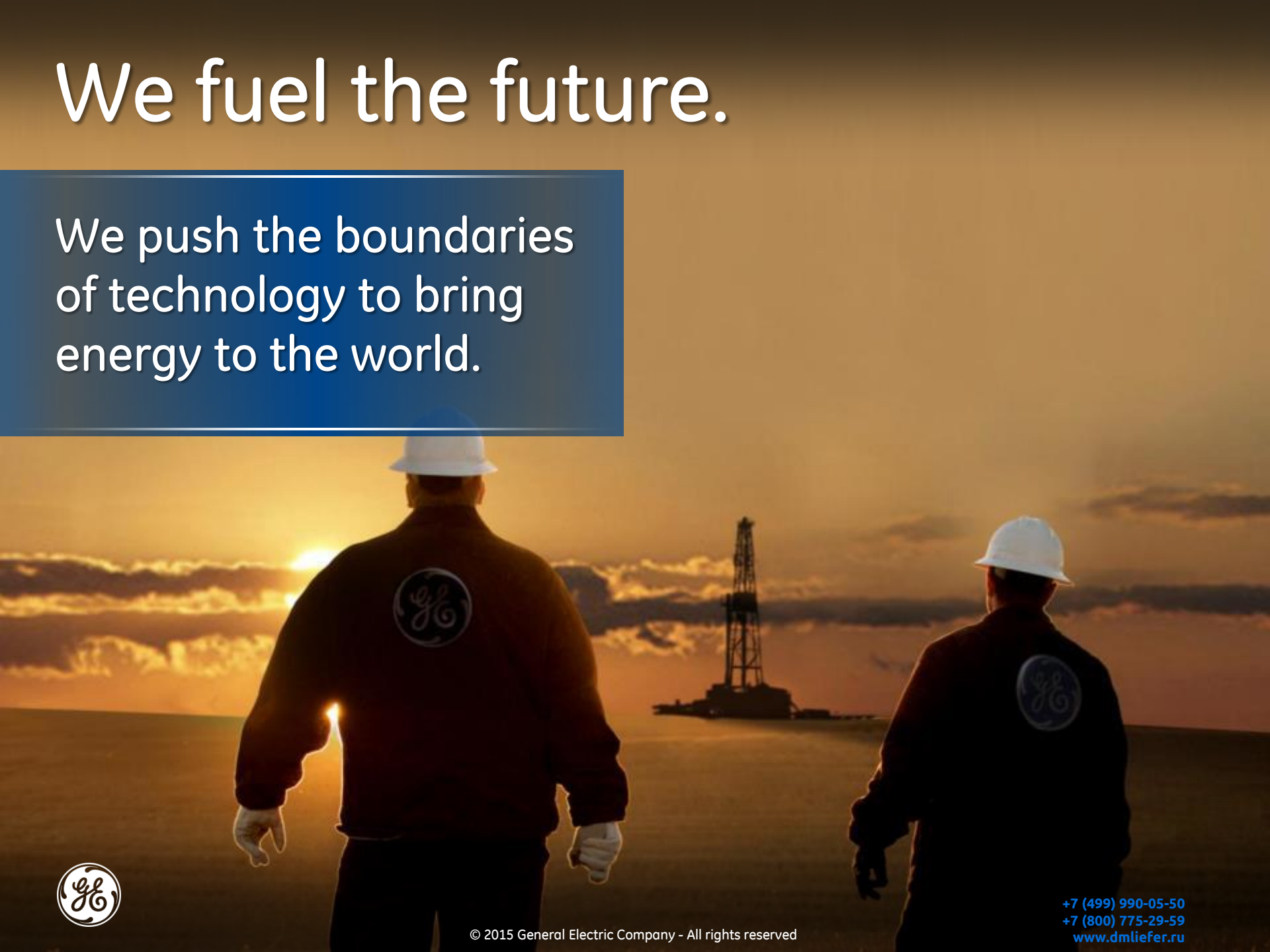
GE Oil & Gas
Artificial Lift Solutions

CUSTOMER NAME

Imagination at work

We fuel the future.

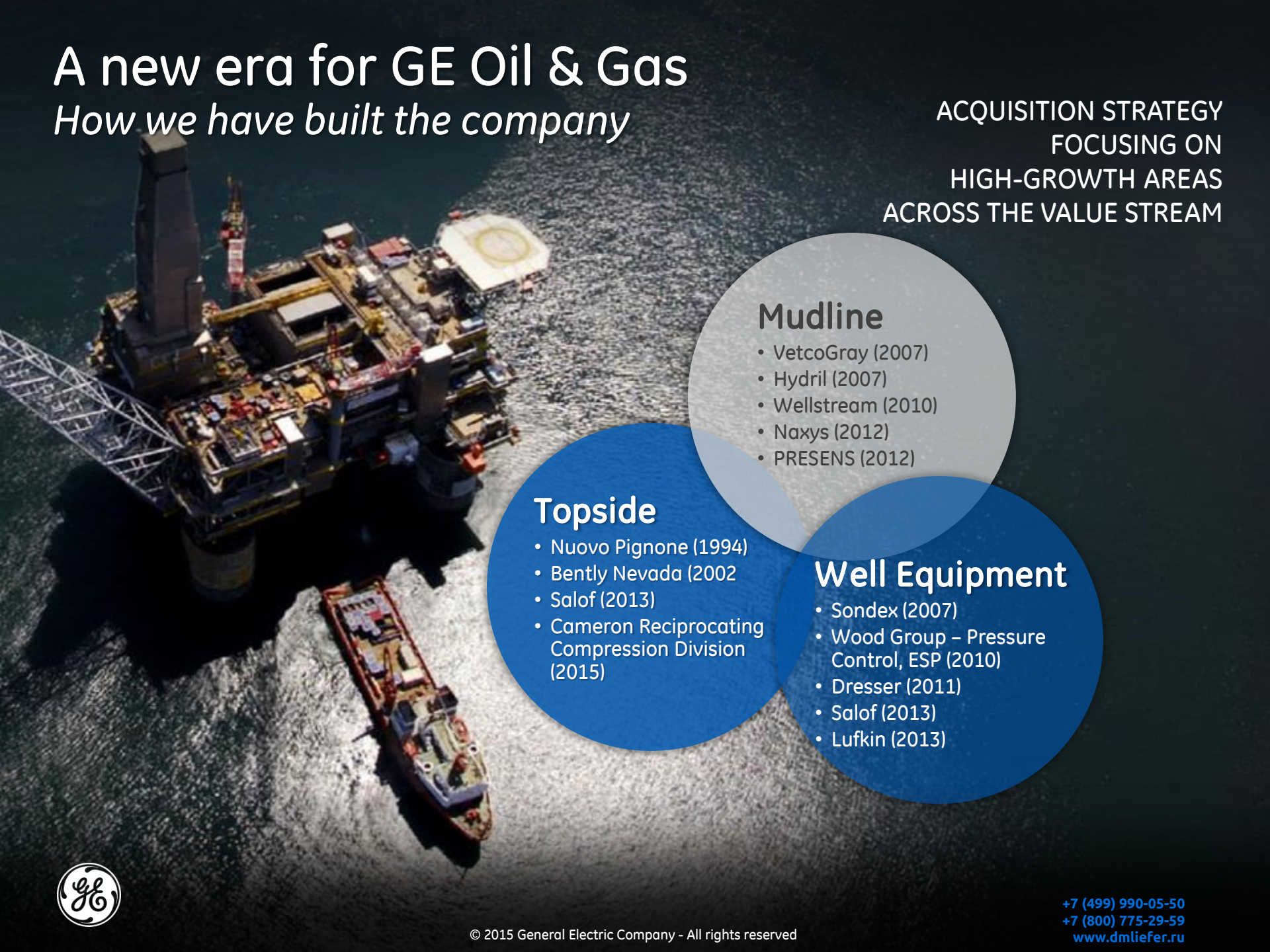
We push the boundaries of technology to bring energy to the world.



A new era for GE Oil & Gas

How we have built the company

ACQUISITION STRATEGY
FOCUSING ON
HIGH-GROWTH AREAS
ACROSS THE VALUE STREAM



Mudline

- VetcoGray (2007)
- Hydril (2007)
- Wellstream (2010)
- Naxys (2012)
- PRESENS (2012)

Topside

- Nuovo Pignone (1994)
- Bently Nevada (2002
- Salof (2013)
- Cameron Reciprocating Compression Division (2015)

Well Equipment

- Sondex (2007)
- Wood Group – Pressure Control, ESP (2010)
- Dresser (2011)
- Salof (2013)
- Lufkin (2013)

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Our technology solutions

Subsea Systems

- Subsea trees & wellheads
- Subsea power & processing
- Controls
- Manifolds
- Flexible risers
- Flow lines
- Specialty connectors & pipes

Measurement & Control

- Asset condition monitoring, control sensing & inspection solutions
- Optimization & diagnostic software
- Pipeline inspection and integrity services
- Control & safety relief valves
- Fuel dispensers & payment terminals
- Fuel control & retail systems

Turbomachinery Solutions

Turbomachinery equipment and services for the upstream, midstream and LNG segments including:

- Gas turbines
- Axial & centrifugal compressors
- Electric motor driven compressors
- Turn-key industrial modular solutions
- Turboexpanders & heat exchangers
- Contractual & maintenance services
- Upgrades & industrial applications
- Monitoring & diagnostics

Drilling & Surface

- Drilling risers
- Blow-out preventers
- Electric submersible pumps
- Logging while drilling & wire line tools
- Surface wellheads & flow control
- Logging services
- Well Performance Services
  - Artificial lift solutions: Lufkin beam pumping units, electric submersible pumps, rod lit, gas lift, plunger lift, progressive cavity pumps
  - Automation and field optimization
  - Power transmission
  - Service and repair

~43,000
employees

Downstream Technology Solutions

Equipment & services for the refinery & petrochemical, distributed gas and industrial applications including:

- Steam turbines
- Reciprocating compressors
- Distributed gas solutions – small LNG & CNG
- Pumps, valves & distribution systems
- Blowers & compressors
- Maintenance services & remote monitoring & diagnostics

Delivering customer solutions by applying systems-level engineering across the portfolio

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Well Performance Services

Offering full range of artificial lift
... increased customer + regional coverage, applying GE R&D

+

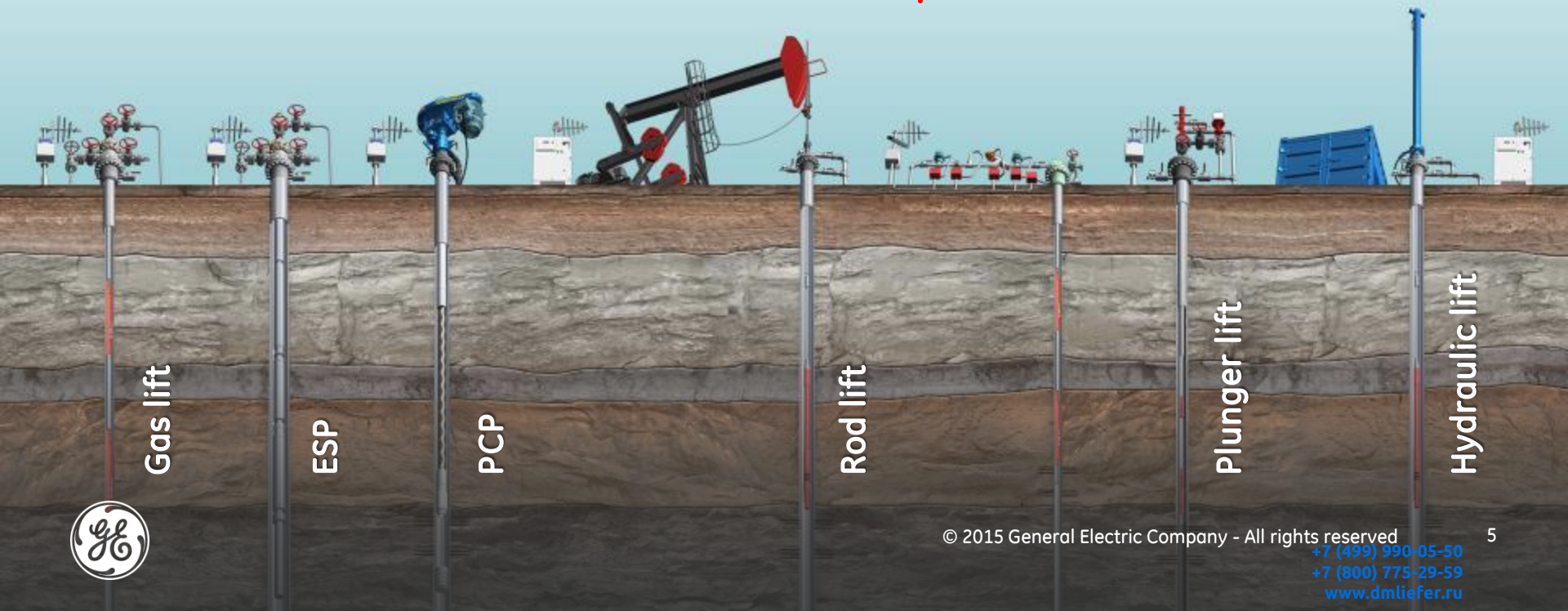
Integrating automation and production optimization software
... common platform across lift technologies

+

Refining GE's oilfield operating model
... closer to customers, service focus, flexible commercial models

Industry's most compelling artificial lift portfolio ...
Wood Group ESP Company + Lufkin + GE Technology ... Foundation for continued growth

Automation & Field Optimization



Total artificial lift solution

We are leading the artificial lift industry through innovation in technology and service models to help our customers reduce lifting costs and increase production over the life of the field.

