



2022 GAS LIFT WORKSHOP



Gas Pump – A New High Pressure Gas Lift System

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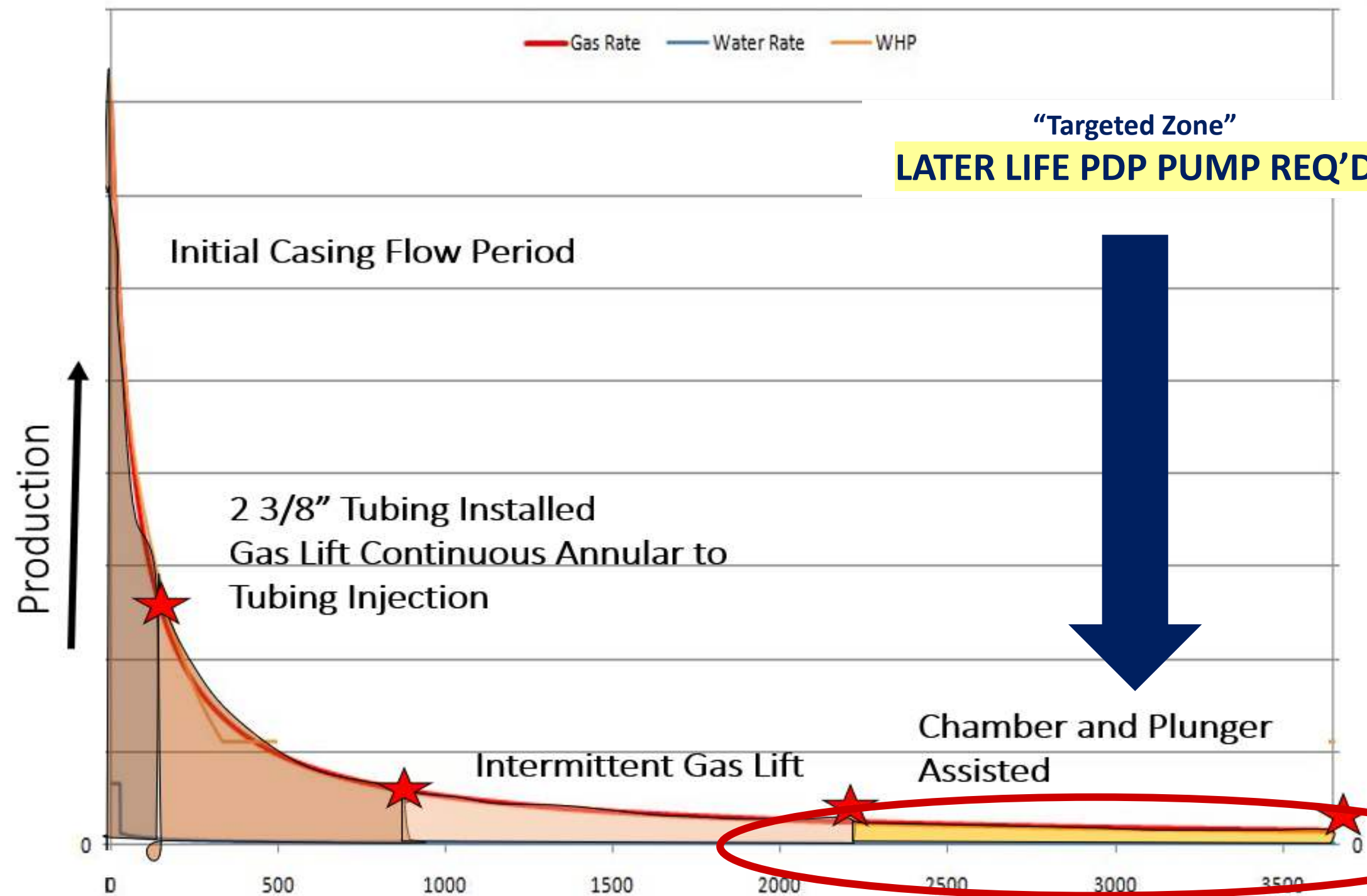
ALRDC Gas Lift Workshop

June 20-23, 2022



2022 GAS LIFT WORKSHOP

Gas Pump Application Target Zone



All shale wells eventually decline to Late Life Conditions
LOW BHP < 500 psi – LOW RATES < 50 BPD

Many/Most shale wells will be successfully Rod Pumped
NON-TORTUOUS WELLBORES – LOWER GLRS

Large Population of shale wells will be idled
LOE TOO HIGH – OPERATING ISSUES
ROD BREAKS – GAS LOCK
TUBING WEAR – OVERSIZED PUMP UNITS

Gas Pump Solves Rod Pump Issues



RRP

Rod Breaks

Tubing Wear

Gas Lock

GAS PUMP

No rods

Minimal down hole movement

Surface controlled gas displacement of accumulated liquids and downhole high pressure gas venting for pump chamber

Market Assessment Gas Pump Candidates

+/- 65,600 candidates in the USA have evolved from wells drilled since 2011

+/- 2,000-3,000 candidates were being generated annually in 2020

ESTIMATED TAM of +/- 11,900 existing wells in 2020.

