





Webinar Series		
1. Introduction to Artificial Lift		Aug 27 '14
2. Reciprocating Rod Lift (RRL)		Sep 23 '14
3. Gas-Lift		Oct 21 '14
4. Progressing Cavity Pumping (PCP)		Nov 19 '14
5. Electrical Submersible Pumping (ESP)		Dec 16 '14
6. Hydraulic Lift: Jet Pump & Piston Pump		Jan 13 '15
7. Plunger Lift and Capillary Deliquification		Feb 10 '15
8. Production Optimization for Artificial Lift		Mar 3 '15

Presentation Outline

- What is gas lift? How it works?
- Benefits, Limitations
- Components & Configurations
- Optimization



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Poll Question

Gas-lift works because injected gas reduces well fluid's ...



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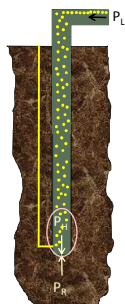
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Ways to Lift Liquids from Wells

- Aeration – Reduce fluid column weight

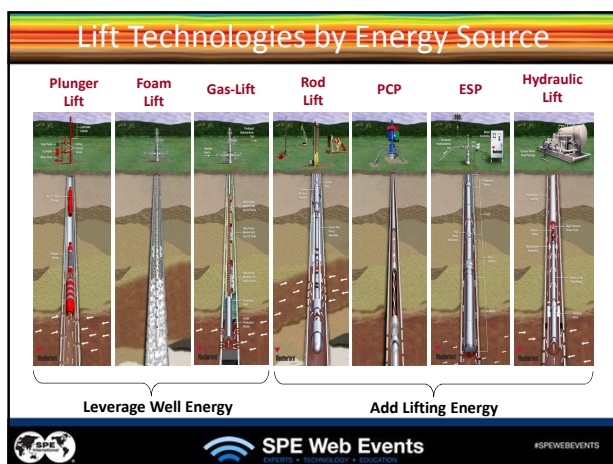
$$P_{\text{Reservoir}} > P_{\text{Hydrostatic}} + P_{\text{Line}}$$

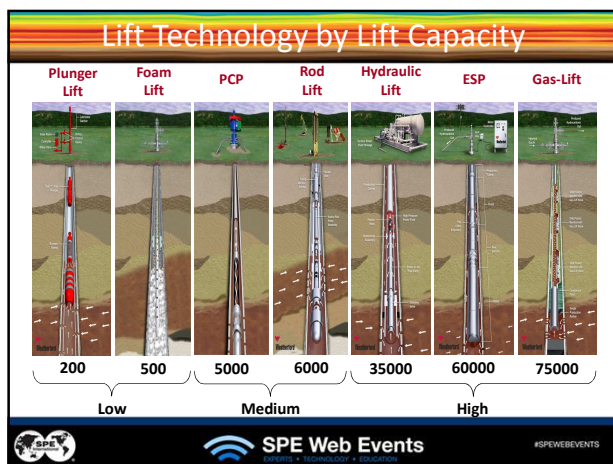
Conventional Gas-Lift



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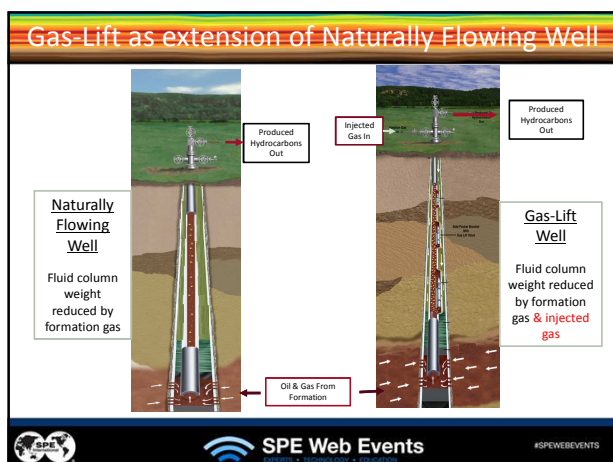