Full Well Lifecycle Offering

Designed to significantly increase cash flow per well

Production

CAPEX

Production (bbl/d)

ESP

Rod lift

Sensing, control & automation

Oilfield power & compression

Asset and well optimization

Flexible Solutions & Commercial Models

Responding to customer needs

- **Well life solution for capex and production optimization**
- **Well optimization** … Sensors, optimization software, remote monitoring and expert consulting
- **Flexible power and compression** solutions
- **Performance-based contracts**
- **Lease/rental** models

↑ Recovery
↑ Speed

↓ Costs
↑ Cash flow

Case study: ***Middle East Customer***

- Automation + range of AL methods + intelligent platform
- Manage equipment and adjust production rates

Value

- Targeting ↑ **5% production** per well
- ↑ predictability and intervention planning
- ↓ exposure to production loss and cost

2 millions bbl of additional production already achieved for this customer

Global services & support

Well Performance Services

230+ PROPERTIES GLOBALLY | **100+** SERVICE CENTERS | 11 MANUFACTURING FACILITIES

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Commitment to Technology

Eight research centers around the world

Global Research HQ
Niskayuna, NY

Focus area: All

Global Research - Europe
Munich, Germany

Focus area: All

China Technology Center
Shanghai, China

Focus area: All

Global Software Center
San Ramon, CA

Focus area:
Software and analytics

Brazil Technology Center
Rio, Brazil

Focus Area: Smart, bioenergy and offshore Subsea Systems and Systems Integration

John F. Welch Technology Center
Bangalore, India

Focus area: All

Advanced Manufacturing
Ann Arbor, MI

Focus area: Aviation

O&G Technology Center
Oklahoma City, OK

Focus area: Oil & Gas

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GE Oil & Gas Technology Center
Oklahoma City, OK

Develop and apply technology to better produce energy that powers the world, protects the planet, and improves lives.

- Ground breaking May 2015
- $125 million investment
- Will employ 125 technologists

Focus

- Production systems
- Well construction
- CO2 methods
- Water optimization
- Energy systems

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Products

Downhole product portfolio

Gas Lift

Promotes reliable performance in higher pressures and harsh well environments with a variety of wireline, retrievable and special application products, including bottom hole assembles and controllers for use in continuous and intermittent flow gas lift production.

ESP

Manage abrasive, corrosive, heavy crude, geothermal and a variety of other application-specific needs with a comprehensive set of electric submersible pumps, motors and seals. Dedicated design, installation and maintenance services keep operations producing at peak.

Progressing Cavity Pumps

Improve well performance from surface to downhole—even in the toughest conditions—with a complete suite of PCPs, direct well head drives, gearbox well head drives and hydraulic bearing drives for a variety of flow rates, pumping depths and well conditions.

Plunger Lift

Choose from a complete portfolio of conventional, bypass, and staged systems and lubricators, tubing and casing that cover a wide range of applications efficiently and productively, with the support and service to get—and keep—you up and running.

Surface Pumping Systems

Our surface pumping systems are a versatile, low-maintenance and cost-effective alternative to many high-speed integral gear-driven centrifugal, positive displacement and vertical-turbine pump models.

Gas Lift

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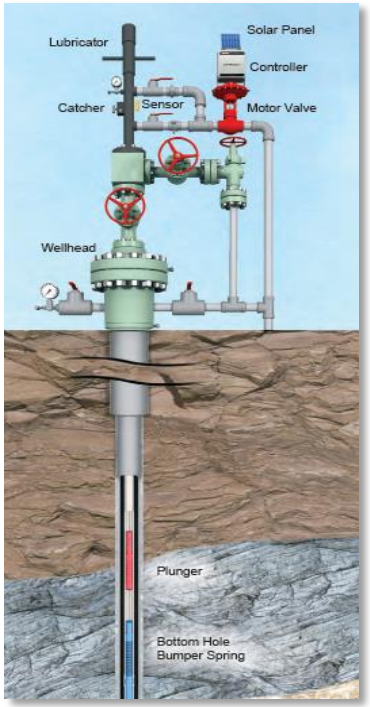
Gas and plunger lift

Gas Lift

- Side pocket mandrels
- Conventional mandrels
- CT (concentric mandrels)
- Retrievable valves and latches
- Conventional valves and checks
- Top Flow™ valve

Plunger Lift

- Uses the wells' own energy to lift accumulated fluids
- SCADA ready controller



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Gas lift systems

Use rapid injection of gas to lighten a column of fluid

Applications

- Used for high GLR wells
- Maintain and increase production rate in flowing wells
- Back flow salt water disposal wells
- Able to constant flow wide range of rates

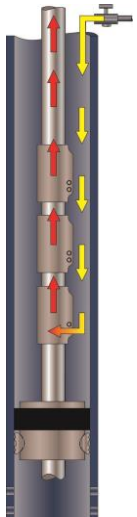
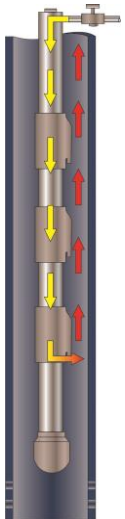
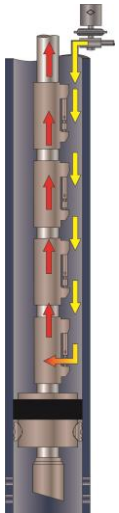
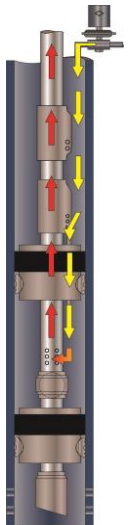
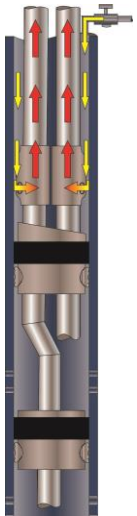
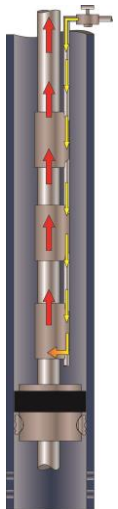
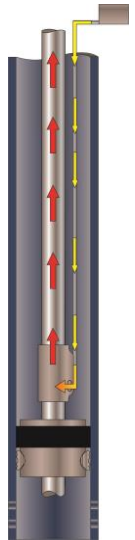
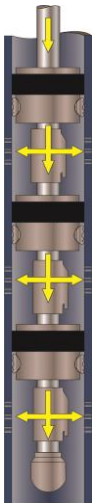
Advantages

- Economical vs other pumping applications
- Flexible installation
- Small surface footprint
- Simple operation

Limitations

- Requires a high-pressure gas source
- Not a recommended choice for wells with low BHPs
- Higher rates produced with other AL methods
- Will not work very well in low API oils
- Gas has a cooling effect

Gas lift configurations

Cont Gas Lift Tubular Flow	Cont. Gas Lift Annular Flow	Intermittent Gas Lift	Gas Lift Chamber	Dual Well Gas Lift	Gas Lift Side String Injection	Chemical Injection	Waterflood Injection
• Gas is injected continuously • Suited for wells where a supply of pressurized gas is available	• Gas is injected into the production tubing • Suited for wells that have a reservoir pressure, have a high PI, low GLR and are tubing sized limited	• Int., high volumes of gas are injected into the well annulus • Suited for wells that produce low volumes due to low BHP or low PI	• Int., high volumes of gas travel down the annulus regulated thru a gas lift valve • Best suited for wells with low BHP and high PI	• Gas is continuously injected into the annulus • Gas is regulated thru gas lift valves into the fluid column inside dual tubing strings • Suits wells with several reservoirs	• Gas is injected down the side string • Suits damaged casing and wells where gas has to be vented up	• Treatment chemicals are pumped downhole to control harmful deposits Suited for preventing corrosive degradation	• Water is pumped into the tubing • Waterflood is used to maintain or increase reservoir pressure in zones that oil production has or is expected to decline
							

Valves and mandrels

Conventional Valve	Wireline Retrievable Valve	Top Flow™ Valve	Conventional Mandrel	Side Pocket Mandrel
• Designed to house a 1.0" or 1.5" sizes	• Designed to house a 1.0" or 1.5" sizes	• Patented, non-API design • Wireline retrievable • Directs gas upward	• Designed to house a 1.0" or 1.5" gas lift valve • Available in a range of sizes	• Designed to house a 1.0" or 1.5" gas lift valve • Available in a range of sizes
				

Optimized designs, convenient locations, quality valves and mandrels
with reliable support to keep you up and running

Plunger Lift

Plunger lift systems

Uses the wells' own energy to lift accumulated fluids

Applications

- Stabilizing productions in oil wells with liquid loading and gas lock problems
- Dewatering of gas wells
- Reducing gas injection on intermittent gas lift wells
- Preventing paraffin and scale build up

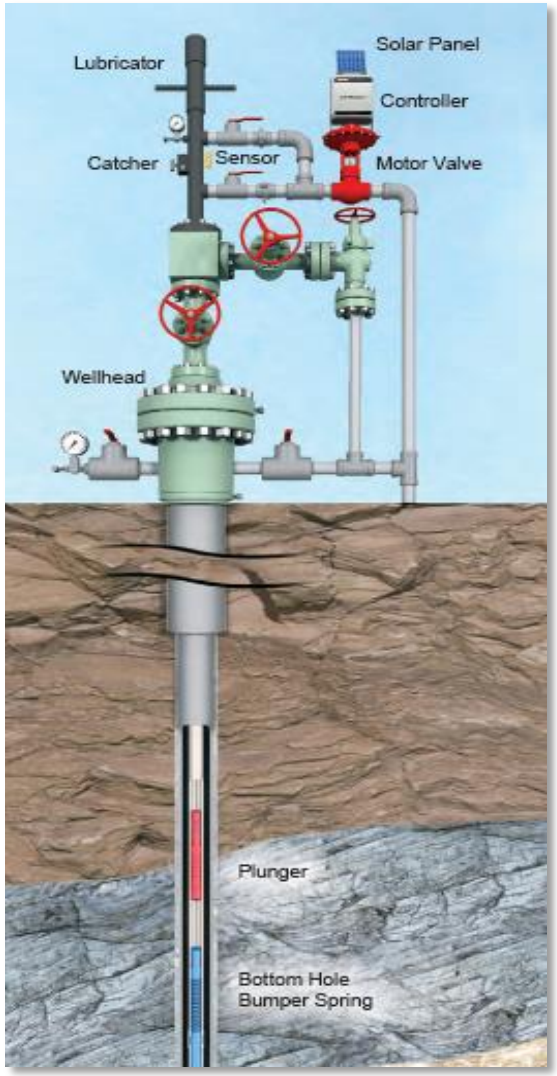
Advantages

- Low capital cost
- No rig required and minimal downtime during installation
- No fuel cost
- Low maintenance
- Stabilized well production
- Prevents paraffin and scale build up
- Can be moved to other wells
- Reduces fluid fallback and fluid slugs

Limitations

- Poor to fair solids handling
- Production limitation

(Suitable for wells producing less than a 100 barrels a day)



Plunger types

Cont. or Bypass Flow	Bullet Plunger	Pad Plunger	Brush Plunger	Spiral Plunger	Tornado Plunger	Turbo Flow Plunger	Recoil Plunger	Staged Plunger
• Combats declining gas flows • Reduces downtime • Maximizes flow rates • Works well with on-site compressions • Eliminates line pressure spikes	• Plunger reaches spring in half the time than conv. plunger • Tornado design provides great seal efficiency to help maximize production	• Good for lower GLR wells • Best suited for low pressure wells • Wear resistant • Can run single, double or triple pad depending on well depth	• High efficiency seal • Good for wells with small amounts of solids • Can be used in irregular tubing ID • Good to 250F bottom hole temp	• No moving parts – max efficiency and durability • Plunger grooves spaced to allow turbulence • Suited for wells that produce solids like sand, salt or paraffin	• Under cut grooves enhance turbulent seal • Improve production for low LGR wells • Riffling allows for more uniform wear in deviated wells	• Enhanced efficiency due to pad and turbo groove combo • Reduced frictional drag • All stainless steel components • Best for wells with liquid to gas ratios of 80-100 bbl/mmcfd	• No fixed spring – provides least downhole restrictions • For higher GLW wells • Low installation cost (no wireline required)	• Suited for packer completions • Works well in slim hole or tubingless completions • Good for existing plunger lift with inconsistent runs
								

A complete portfolio engineered to cover many applications efficiently and productively