Candidate population growing at the pace of +/- 1,100 wells per year in USA.

SPGL 2020 TAM SUMMARY TABLE			
(from BHI Historical Rig Count Basis)			
SWT 07-2020			
Since 2011			
Area	Total Wells	Total Candidates	Estimated TAM
EagleFord	16,919	12,689	2,060
Permian	53,860	40,395	7,802
Utica	2,491	1,868	357
Williston	14,222	10,667	1,678
Total	87,492	65,619	11,897

Area - 2020 Only	Total Wells	Total Candidates	Estimated TAM
EagleFord	822	246	117
Permian	6,118	1,835	872
Utica	159	48	23
Williston	633	190	90
Total	7,731	2,319	1,102

WELLS :

CANDIDATES :

TAM :

TOTAL (NEW) WELL COUNT

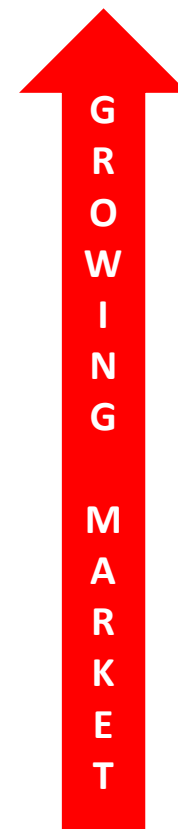
WELLS REQUIRING POSITIVE DISPLACEMENT PUMPING

DIFFICULT POSITIVE DISPLACEMENT PUMPING WELLS

• **Avg Rig Count 2022: 600**

• **Avg Rig Count 2020: 350**

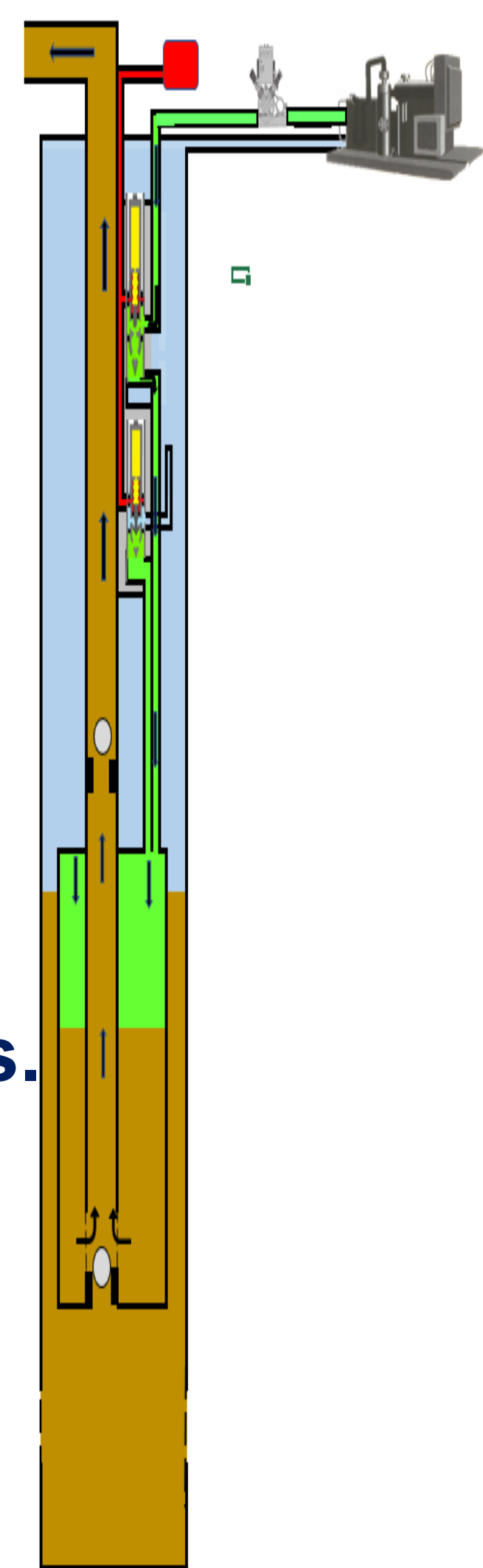
**ACTIVITY
UP
71%
In 2022**



What is Gas Pump?