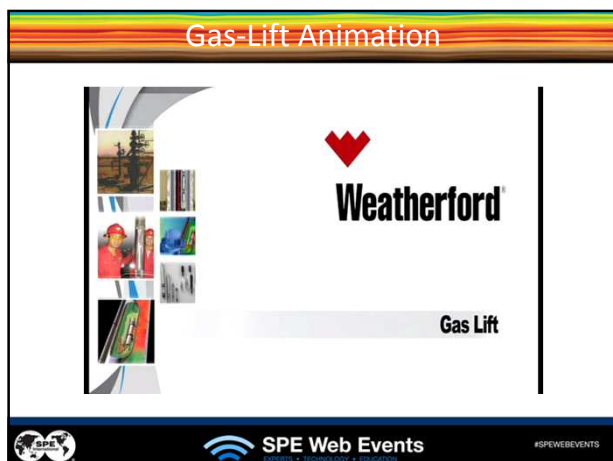


Poll Question

Which 2 lift technologies produce the most oil?

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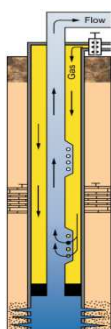
Gas-Lift Types:: Continuous & Intermittent Flow

CONTINUOUS FLOW	CONDITION	INTERMITTENT FLOW
100 – 75,000	Production Rate (BPD)	Up to 500
> 0.3 psi/ft	Static BHP (psi)	< 0.3 psi/ft
> 0.08 psi/ft	Flowing BHP (psi)	150 psi and higher
50 – 250 per 1000 ft of lift	Injection gas (scf/bbl)	250 – 300 per 1000 ft of lift
> 100 psi per 1000 ft of lift	Inj Pressure (psi)	< 100 psi per 1000 ft of lift
Larger volumes	Injection rate	Smaller volumes

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Continuous Flow



- High pressure gas injected into tubing
- Injected gas aerates fluid from the injection point to the surface
 - Reducing fluid density
 - Reducing hydrostatic head on the formation
 - Allowing reservoir pressure to lift the column of fluid



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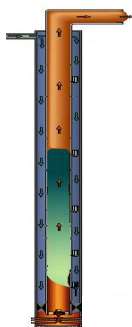
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Intermittent Flow

- High pressure gas injected into tubing
- Expanding gas displaces fluid *slug* from the injection point to the surface
- In gas well dewatering, tubing velocities increase during the lift cycle thus sweeping fluids to surface



Surface facilities and piping must be capable of handling periodic sudden high rates of liquids & gas.



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Gas-Lift Advantages

- Initial equipment costs are lower than other lift methods (CAPEX<US\$20k)
- Maintenance/repair costs are less costly and less frequent
- Simplified well completions
- Flexibility - wide range of production rates and well conditions
- Good operation in high GOR wells
- Good performance in sandy well conditions
- Good performance in deviated wells



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Gas-Lift System Limitations

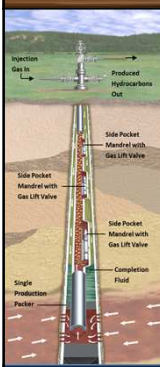
- Needs high-pressure gas well or compressor (capital cost~)
- One-well leases may be uneconomical or require a rental compressor
- Fluid viscosity : Gravity less than 12° API
- Bottomhole pressure less than 0.04 psi/ft
- High back-pressure (common issue for all flowing wells or other ALS)



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Gas Lift Application Considerations



	Typical Range	Maximum*
Operating Depth (TVD)	5000' – 10,000'	15,000'
Volume	100 - 10,000 BPD	30,000 BPD
Temperature	100 to 250° F	400° F
Well Deviation	0 to 50°	70° Short to Medium Radius
Corrosion	Good to Excellent (with Upgraded Materials)	
Gas Handling	Excellent	
Solids Handling	Good	
Fluid Gravity	Best in >15° API	
Servicing	Wireline or Workover Rig	
Prime Mover	Compressor	
Offshore	Excellent	
Efficiency	10% – 30%	

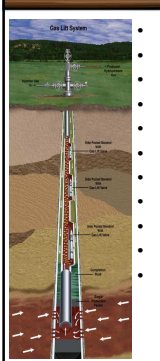
*Requires special analysis



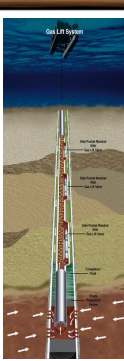
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Potential Gas-Lift Applications