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Electric submersible pumps

High production volumes

Applications

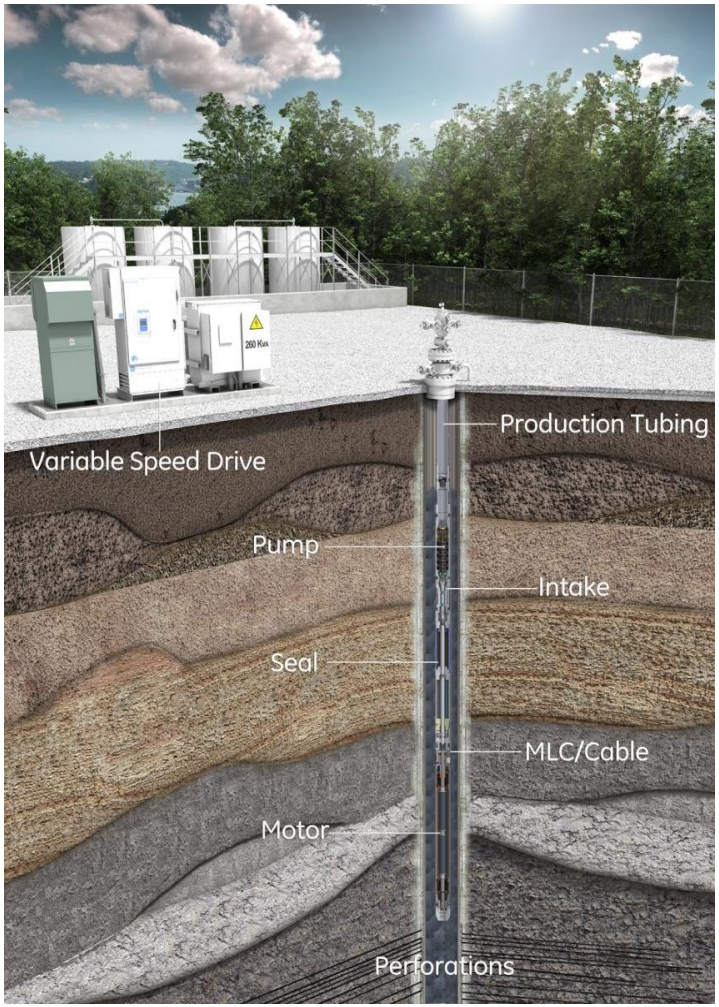
- Gaining high initial production quickly
- High production wells; can pump from 80-80,000 BPD

Advantages

- Can handle a wide variety of production volumes
- Able to work in very deep wells

Limitations

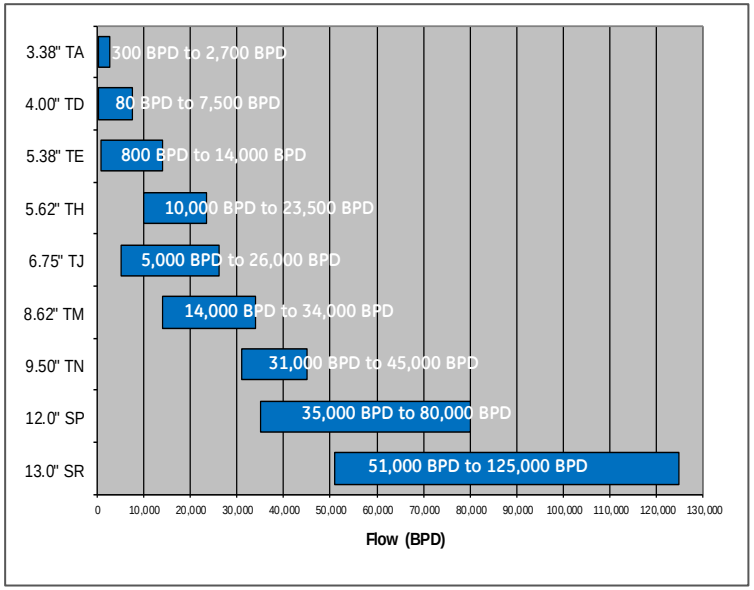
- Only fair at handling solids and gas



Flexible to meet a variety of needs

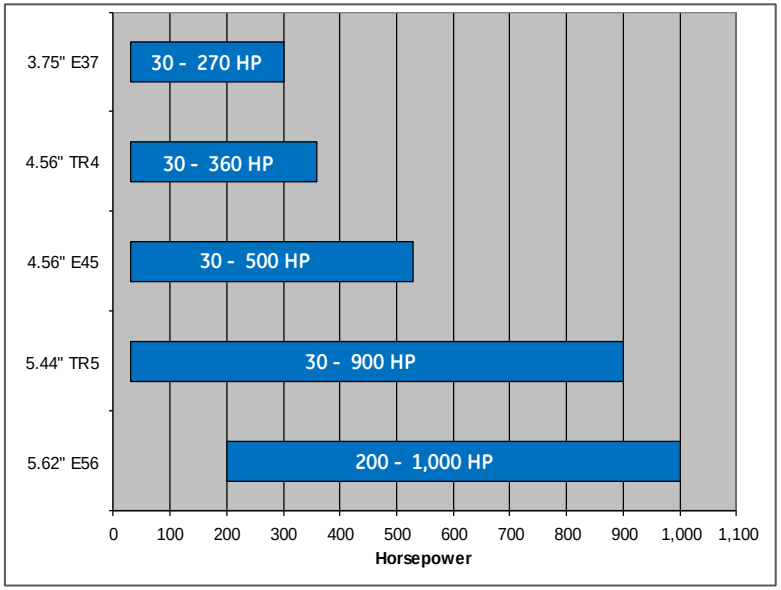
Pump sizes and flow rates

Pumps range from
80 BPD – 80,000BPD



Motor sizes and HP ranges

Motors range from
30HP– 1,000HP



ESP components

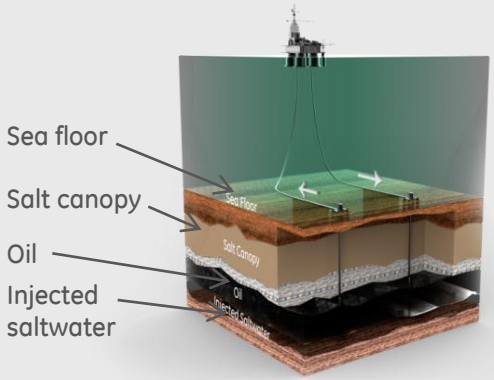
Pump	Intake	Seal	Motor	Sensor
• Attaches to the production tubing with a bolt-on discharge head. • Multistage centrifugal • Produces a total dynamic head.	• Up to 3 stage gas separator • Handles 65% of free gas without gas lock at low intake pressures	• Protects the motor • Equalizes pressure and absorbs shaft thrust • Available in a variety of configurations	• Shaped rotor bars • Higher efficiency • All high temp construction • Plug-in MLE, remove filter base	• Provides reliable and accurate retrieval of critical, real-time system and wellbore performance
				

Combination of industry-leading technology with proven reliability.
The GRC will continue to keep them on the cutting edge

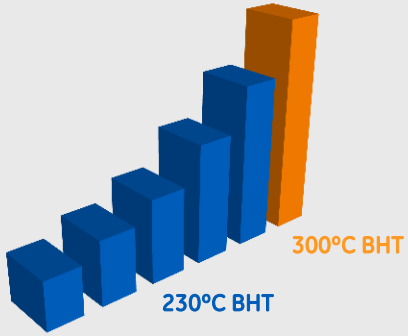
Driving growth through innovation

Deeper – Greater lift capabilities

- Larger and higher hp motors
- Power density
- Higher efficiency pumps and motors
- Slim line motors
- Deepwater boosting



Hotter – High temperature capabilities

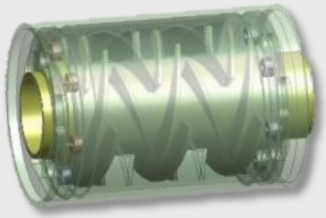


- Dielectrics (temperature and voltage ratings)
- High temperature advanced nano and other new materials
- Disruptive technology for motor design

Harsher - Abrasives

Abrasion/erosion resistance
- Step change coatings with 9x current life

Sand tolerant components
- Key pump parts from new ultra-hard alloys
- Additive manufacturing (direct laser metal sintering)



Compact sand and gas handling pump

Smarter – RM&D

- Diagnostics/ prognostics
- Big data analytics
- Real-time advanced sensing and data management

Faster – Quicker customer response

- Shorter cycle time
- Advanced manufacturing
- Higher efficiency

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Downhole technology

AR modular pump design

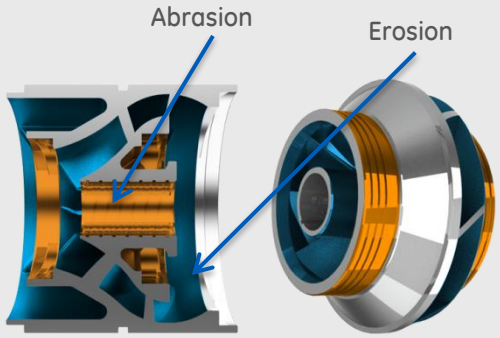
- Tungsten Carbide (TC) bearing
  - Radial and down thrust wear
- Each module carries down thrust load
- Expanded pump range
- Superior down thrust protection
- Expanded thrust load cap
- Deeper setting depth applications

Low flow mixed flow stage

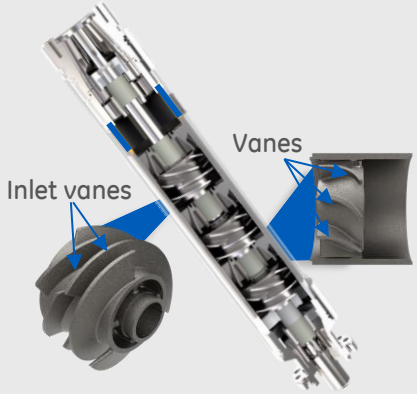
- 1000 BPD mixed flow stage
- BEP Targets at 60 Hz
- BPD: 1000 ± 200
- Ft/Stage: ≥ 25
- Efficiency: 64%

Technology infusion - Coatings

- Abrasion and erosion resistant coatings.
- Proprietary GE material/process with extended wear life



Gas handler



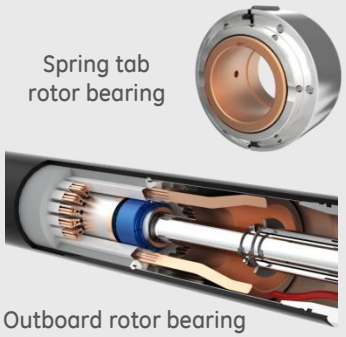
- Handles 65% of free gas without gas locking at low intake pressures
- Compression design
- GRC technology and fast track development methods

Downhole technology

Anti asphaltene seal section

- Modified head to flush away well fluid and solids with a unique mechanical seal protection cover
- Modified housing to avoid depositions
- Extremely wide operating temperature, up to 500 °F continuous operating temperature

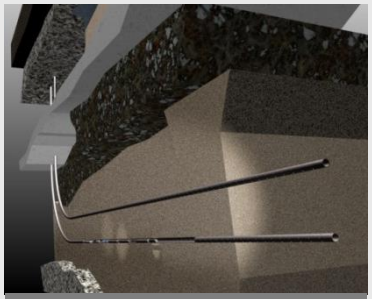
E-45 and E-56 motors



- Shaped rotor bars – higher efficiency
- All high temp construction
- Plug-in MLE, remove filter base
- Connects to existing 400 series seal and 400 series MLC
- Full line (25HP-500HP) is E-45 E-56 is 50HP – 900HP
- CR Housings available Q1 2015

SAGD system 230°C BHT

- Matched coefficients of thermal Expansion in all components
- Locking abrasion resistant (AR) bushings in pump, seal, and intake
- "Bottom Feeder" pump intake
- Extreme temperature seal bags
- High temperature PEEK insulation



Steam assisted gravity drainage system

High temperature GRC R&D efforts

- 250°C BHT Insulation
  - Current for O&G PEEK insulation
  - HT Oil
  - HT slot liner
  - HT wire
- 300°C BHT Insulation
  - Developed for GE Aviation
  - HT wire

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Progressing Cavity Pumps

GrenCo Progressing Cavity Pumps

High production volumes

Applications

- Sand-laden heavy crude oil and bitumen
- Medium crude oil with limits on H2S and CO2
- Light sweet crude oil with limits on aromatic content
- High water cuts wells
- Dewatering gas wells such as coalbed methane projects
- All type wells, including horizontal, slant, directional and vertical
- Surface transfer of fluids
- Visual and height sensitive areas
- Thermal applications (steam drive)

Advantages

- High system efficiency with low power consumption
- Pumps oils and waters with solids
- Quiet operation, low surface profile for visual and height sensitive areas
- Portable, lightweight surface equipment, simple installation

Limitations

- Depths up to 6,000 ft.
- Volumes up to 5,000BPD
- Temperatures up to 300F

Integral flow tee/BOP

Hydraulic drive

Electric drive

PCP Product Family

Electric Wellhead Drives

Models:

- M-2100 40Hp
- G-2100 60Hp
- L-2100 75Hp
- D-2100
  (single motor 100Hp)
  (dual motor 150Hp)

Hydraulic Wellhead Drives

Models:

(Belt Driven)

- H-2000 60Hp

(Beltless Gear Driven)

- M-2100 40Hp
- L-2100 75Hp
- G-2100 100Hp

Common Features:

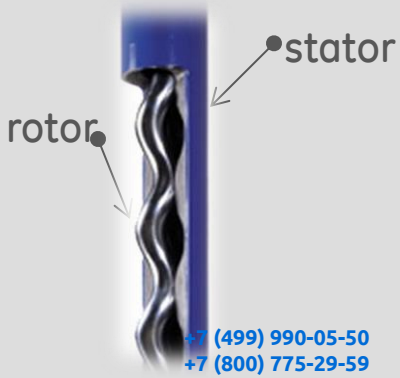
- Proven Back-Spin Brake
- Superior Primary Sealing System
- No Polish Rod Wearing Secondary Seal
- High Axial Load Ratings
- Flanged Wellhead Connection
- Rigid Motor Mount With Simple Adjustment

Integral Flow Tee/BOP

- Combination Blow Out Preventer and Flow Tee
- Various flange sizes available
- Various port sizes available
- Optional Polish Rod Lock Out Rams available
- Provides rigid connection for wellhead drive

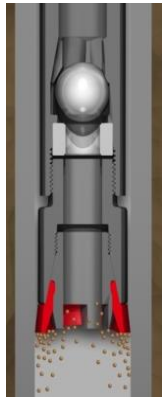
PC Pumps

- Available in a wide range of volumes and lift capacities
- Specific geometries available for sand applications
- Several elastomer compounds for diverse applications
- Options available for rotor base materials and coatings



Reciprocating Pumps

Pump components

Top Lock	Bottom Lock	Tubing Pumps	YP Frac
• Insert pump • Not for deep wells • Best for gassy wells • Easier to unseat	• Insert pump • Good for deep wells • Often require strip out • Slimhole	• Larger production • Barrel ran on tubing • Most common • Can be wild standing or positive standing	• Eliminates dead space between adapter discharge ports and leading edge of plunger • Wiper/seal wear is reduced by 50%
			

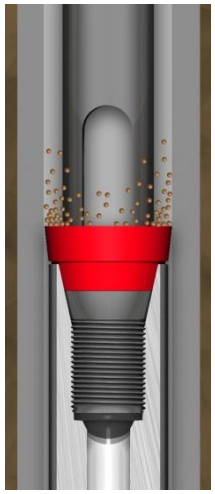
Quinn in-house chrome plating shop and WellTrack™ software provide unparalleled reliability and well-tracking

Technology growth – YP Frac Pump

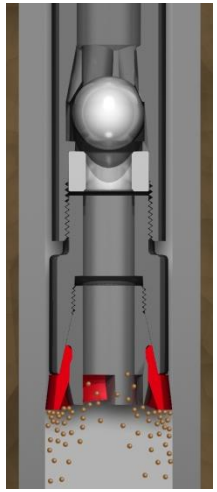
Designed for increased efficiency

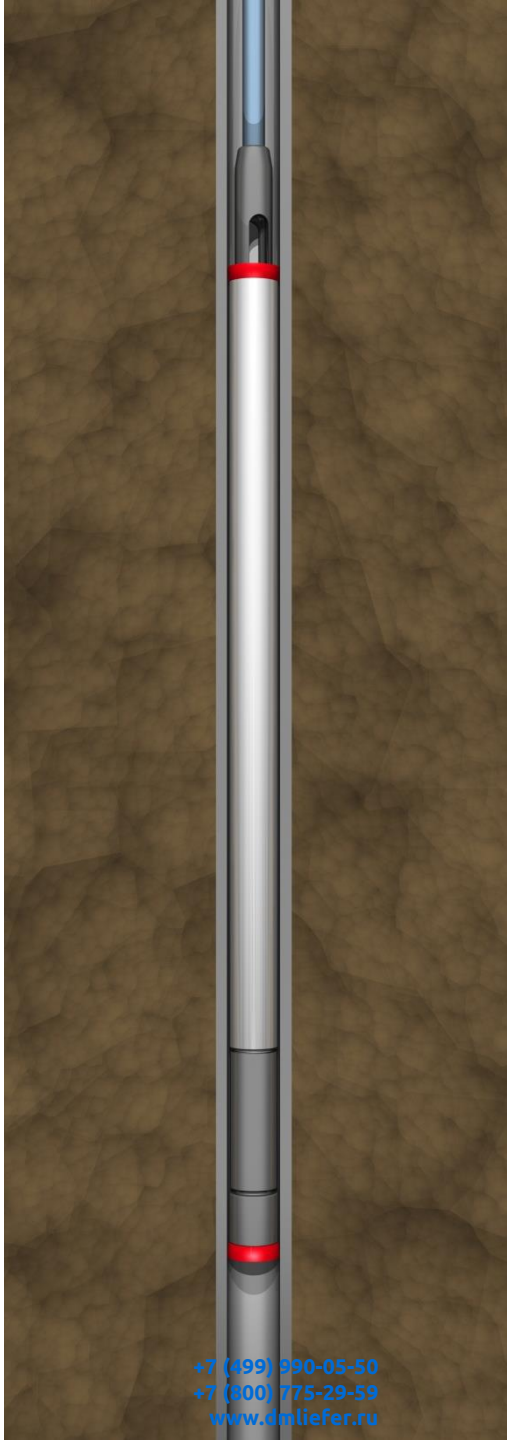
- Eliminates dead space between adapter discharge ports and leading edge of plunger
- Wiper/seals promotes continuous wiping of barrel internal diameter on both upstroke and downstroke
- Wiper seals are pressure activated independently on upstroke and downstroke
- Wiper/seals center the plunger within barrel I.D. promoting even barrel and plunger wear
- Wiper/seal wear is reduced by 50%
- Wiper/seals reduce fluid slippage thereby increasing efficiency

Upper



Lower



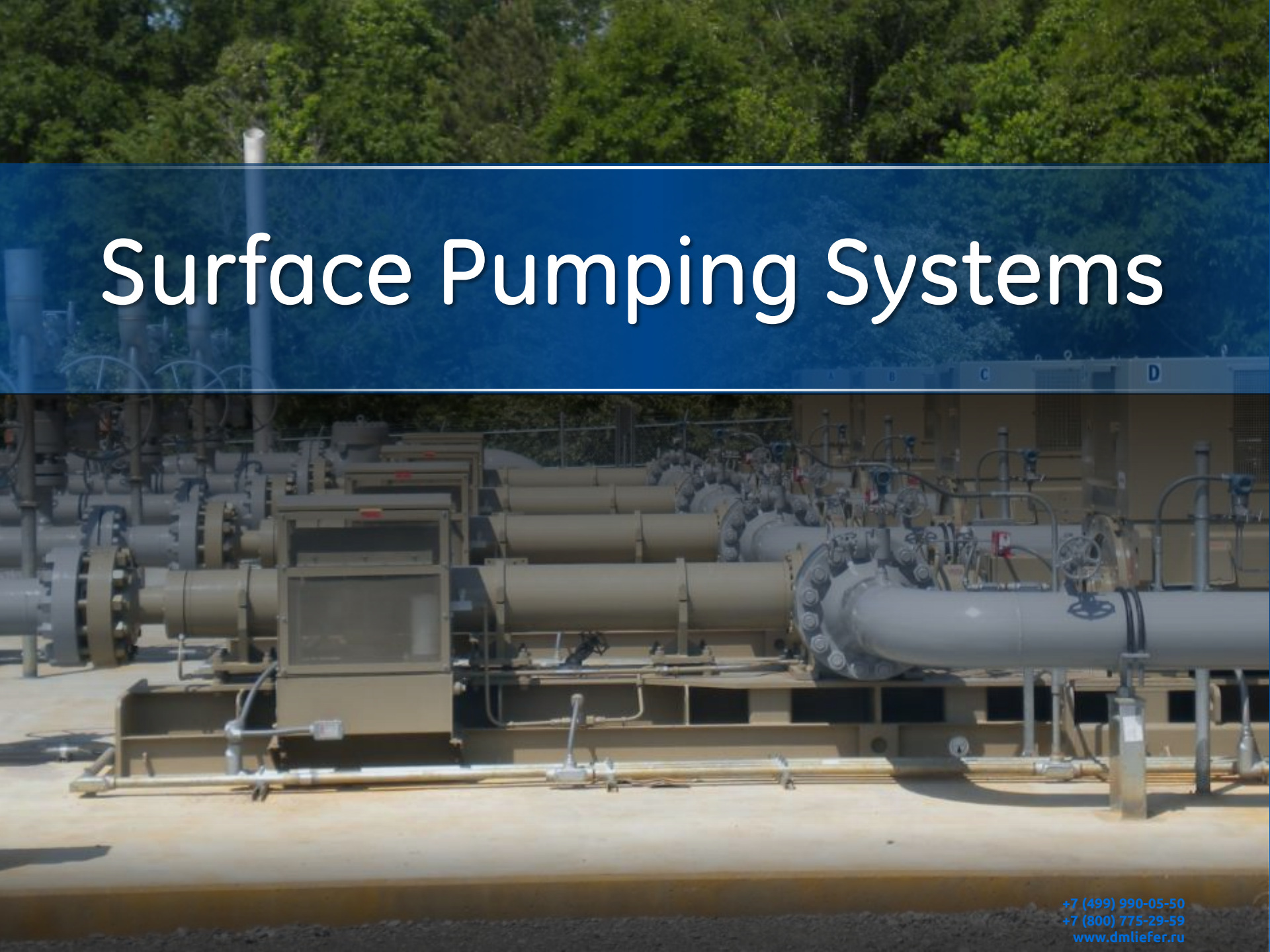


Reciprocating pump facilities, Canada

New chrome plating facility

- $25MM investment – Finished October 2013
- State of the art operation
  - Fully self contained
  - Minimal waste streams
  - Purified water
  - Compressed dry solid waste
  - Digitally controlled process

Surface Pumping Systems



Surface pumping systems

Proven pumps with unmatched support

Applications

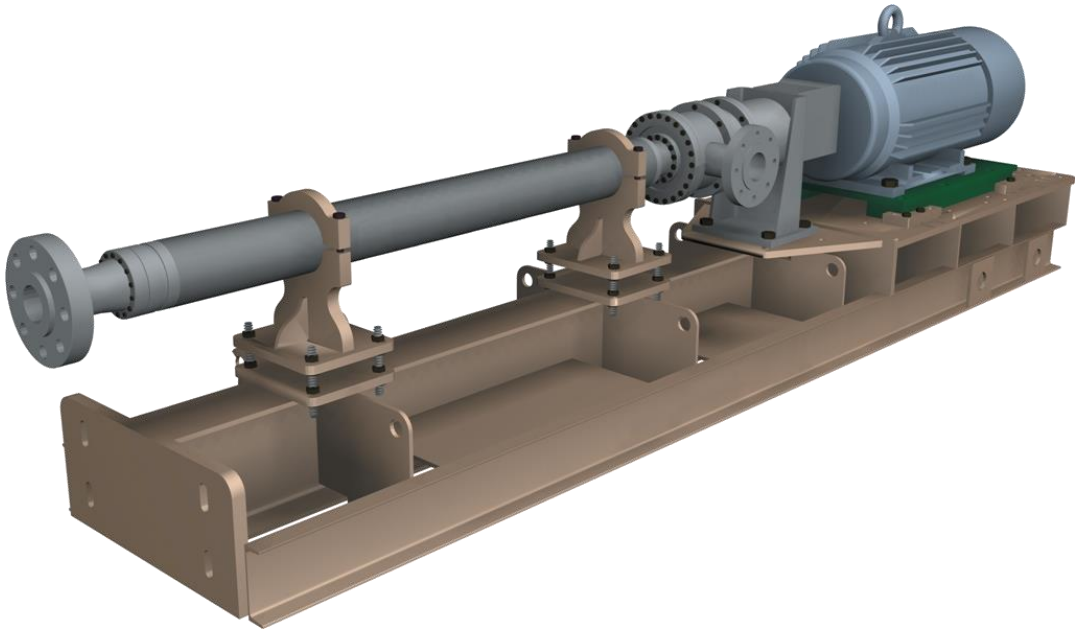
- Water injection/disposal
- Transfer and boosting of crude/NGL/water
- Gas treatment (i.e. Ammine recirculation)
- Refinery wash-water
- Mining dewatering
- Offshore

Advantages

- Motor range ~50HP-2000HP
- VFD, DOL or Softstarter
- Mechanical sealing system (various API plans available)
- Skid-based

Limitations

- Large footprint
- Solids handling



Surface pumping systems

Upstream
- Water injection/disposal
- CO2 and water flood (EOR)
- LACT pumps
  (lease automatic custody transfer)

Midstream
- Crude transfer and boosting
- NGL transfer and boosting
- Water transfer and boosting