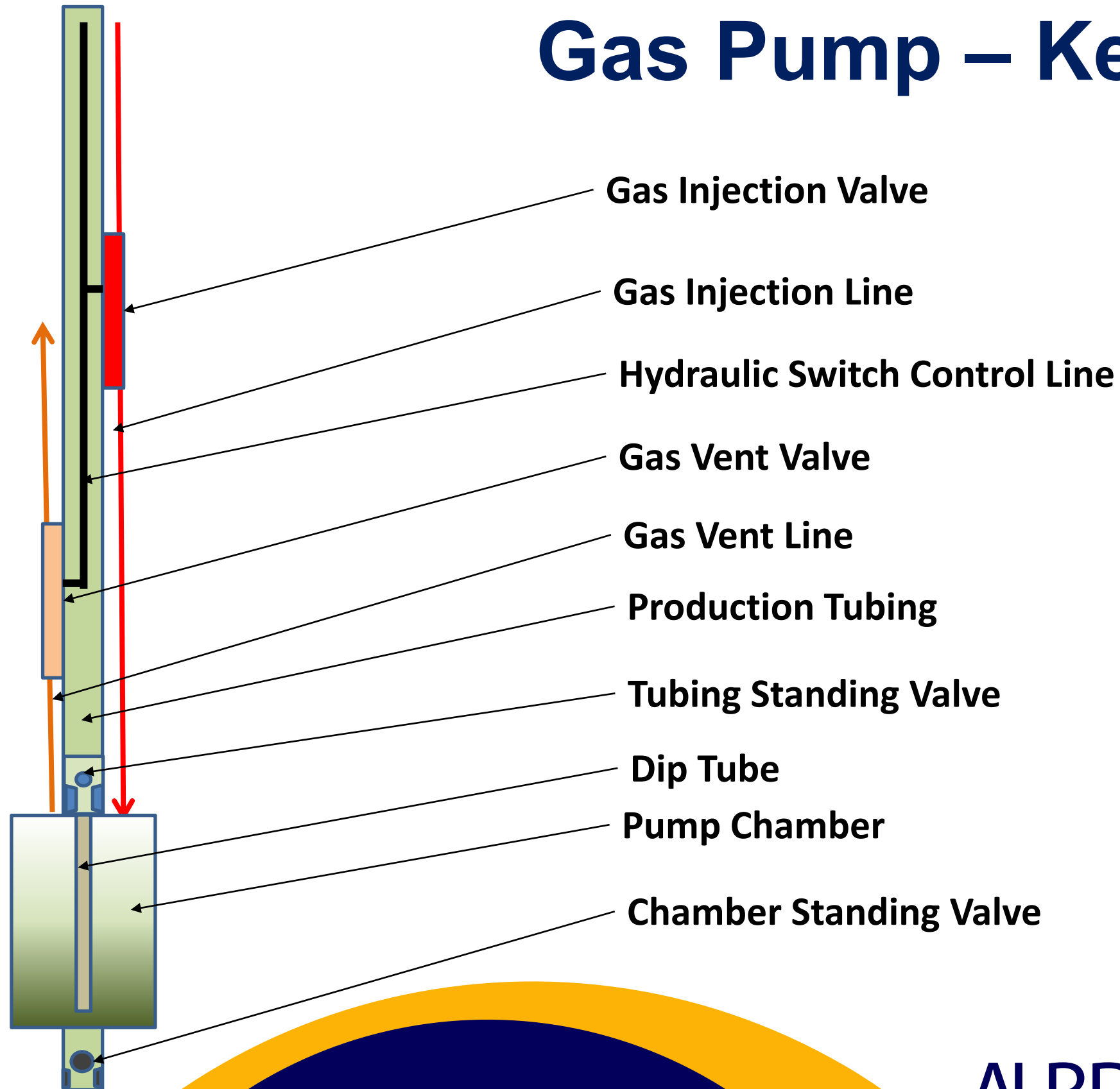
A downhole blow case system that is.....
modified to be surface controlled to
pumps liquid from wells

Let's look at an overview of its components, and how it works.





