6,400 Foot Deep Well
Well Performance Report

- Comprehensive Well Reporting
- Inferred Well Production
- Gauged Production Data
- Surface and Down-hole Dynamometer Plots

- Measured Gearbox Torque
- Pumping Unit Balance Assistant
- Predicted Surface & Down-hole Plots
- Valve Check, and more…
GMC™ Overview

- Multiuser / Web hosted (at user facility)
- Scalable
- Supports all Unico pump types
- Alarming / notification
- Analysis / reporting
- Flexible / robust communication options
- Systems integration
- Oracle enterprise database
GMC™ Features

- Rod Pumps
  - Continuous monitoring of Rod speed, Rod loads, Rod torque, Fluid level, Production values, Motor data
  - Valve check report
  - Event and fault logs
  - Parameter change log
- ESP or PCP
  - Continuous monitoring of Motor data, Pump/rod speed, Production values, Fluid level, Downhole sensors
  - High-speed start-up chart
  - Event and fault logs
  - Parameter change log

System View
- Supports large numbers of wells and well groups
- Easily view status of all wells
- Quickly identify wells requiring attention
- User may sort/filter wells by status, type, real-time values
GMC™ Reporting

- Scheduled and on-demand
- PDF, Excel, CSV, XML formats
- Email delivery
- Custom report development
Head-End Software Interface Options

The SRP controller is compatible with both Case Services and Theta Enterprises head-end software packages.
Linear Rod Pump Technology—Tomorrow

- Creating a lower footprint for center pivot locations
  - New 20 “ LRP design
- Adding air counterbalance for increased capacity
- Evaluating new motors for increased cycle rates
- Increasing the rod stroke for greater well depths
  - Current design for 68” LRP unit
- Continued mechanical evolution based on field experience
- Motion profile development for production optimization
- Continued LRP well evaluations with new producers
Partnership

Working together
to provide solutions
to the oil and gas market
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