Downstream
- Gas treatment (i.e. amine recirculation)
- Refinery wash-water

Efficiency quick glance	% eff. @ BEP
525 GPM (18,000 BPD)	80%
1500 GPM(51,428 BPD)	85%
2500 GPM (85,714 BPD)	86%

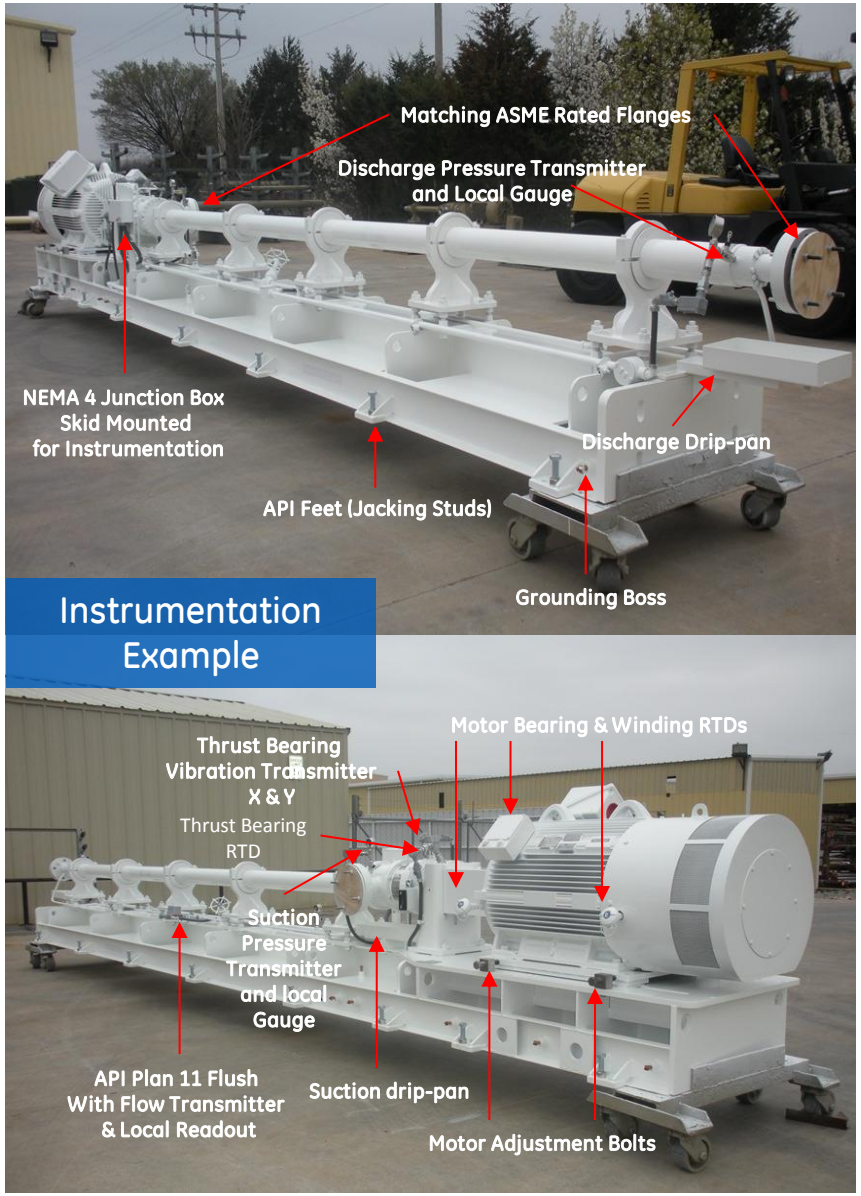
Mining and storage
- Mining dewatering
- Water supply and transfer
- NGL injection and storage (cavern storage)
- Salt dome cavern leeching and storage

Offshore
- FPSO crude transfer and water injection
- Platform transfer and injection pumps
- Recirculation applications
- Seawater injection applications

SPS Ranges quick glance	Min	Max	Unit
HP range	50	2000	HP
Flow range BPD	170	102,000	BPD
Flow range GPM	5	3000	GMP
Flow range M ^{3}/HR	1	675	M ^{3}/HR
Pressure range?		10,000	PSI

SPS packages

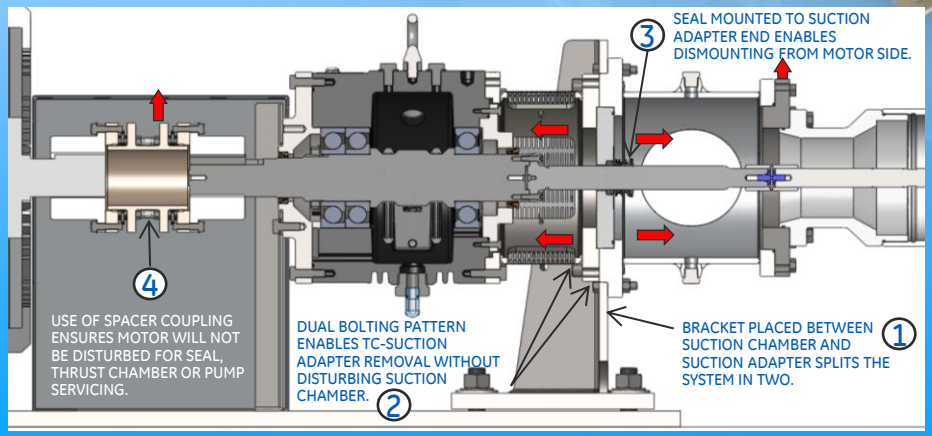
- Motor range ~50HP-2000HP
- VFD, DOL or Softstarter
- Mechanical sealing system - (various API plans available)
- Skid
- Instrumentation
  - RTDs for bearing and lubrication temperature
  - Vibration transmitters
  - Suction and discharge pressure transmitters
  - Flow meters
  - Custom instrumentation



Patent pending quick service option

Dual access mounting system

- Bi-directional seal removal
- Thrust chamber removal without disturbing pump/motor
- Service flexibility
- Less downtime/reduced service charges for customer
- Improved and standardized components



Rod Lift Systems

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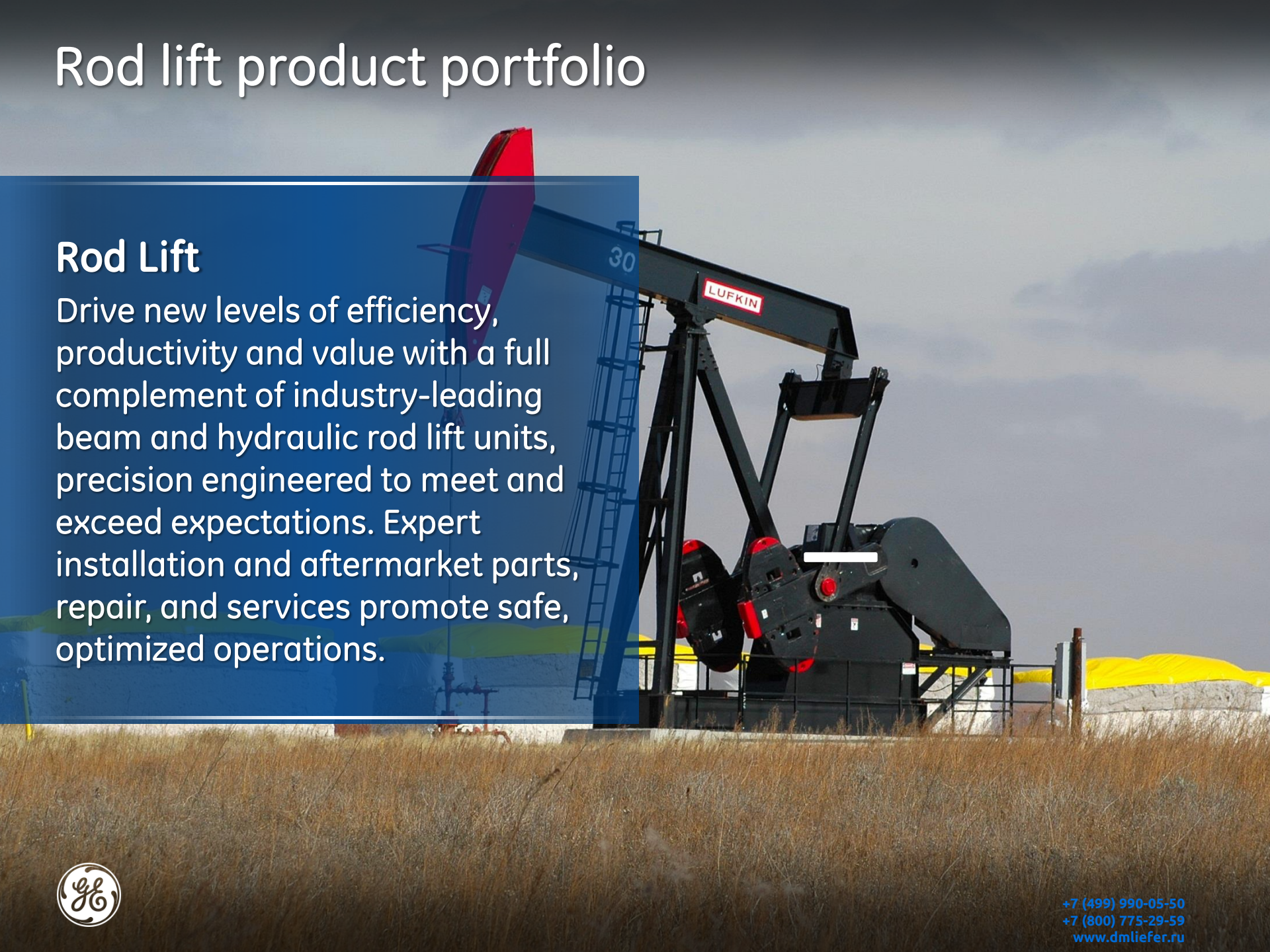
Rod lift product portfolio



Rod Lift

Drive new levels of efficiency, productivity and value with a full complement of industry-leading beam and hydraulic rod lift units, precision engineered to meet and exceed expectations. Expert installation and aftermarket parts, repair, and services promote safe, optimized operations.

Lufkin beam pumping units

"The workhorse of the oil field"

Applications

- Pump depths up to 16,000 ft
- Volumes from 1-6,000 BBD
- Wells with low bottom hole pressures

Advantages

- Proven, tested design
- Extremely reliable
- Can produce very efficiently
- Variety of models available
- Products backed by a network of installation, service, and repair expertise

Limitations

- When very high flow rates are needed

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Lufkin beam pumping systems

Conventional

- Simple operation
- Minimum maintenance
- The "workhorse" of the oil field

Mark II

- Available in 50 different sizes
- Unique geometry that can reduce torque up to 35% and deliver lower power costs

Air Balanced

- Approximately 35% shorter and 40% lighter than crank-type units
- Ideal for use as portable or test
- Can be installed on piling or superstructures

Low Profile

- Designed for installation in fields irrigated by traveling sprinkler systems or in urban areas
- Low profile feature makes for a more compact footprint

Reverse Mark

- Improved alternative to the conventional type geometry
- Reduced torque and power requirements on many pumping applications

Portable Roadrunner

- Can be erected and fully functional in a few minutes at the well site
- Trailer-mounted self-contained conventional pumping unit that lowers for legal highway transport

Lufkin specializes in appropriate geometries for well conditions that minimize loads and maximize production

Conventional

- Considered reliable "work horse" in the oil patch
- Available in sizes up to 1824D-305-240
- Simple to operate
- Require minimum maintenance
- Crank-balanced design

Lufkin's conventional … The original

First "enclosed geared" pumping unit was designed and built by Lufkin for Humble Oil in 1923.