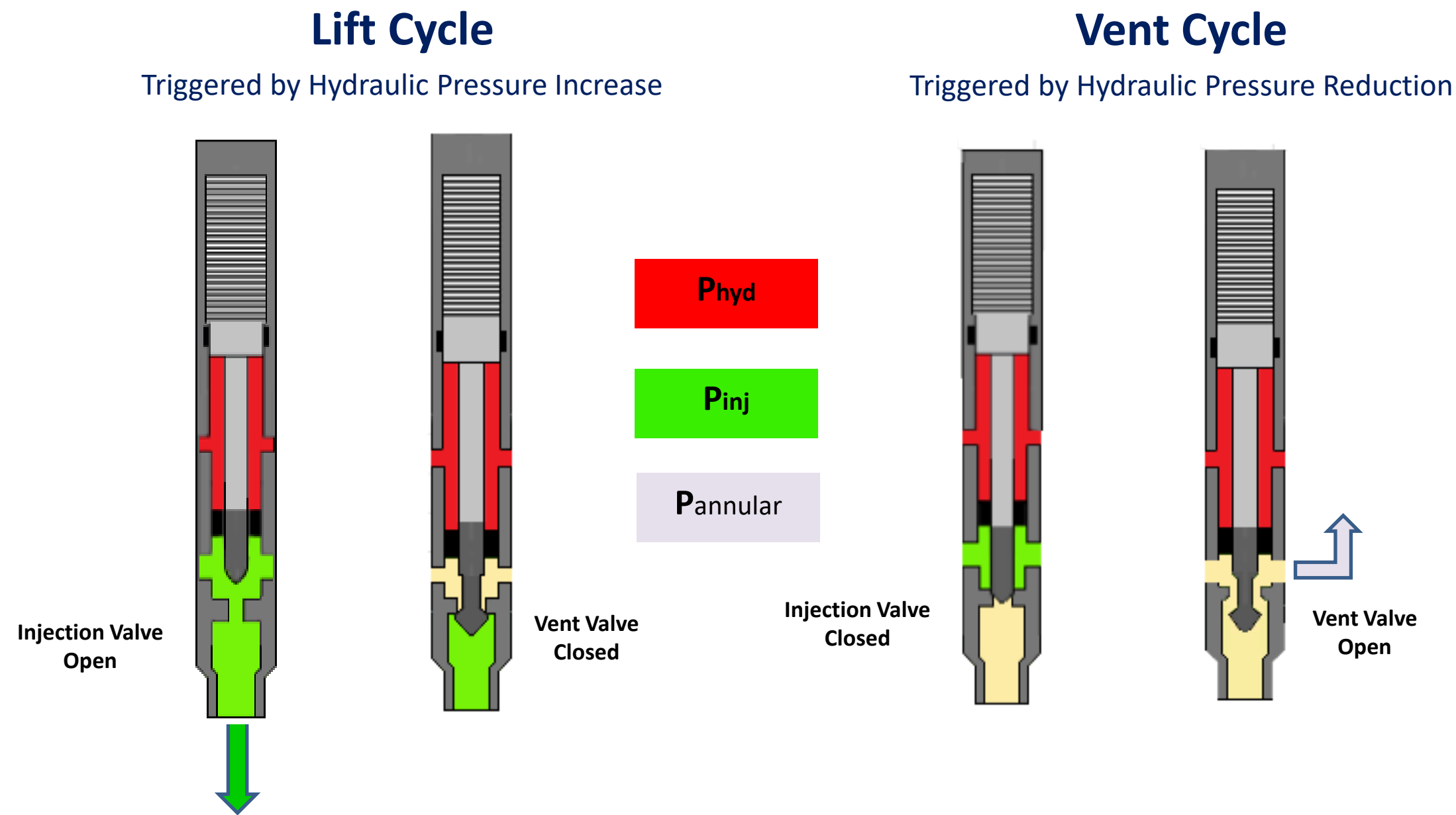
Gas Pump – Key Components



Patented Gas Pump Injection and Vent Valves are Synchronized

On injection cycle transition, as hydraulic pressure increases, the vent valve closes first and then the injection valve subsequently opens.

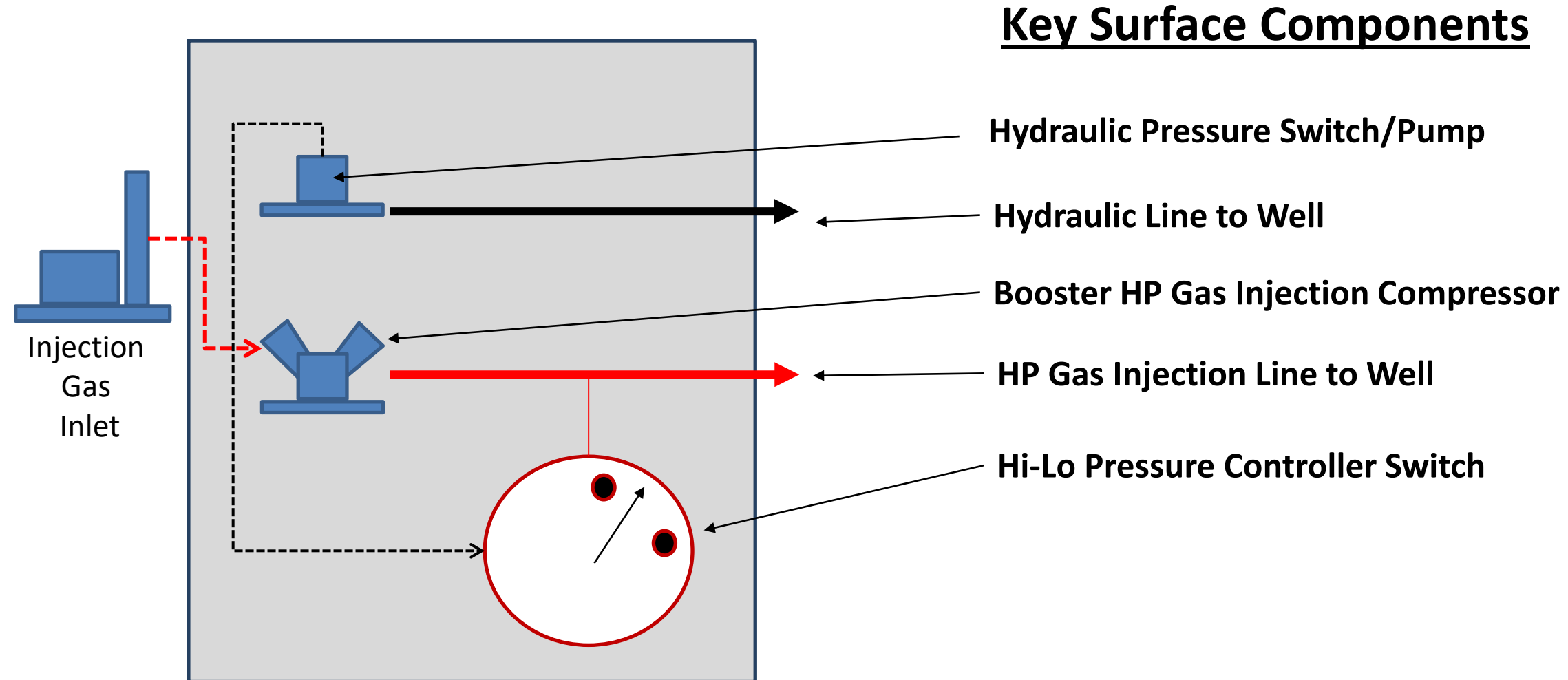
On vent cycle transition, as hydraulic pressure decreases, the injection valve closes first and then the vent valve subsequently opens.