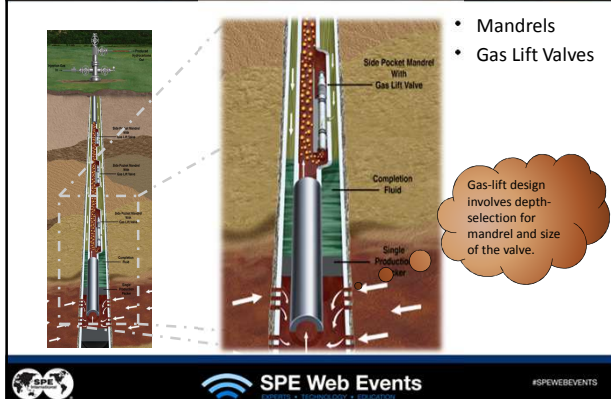
- Remote and offshore
- High volume
- High GOR
- Variable production rates, GOR, fluid phases
- Limited well data
- Thermal wells
- Long perforation intervals
- Horizontal
- Sand, scales, salts
- Increasing production in flowing wells
- Unloading a naturally flowing well



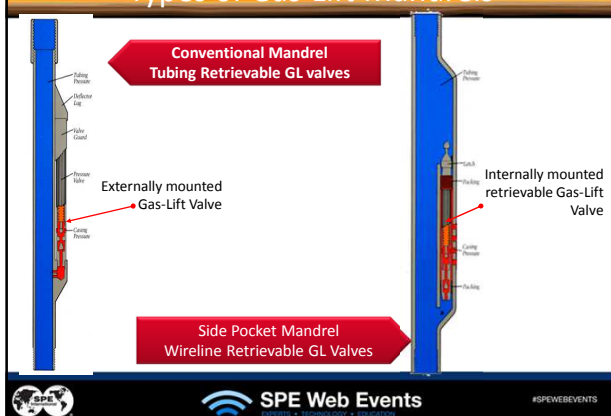

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Gas-Lift System Downhole Components

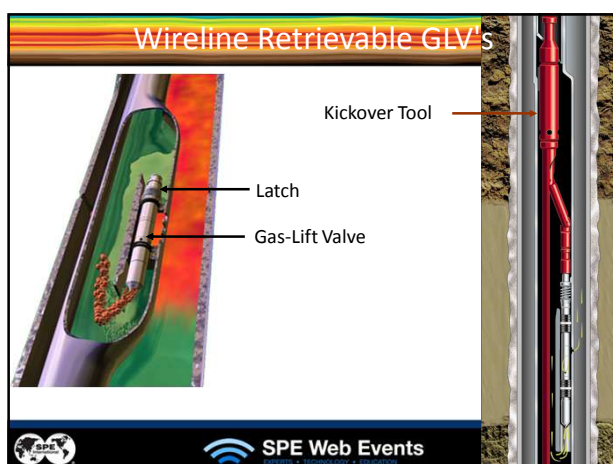


Types of Gas-Lift Mandrels

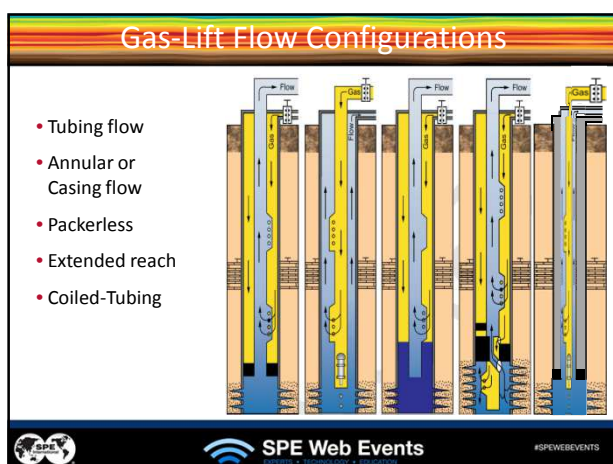


Types of Gas-Lift Valves









WHAT IS GAS-LIFT DESIGN AND OPERATIONS PROBLEM?