Mark II

- Lowers peak torque and horsepower requirements
- Produces slower upstroke and faster downstroke with reduced acceleration where the load is greatest
- Unitorque geometry to reduce torque on gearbox up to 35%

The Mark II is characterized in the following ways:

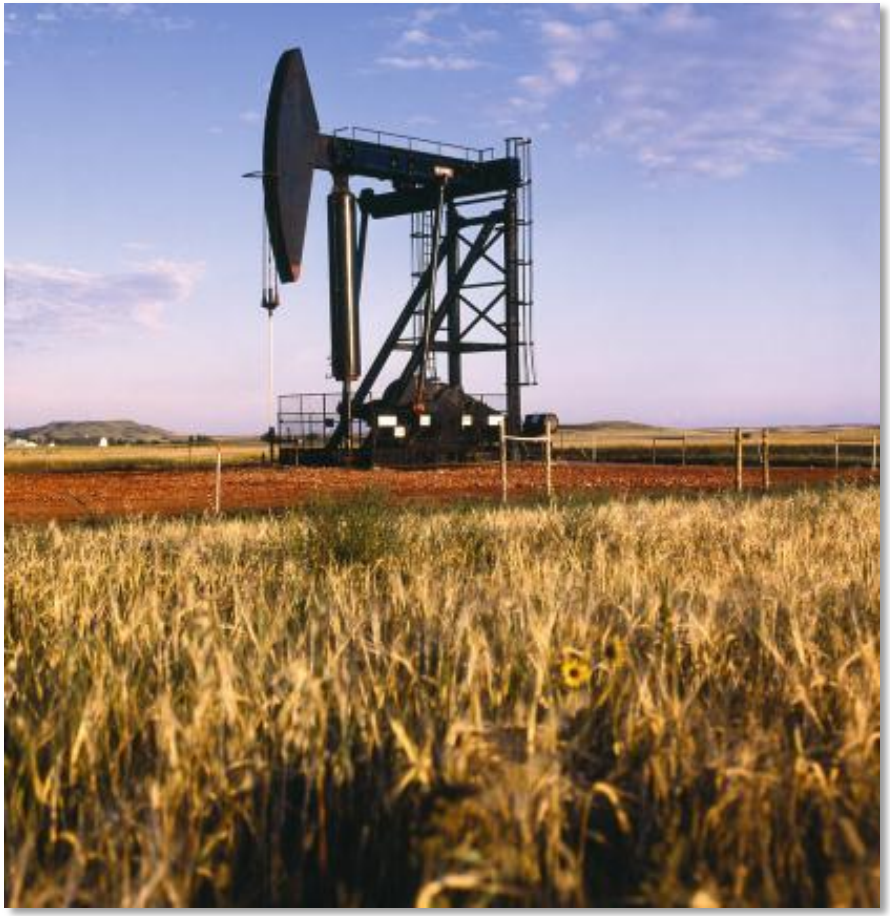
- Shifting of the gearbox towards the Samson post
- Placement of the equalizer between the horsehead and Samson post
- Angular offset in the crank produces more effective counterbalance torque

Reverse Mark “RM” series

- Similar in appearance to the Lufkin Conventional Pumping Unit, but the “RM” Series Unit geometry can reduce the torque and power requirements on many pumping unit applications
- Offers an improved alternative to the conventional geometry
- In some instances a smaller reducer and prime mover can be used

Air-balanced

- Distinct advantage for long stroke applications
  - Stroke lengths to 20 feet for high volume production at greater depths
- Utilizes compressed air instead of cast iron counterweights
  - Perfect counterbalance with finger-tip control
- Weight of unit is greatly reduced leading to …
  - Compactness and portability
  - Ideal for well testing



Churchill - beam balanced units

- Churchill Beam Balanced Pumping Units are exclusively offered by Lufkin
- Unit of choice around the world for shallow well applications
- Unique StepDown™ housing
  - Minimizes shaft deflection
  - Improves proper gear meshing
- Positive lubrication w/integral wiper system
- Precision-cut Lufkin helical gears

Specialty unit designs

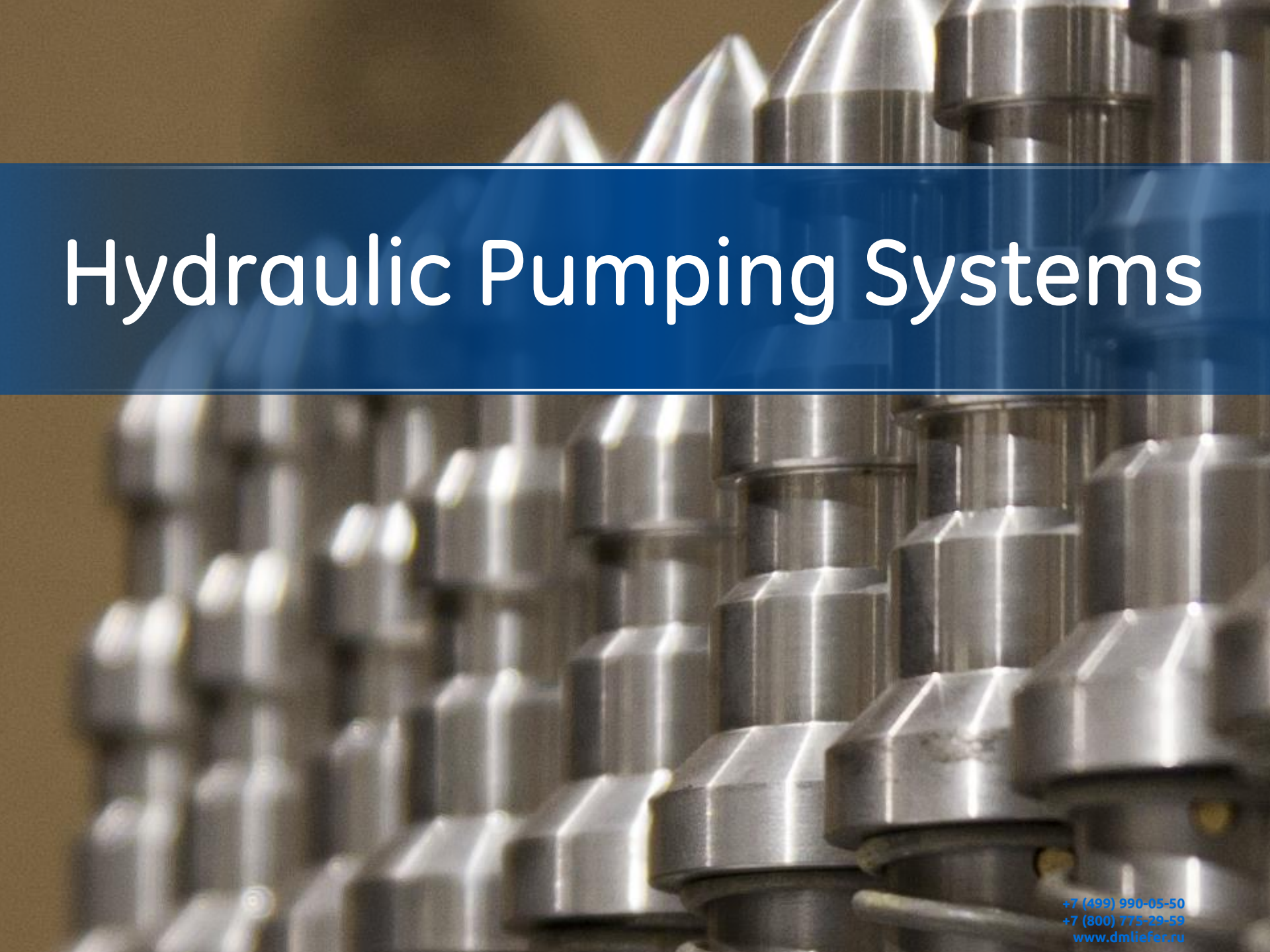
LPII Low Profile Pumping Units

- Compact design for installation in fields with irrigation systems or in urban areas
- Can be shipped from factory completely assembled

Roadrunner – Portable units

- Self-contained conventional pumping unit
- Lowers for legal highway transport
- Quick set up @ Wellsite
- For sale, lease or rental

Hydraulic Pumping Systems



Lufkin hydraulic pumping systems

An innovative approach to rod lift

Applications

- Deep wells
- Dewater gas wells
- Stripper wells
- High or pad restrictions
- Close proximity wells

Advantages

- Long stroke-length
- Minimal footprint
- Change lift speeds instantaneously
- Reduced rod wear
- Quick setup and takedown

Limitations

- Solids handling

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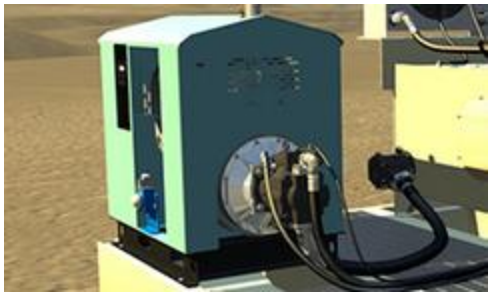
Lufkin hydraulic pumping system components

Base	Prime Mover	Mount Type
• Can be mounted on a skid or in a container	• Can use natural gas, diesel, or electric	• Direct mount • Pedestal mount • Dual mount
		

An ideal choice for wells with restricted footprints or other environmental considerations.

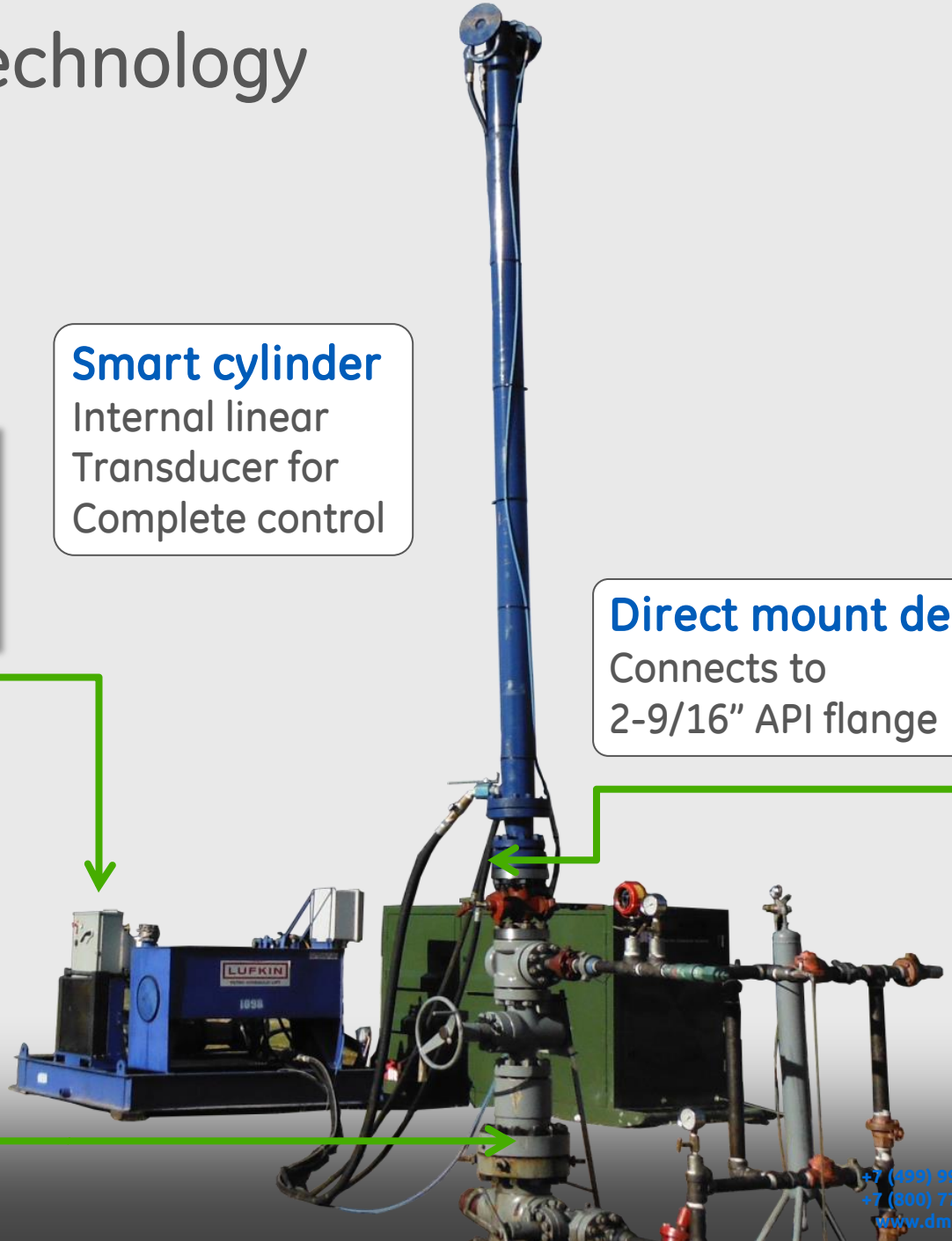
Hydraulic lift technology

Improved control
Pressure/polished
Rod load

Smart cylinder
Internal linear
Transducer for
Complete control

Direct mount design
Connects to
2-9/16” API flange

Internal sucker
Rod connection



Automation & Optimization

Our smart controllers, sensors software, gauges and field optimization software along with our connectivity and consulting services optimize your operations across all lift categories, using intelligence from one machine or network to improve performance, avoid failures and minimize downtime.