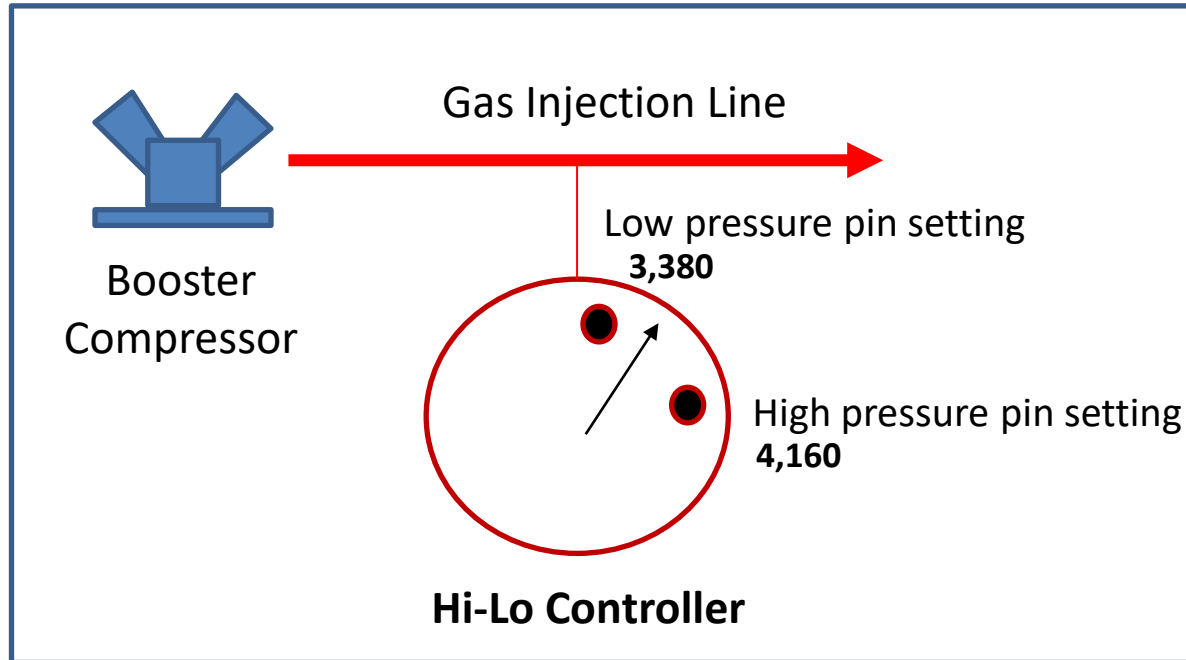




How does Gas Pump Controller work?

A Hi-Lo Pin Pressure Controller activates a hydraulic pressure pump (control switch) that toggles a gas injection and gas vent valve to effectively “pump” liquids from the gas pump chamber (blow case) with gas



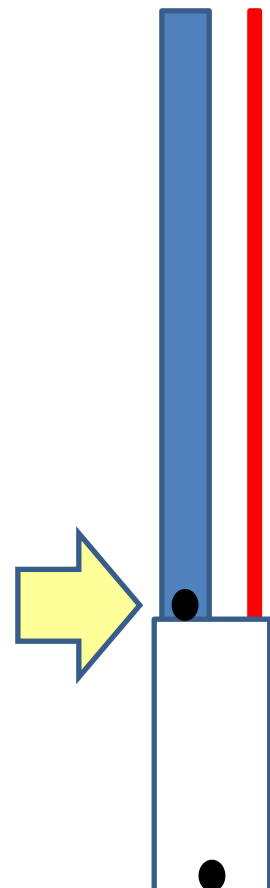


Simple to Set Up and Operate

- Low Pressure Pin set at minimum pressure setting required to lift liquid in tubing
- High Pressure Pin set at minimum pressure setting required to accumulate sufficient gas volume in gas injection line to flush down hole chamber when toggled open