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Gas-Lift Design Operations Problem

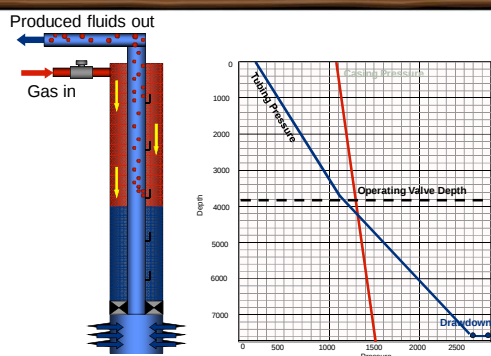
- Gas-lift design modeling
 - How to design an installation that will perform optimally for the longest possible time period?
- Gas-lift operations
 - Now that design is installed, how do I ensure that the installation is stable and working per design?
 - I have multiple g/l wells. Effective problem identification and troubleshooting in timely manner is key to production optimization...



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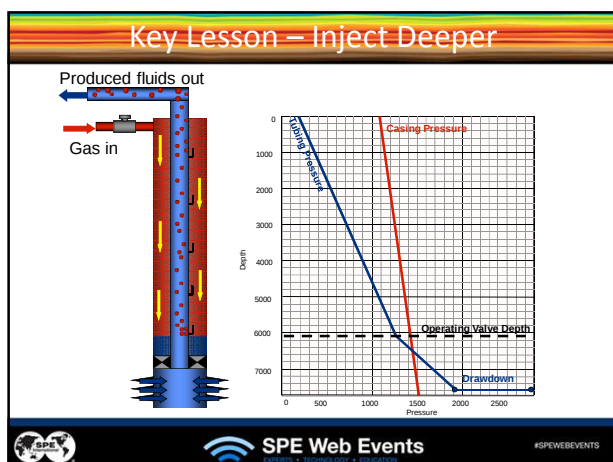
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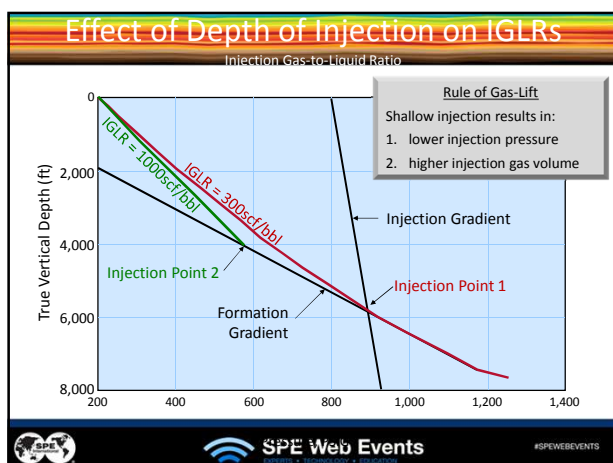
Key Lesson – Inject Deeper

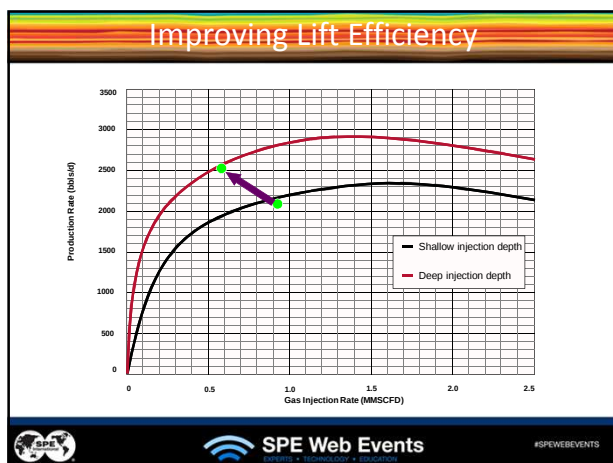


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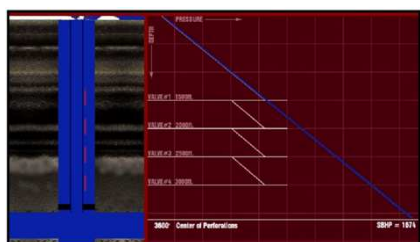
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Gas-Lift Operations – Unloading Animation



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Poll Question

Which of these statements is not always true?