Oilfield automation

Increasing well production, reducing electrical costs, improving uptime, and cutting maintenance costs through technology and services

Field automation

- Pump-off controllers
- Injection well controllers
- Progressing cavity pump controllers
- Variable speed drives
- Motor control panels
- Design/analysis software

Well monitoring

- Artificial lift and reservoir monitoring systems
- ESP bypass systems
- Auto flow valves
- Dual ESP completions
- Remote Monitoring
- Predictive Analytics

Optimization

- Consulting
- Production
- Reservoir
- Power
- Run life

Field Vantage™

imagination at work

Automation

Optimized artificial lift equipment and well performance

Equipment automation

Continuous monitors equipment data to promote performance and reliability

- Lufkin Well Manager (LWM)
- Pump-off controllers
- Injection well controllers
- Progressing cavity pump controllers
- Variable speed drives
- Motor control panels
- Design/analysis software

Well monitoring

Monitors and optimizes artificial lift equipment and performance for enhanced production

- Artificial lift and reservoir Monitoring systems
- ESP bypass systems
- Auto flow valves
- Dual ESP completions
- Field Vantage™ auto well surveillance system
- Z-Trendz data management

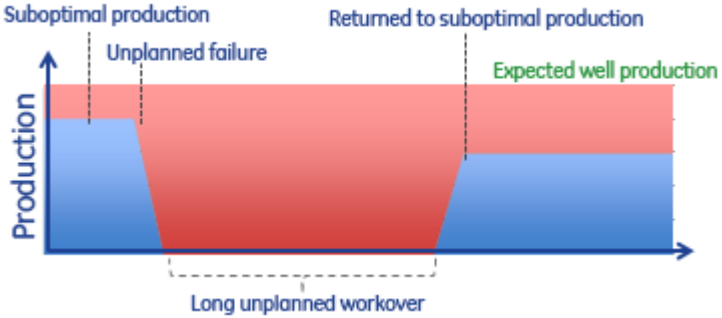
Data management

Data management and wireless transmission

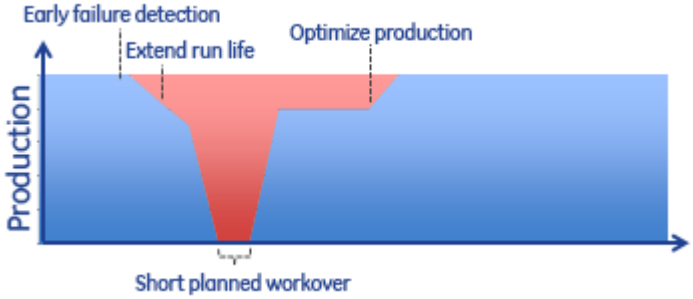
- Pipeline SCADA systems
- Wellhead control systems
- Platform automation
- Pipeline management solutions

Field Vantage™ solutions

Without Field Vantage



With Field Vantage



Visualize

Predict

Optimize

Data-driven insights that empower you to make better decisions faster—enabling results such as production gains of 5-8%

Field Vantage™ solutions

- **Advanced Services** GE's highly experienced Production Consultants, Advisory Services, and on-site field service engineers help customers get the most of technology and maximize outcomes.
- **Optimization and Predictive Analytics** When operations are transformed from reactive to proactive, and pumps run for optimal flow, operators eliminate the risk and variability of meeting and exceeding production targets.
- **Instrument and Connect** Operators are more effective when they can visualize operational data gathered with high integrity, transmitted reliably and presented for the way they work—anywhere and on any device.

Move from reactive to predictive, proactive operations

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Equipment automation

Lufkin Well Manager (LWM)

- For beam pumping unit, PCP, gas lift and plunger lift systems
- Real-time dynamometer, monitoring and control
- Protect the system against the severe fluid pound
- Accurate end devices and data
- Peak and min. load protection

LWM with Variable Speed Drive (VSD)

- Sanding/pump sticking problems
- Heavy crude oil and rod float problems
- Steam flood with erratic inflow
- Situations where shutting down would adversely affect production operations
- Speed changes without replacing sheaves

LWM Regen

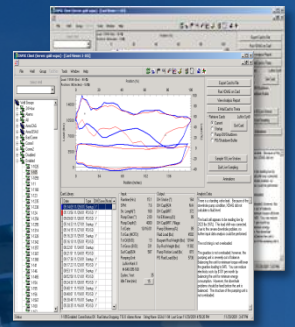
- Capture the energy normally lost in dynamic braking
- The only drive solution that can meet IEEE519-1992 especially with unbalanced 3-phase power
- Meet many new specs as seen in Northern US, Canada, and International locations
- Regen drives have <5% harmonics at full load

Injection Well Controller

- Protect reservoir and productivity with IWC
- Avoid reservoir damage from excessive pressure
- Monitor injection speed to optimize production
- Easily track water/CO2 supply
- Quickly identify clogged filters or equipment malfunctions

SCADA

- Maximize production
- Can reduce failures and downtime
- Optimization properties
- Remote wells
- Scattered locations
- Daily well test and PIP
- Daily reports
- Well diagnosis

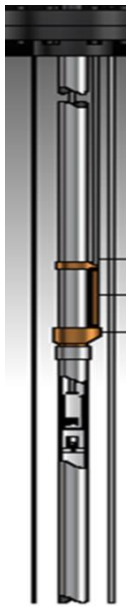


Well optimization - Zenith sensors and gauges

Precision monitoring

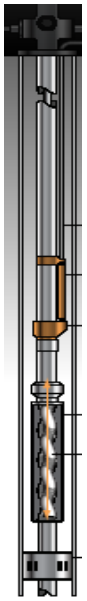
Beam Pumping Downhole

- Sensor installed above the pump
- Used to monitor the reservoir performance
- Field development
- Optimize reservoir draw down



PCP Downhole

- Sensor installed above the pump.
- Used to enhance PCP performance
- Production optimization
- Improve PCP runlife



Gas Lift Downhole

- Monitors annulus and internal tubing pressure at the injection point
- Optimizes gas injection and production real time
- Data is used for field development

ESP Downhole

- Installed on the ESP motor
- Monitors ESP performance and increases ESP run life
- Can be used to calculate water cut and flow rate real time to within 5% accuracy

Natural Flowing Wells Downhole

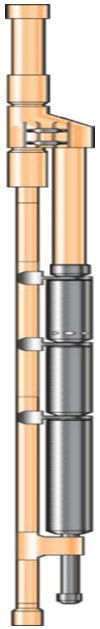
- Installed close to the perforations.
- High accuracy gauges used to monitor reservoir performance
- Data used for field development
- Data used to convert wells to artificial lift

Well automation - Zenith ESP & PCP optimization

Enhanced well operation and performance

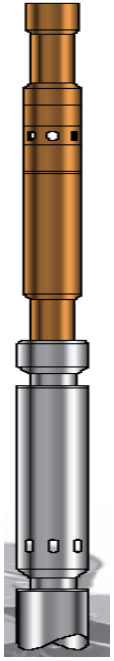
ESP Bypass system

- Installed with the ESP to allow access below the ESP
- Used to perform wireline and coiled tubing actives at the reservoir
- Logging data is used for field development



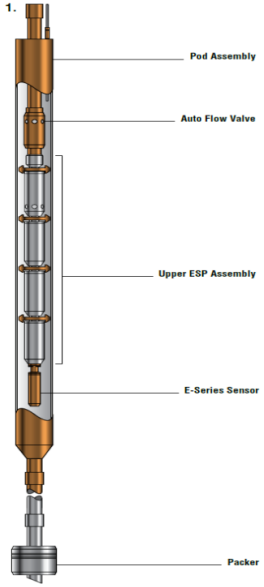
ESP Tubing Drain Valve

- Installed directly above the ESP
- Used to enhance ESP performance by diverting debris away from the ESP
- PCP version is available



ESP POD System

- ESP is encased in a metal can (POD)
- Used to install an ESP where the completion is latching onto a lower assembly
- If installed with a formation saver valve the customer can do a workover without killing the well

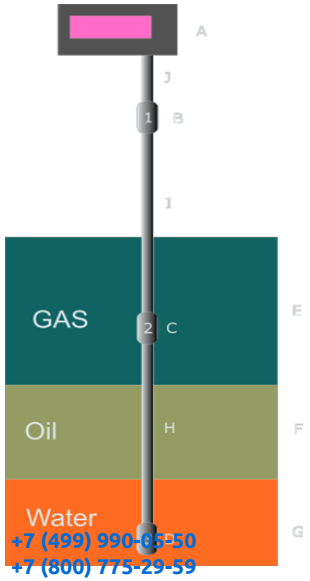


Field Vantage™ PCP & ESP

- Automation software is installed beside or inside the ESP VSD at the well site
- Provides real time flow rate, water cut, Pwf, gas at pump intake ...
- Provides real time production optimization recommendations

Ztorm

- Installed in observation or abandoned wells
- Designed to measure oil and water contact and oil and gas contact
- Based on TDR technology
- Accuracy 1m, resolution 0.01m



Vector™ Plus variable speed drive

Greater ease of use and improved intelligent control capabilities

- 173 KVA to 998 KVA
- 6 Pulse and 12 Pulse
- VSG and Non-VSG
- NEMA 4 Enclosure

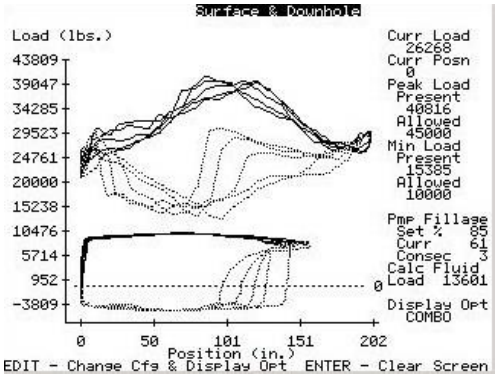
Automation technologies

Automation

What it does:
- Cloud based software; communicates to controllers on wells
- On board analysis/design tools

Benefits:
- Subscription based pricing model
- Limited customer IT support required

iWELLManager

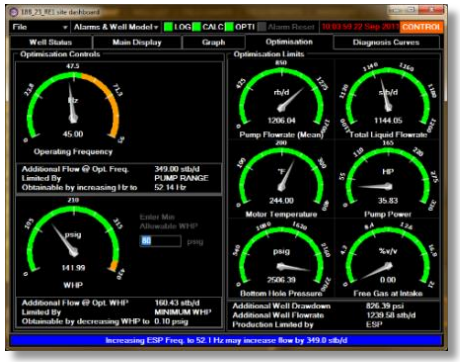


Integrating Big Data to drive improved well performance

Field Vantage

What it does:
- Located at site; web-based access
- Calculated well performance
- Tracks essential system parameters

Benefits:
- Optimize and analyze in real-time
- User friendly interface
- Reservoir Monitoring Systems
- Auto Well Surveillance System
- Z-Trendz Data Management

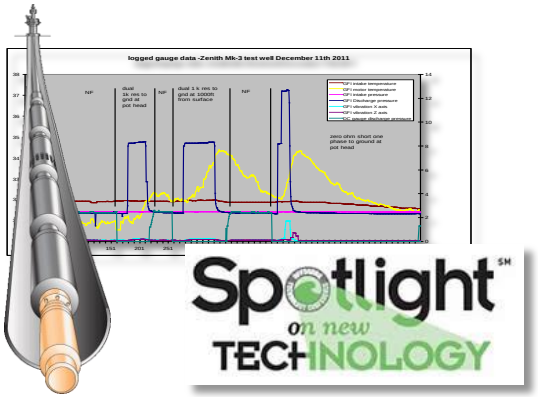


Increasing production and well tracking capabilities

GFI (Ground Fault)

What it does:
- Maintains pump data collection during a ground fault … increases reliability

Benefits:
- The worlds first gauge that can operate with ESP cable ground faults
- Will operate with any cable condition the pump can run in
- Measures the ESP cable condition
- Fast 1 sec data updates



Receiving Innovation Award at 2015 OTC conference

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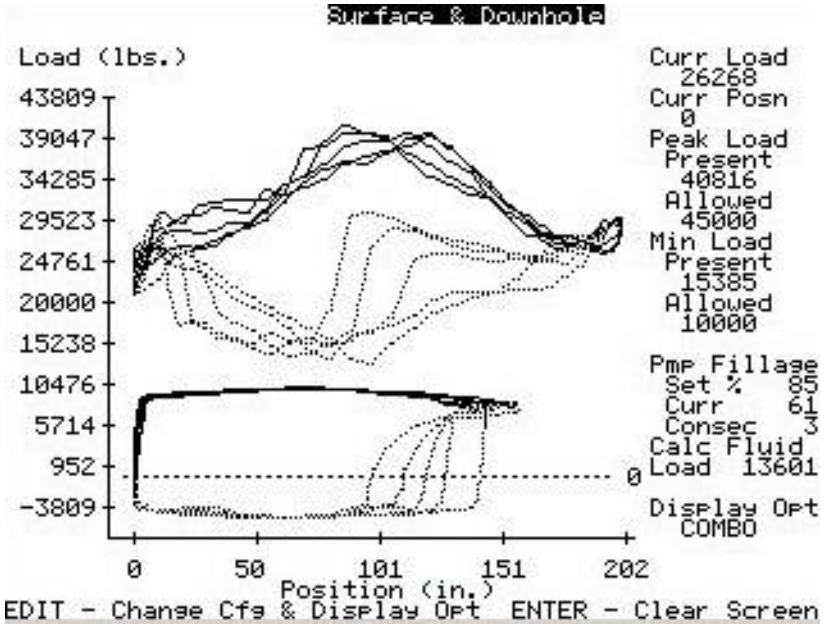
Automation at the well site

Full ESP operational data on a simple to understand well site display:

- ESP gauge data
- VSD data
- Well head data
- Flow rate (surface and down hole)
- Water cut
- Pump curve
- IPR curve
- Bottom hole flowing pressure
- Motor cooling
- Gas at pump intake
- Alarm set points on dials