Note – Calculations do not correct for natural gas properties and z factor

Low Pressure Pin Setting Calculation



Depth = 8,000'

Pressure on Tbg SV = 8,000' X 0.45psi/ft = 3,600 psi

Added Differential Pressure = 100 psi

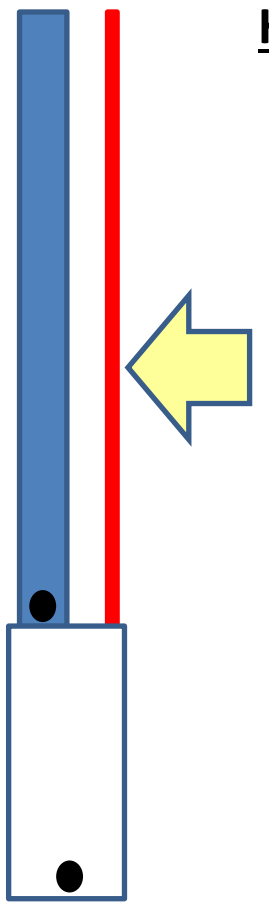
Required BH Lift Pressure = 3,700 psi

Injection Gas Gradient = 0.04 psi/ft

Gas pressure at injection point = 8,000' X 0.04 psi/ft = 320 psi

Low Pressure Pin Setting = 3,700 psi – 320 psi = **3,380 psi**

High Pressure Pin Setting Calculation



Depth = 8,000'

Chamber Volume = 1.75 gallons (0.234 ft³)

Gas Injection Line Volume = 8.33 gallons (1.113 ft³)

Required BH Lift Pressure = 3,700 psi

Chamber Volume (SCF) @ 3,700 psi = (0.234 X 3,700)/14.7 = 59 ft³

Gas Injection Line Volume (SCF) @ 3,700 psi = (1.113 X 3,700)/14.7 = 280 ft³

Gas Injection Line Pressure Increase Req = [3,700 X (59 + 280)]/280 = 4,480 psi

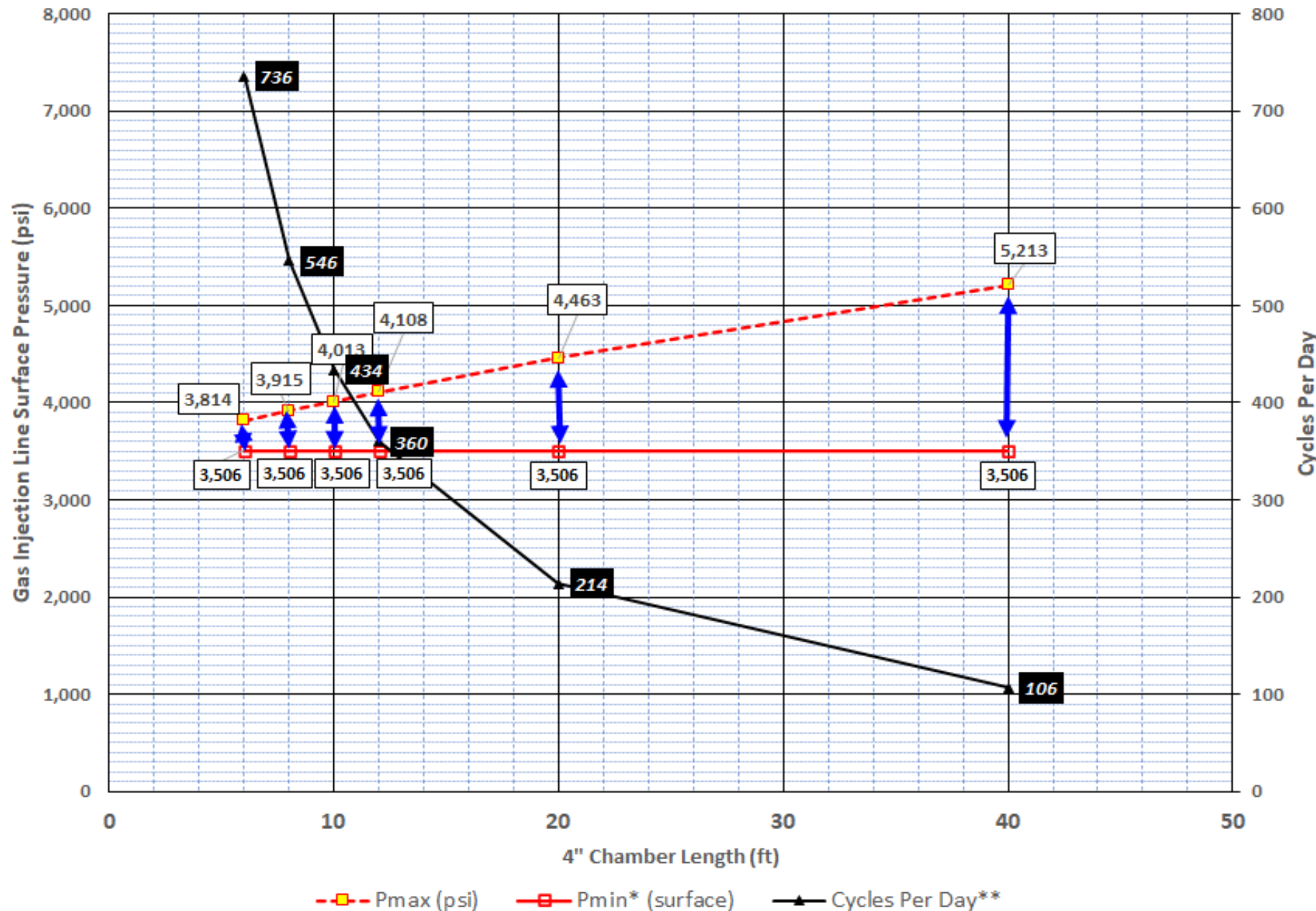
Gas pressure at injection point = 8,000' X 0.04 psi/ft = 320 psi