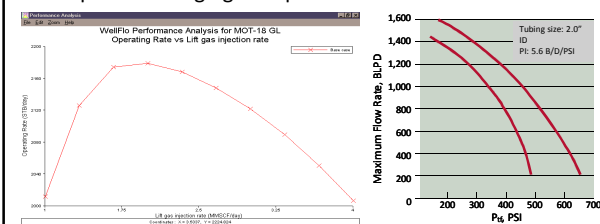


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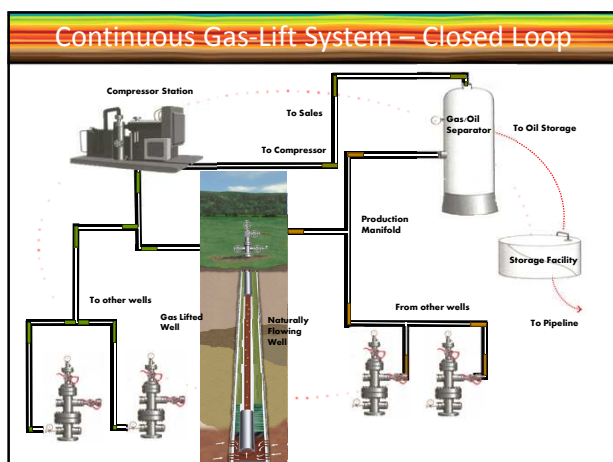
Well Modeling & Optimization

- Effects of injection rates, injection depths, pressures, tubing sizes, operating differential, wellhead pressure...
- Impact of gas-lift on a flowing well
- Impact of changing fluid phases



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Poll Question

Which of these statements is false?



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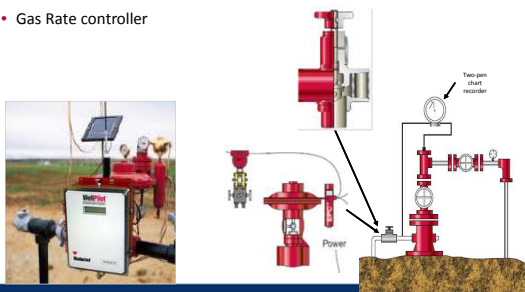
GAS-LIFT AUTOMATION - OPTIMIZATION



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Surface Gas-Lift Equipment

- Simple fixed or adjustable choke valve
- Time Cycle controller and/or choke valve
- Gas Rate controller



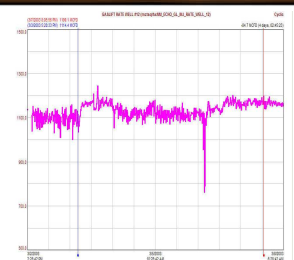
Two pen chart recorder

Power

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Typical Gas Injection setup

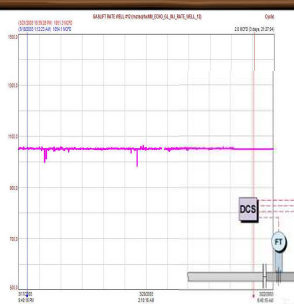


Automatic or manual gas injection choke valve

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Automated Gas-Lift Setup

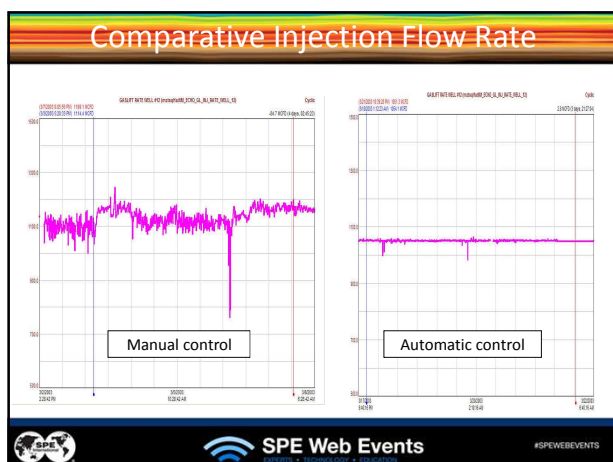


DCS

RTU with gas rate controller functions

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Take aways on Gas-Lift...

- Gas lift is typically the best solution for multiple high volume wells with high Gas-Liquid Ratio.
- Capital expense in gas lift is the compressor and injection pipeline network.
- Inject gas as low as possible and through a single location.
 - Injection depth is limited by the available pressure of the injection gas and completion depth.
- An efficient gas lift installation requires monitoring, so automated control is highly recommended.

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