Rod pump, pump-off control - RPC



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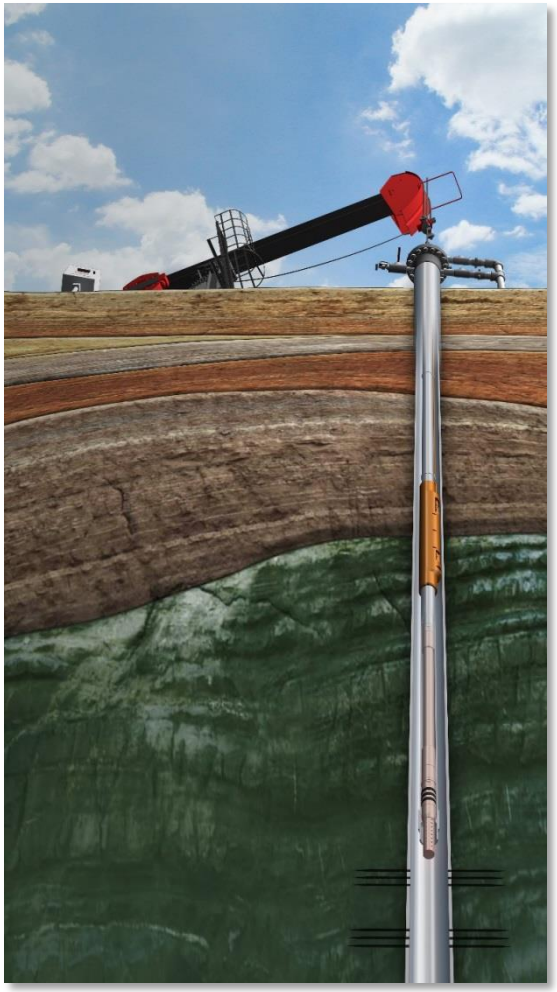
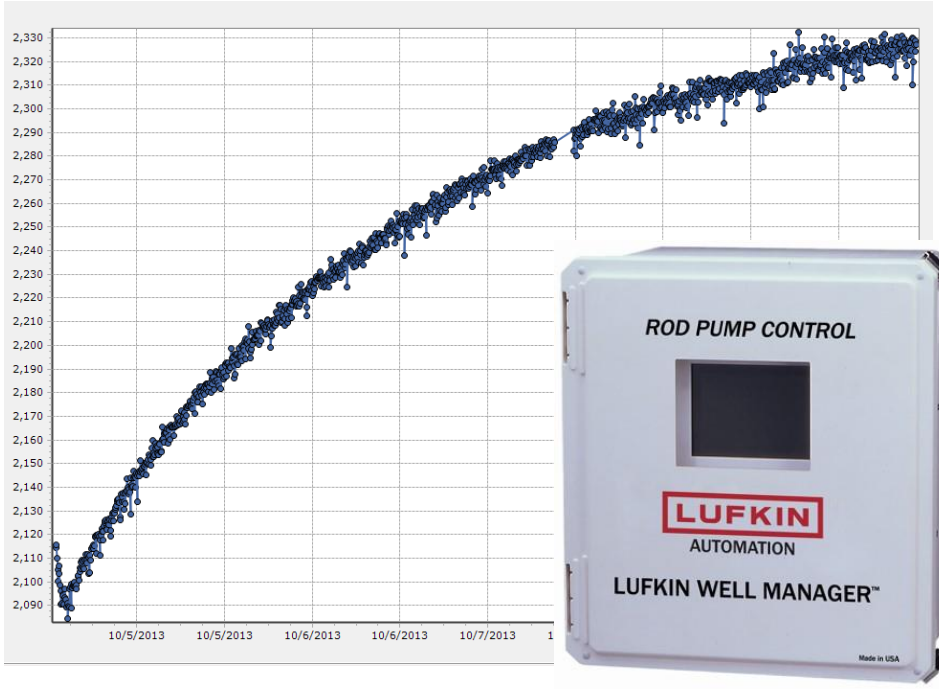
Downhole gauges beam and PCP



- Pressure build surveys
- Well performance monitoring
- Pump and well optimisation



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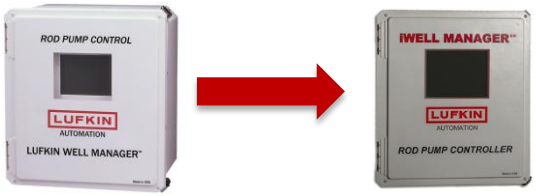
Innovative automation technology

SCADA Info Server:
1. Application Server
   - Asset Management
   - Predictive Failure Analysis
   - Analytic Tools
2. 3rd Party SCADA Systems
3. Production Optimization
4. Reservoir Consulting and Modeling
5. Business System Integration

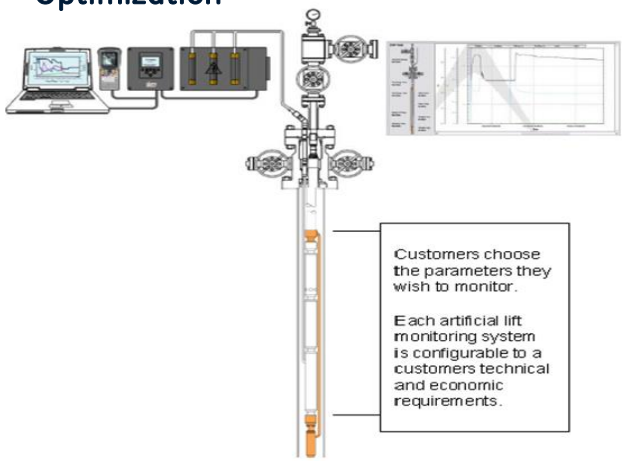
Connectivity:
1. Ethernet
2. Radios
3. Cellular
4. Satellite
5. OPC

Zenith
ESP & PCP
Optimization



Lufkin Well Manager
1. RPC
2. PCP
3. IWC
4. Plunger Lift

Lufkin Well Manager (next gen)
1. Same Base as LWM + ESP
2. Optimization per Stroke
3. Improved Communications
4. Surveillance for Asset Mgmt
5. Improved Color User Interface



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Field Vantage™ prognostics

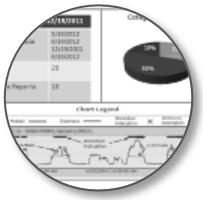
Reactive to proactive

GE Field Vantage Chicago Monitoring Capabilities

160+ Units

4000+ Assets

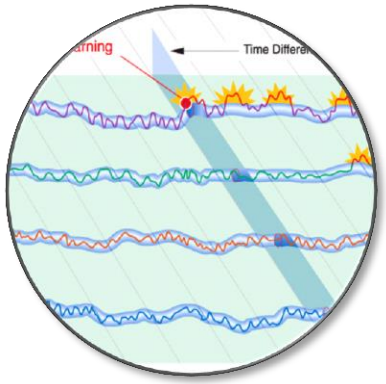
100k+ Sensors



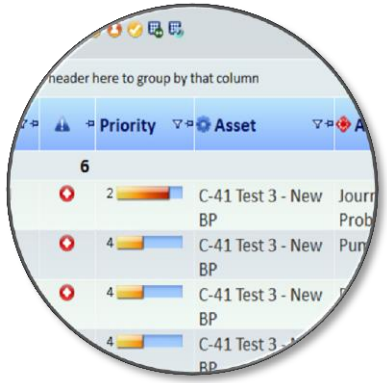
40+ Reports

35+ Calls

40+ Actionable Notifications



Multiple sensors compared thresholds exceeded result in advisories



Monitoring center tracks issues and reports weekly

Field Vantage™ prognostics

Reactive to proactive

ESP bearing failure example

5

3

ESP slowed down

Workover rig scheduled

1

Nov '11 Pump install

Jan 1, 2012 high vibration indication

Jan 12, 2012 very high priority 3 **vibration** indication. Decided to slow ESP down

Mar 1, 2012 persistent priority 4 vibes

Apr 9, 2012 pump speed increase high vibes return after

Apr 30, 2012 pump failure

Power to Lift™ System

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Power to Lift™ system

A fast, modular, and flexible power solution for evolving artificial lift needs

Applications

- Areas where there is no pre-existing power infrastructure and capacity
- When power assurance is uncertain or power requirements are difficult to predict

Advantages

- Powered by well gas
- Provides power, power management & artificial lift
- Single package modular design
- Multi-well capabilities
- Communication & control solutions for smarter operation
- Flexible power range
- Environmentally efficient

Limitations

- Well gas must be present in sufficient quantities

Power to Lift™ value

A fast, modular, and flexible power solution for evolving artificial lift needs

Modular and complete

Provides power, power management and artificial lift/SPS in a single integrated solution with common system communication and control

Flexible

Ability to operate efficiently across a wide range of power demand scenarios from multiple pumps to decreasing power output needs

Fast deployment

Package skidded design allows truck-able deployment/ retrieval with rapid set up where natural gas is available

Cost and environmentally efficient

Running off treated field gas, price per Kwh is competitive with utility power or significantly less cost and emissions than diesel

Reliable

Dedicated power provides consistency of output with the ability to monitor and prevent outages across the system prior to unexpected failure

Power to Lift™ components

Waukesha Engine	eHouse	Remote Monitoring
• Comes on a skid • EPA Certified suitable for operation anywhere in US (Additional certification required for CA) • Market leading rich burn design, is ideal engine for Field Gas Ability to run on Propane or CNG • No de-rate required up to 8,000' • Wide operating range 0.1 to 1MW • Longer run time between scheduled maintenance (approx. 83 days vs. 14 days for diesel)	• Fault protection for manned/ unmanned operations • High capacity feeders segment & distribute power downstream, isolating individual components from one another • Harmonic protection and power factor correction • The two major components do not require permits to transport; cranes are not required • Generator control panel allows two or more Power to Lift systems to be paralleled with each other or existing grid infrastructure	• ComAp RM&D for each unit provides comprehensive information to any web enabled device • Security video surveillance for remote monitoring of each unit

A fast, modular, and flexible power solution for evolving artificial lift needs... And it's cost effective and environmentally friendly

Power transmission

Industrial gears

- Designs and manufactures enclosed gear drives
  - Low speed
  - High speed
- Epicyclic gears

Gear repair

- Provides aftermarket gear box repair and field service
  - Lufkin HS and LS
  - Competition gear boxes
- Global service centers

Bearings

- Manufactures precision tilting pad bearings
  - Tilting and fixed pad
  - Pressure dam
  - Multi-lobe
  - Plain journal

Customers in a range of industries around the world rely on Lufkin's enclosed gear drives, epicyclic gears, and engineered bearings

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Power transmission division

Producer of industrial gear drives since 1939

Industries served

- Energy
  - Oil & gas production
  - Refining and Petrochemical
  - Wind
  - Transmission
  - Hydro
  - Nuclear coal gas
  - Marine propulsion
- Industrial
  - Metals processing
  - Tire and rubber
  - Plastics

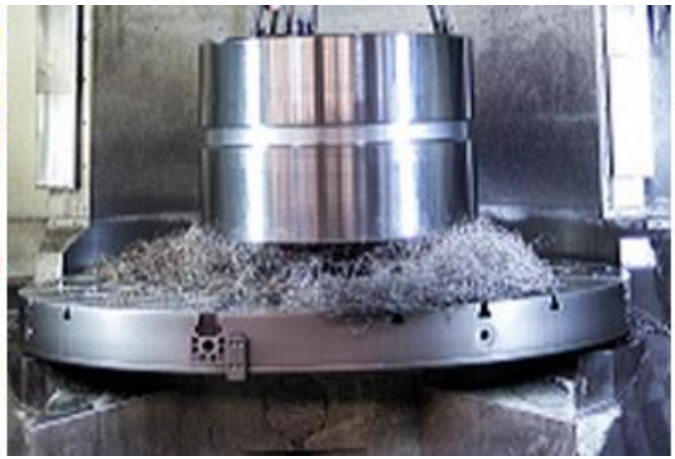
Promoting extended uptime through…

Research

Process integration

ISO 9001 Certification

Inspection & testing



Backup

Why do we need to artificially lift?

The North and South American market

96% of all oil fields in North & South America use artificial lift technology

Unconventional Oil Sources

- Experiencing quick production decline
- Quick decline leads to use of multiple types of artificial lift technology

Mature Conventional Fields

- Low production (per well)
- artificial lift use needed to continue production
- Some on ESP, most on SRP

Heavy Oil (SAGD) Sources

- Majority of world oil reserves
- Extremely viscous oil
- artificial lift needed to bring oil to surface

Remaining world market

Russia

96% artificial lift

- Maturing fields require artificial lift use
- Most prominent ESP user in the world
- artificial lift use needed to maintain production

Middle East/Africa

53% artificial lift

- High initial production
- Maturing wells have been producing for many years
- artificial lift use needed to maintain production/ control decline

Far East

72% artificial lift

China

99% artificial lift

- Maturing fields require artificial lift use

Thailand:

- Vibrant oil & gas market
- High temperature oil and gas wells
- Challenge to down hole equipment longevity

Indonesia (Duri):

- Largest steam flood in the world
- Largest user of ESPs (in region)

China:

- Requires artificial lift use to grow production, and for unconventionals