High Pressure Pin Setting = 4,480 psi – 320 psi = **4,160 psi**

Gas Pump is a Positive (Volumetric) Displacement Pump

To pump a barrel of liquid from a chamber at the bottom of a well, you have to displace the chamber with a barrel of gas at chamber conditions

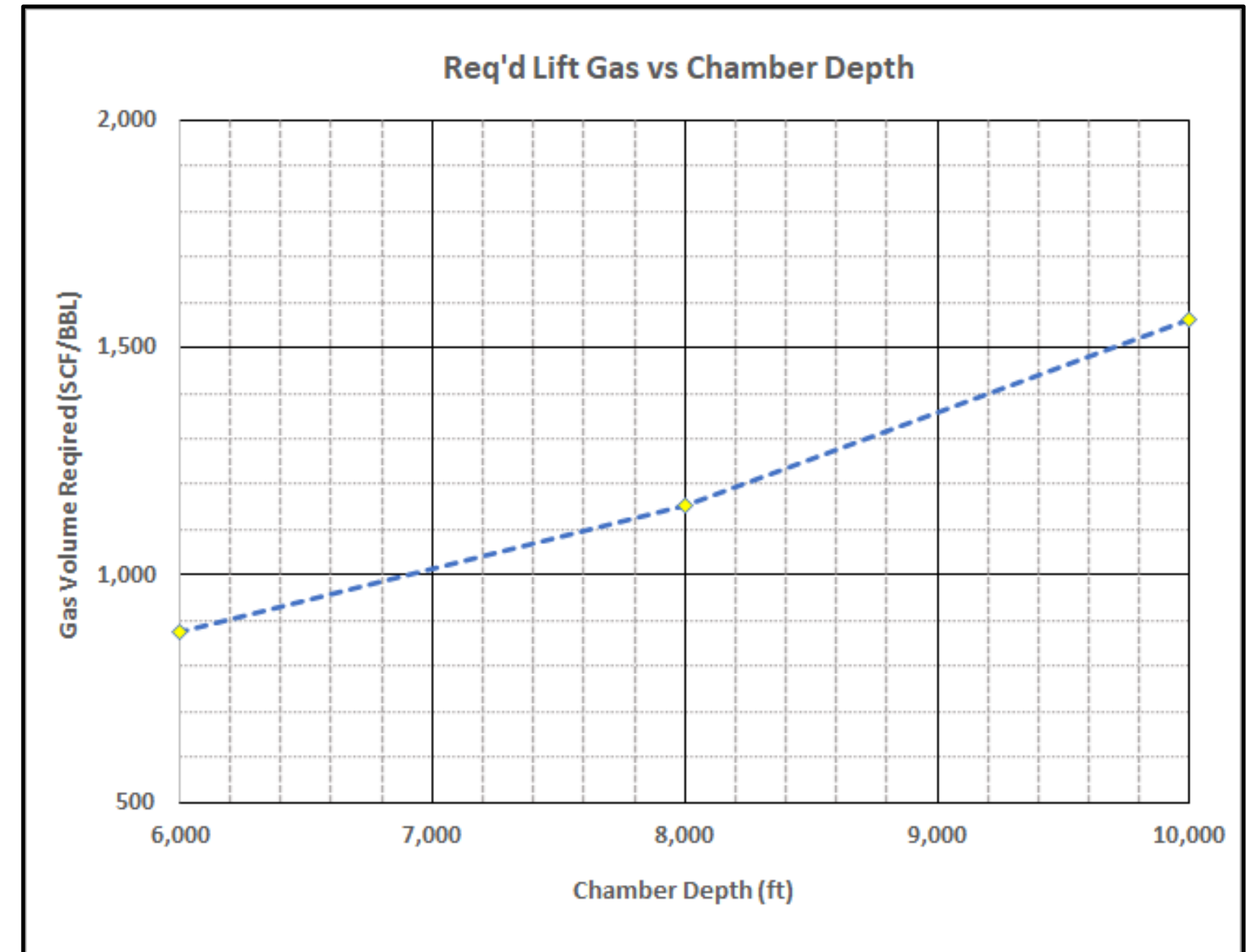
3/8" Gas Injection Line -- 4" Bottom Hole Chamber with 1/2" Dip Tube
 Surface Injection Pressure Requirements and Cycles Per Day vs. Chamber Length
 Lift Volume = 50 BPD - Gas Equivalent Volume = 68.4 MCFD



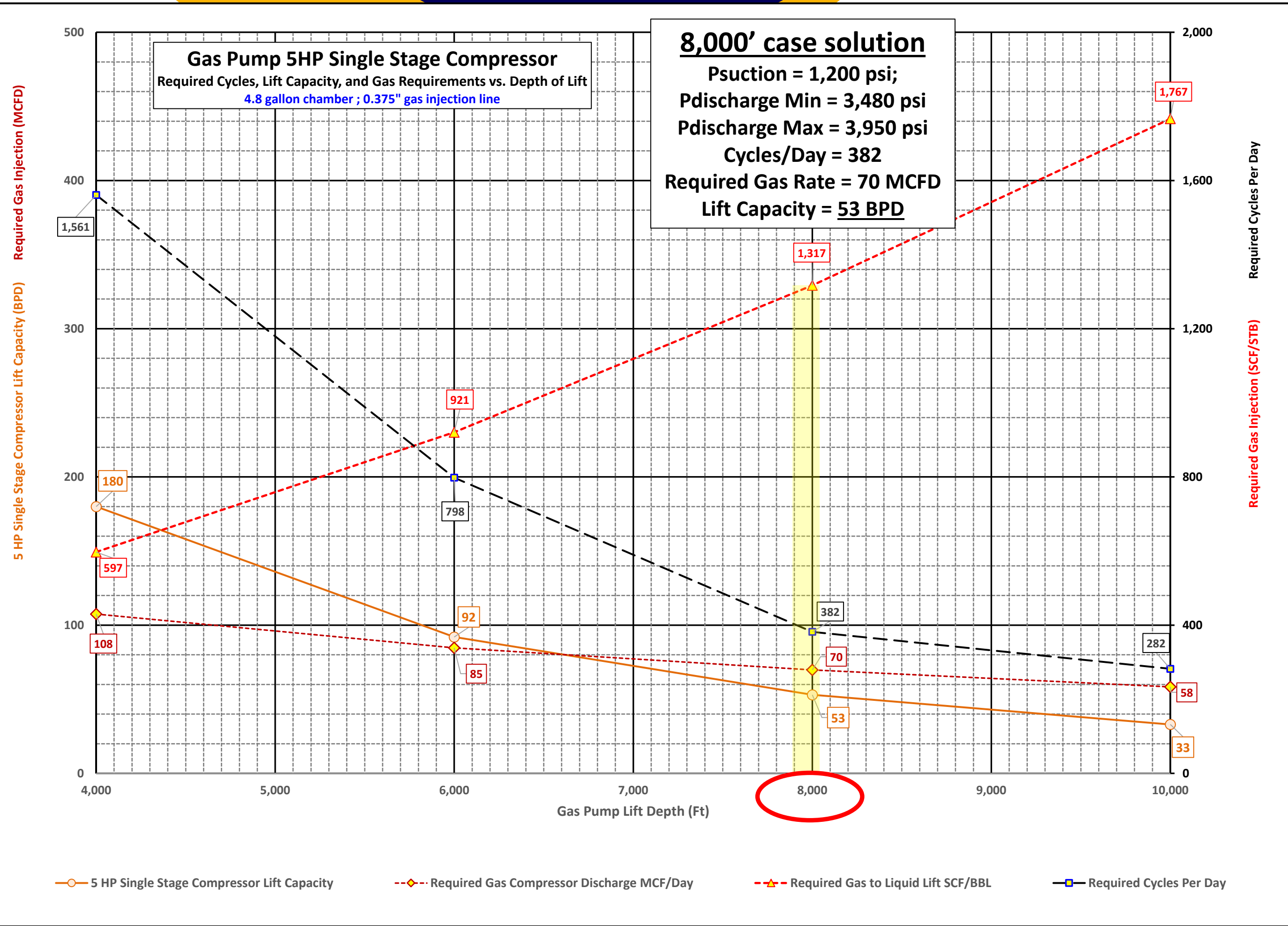
8,000' Gas Injection Line Volume (ft3)	Pmin* (surface)	4" Chamber Length	Chamber volume (ft3)	Chamber volume (gals)	SCF/Cycle	Pmax (psi)	Cycles Per Day**	Daily Gas Required (MCFD)
3.348	3,506	6	0.382	2.9	93.0	3,814	736	68.4
3.348	3,506	8	0.515	3.8	125.3	3,915	546	68.4
3.348	3,506	10	0.647	4.8	157.7	4,013	434	68.4
3.348	3,506	12	0.780	5.8	190.0	4,108	360	68.4
3.348	3,506	20	1.311	9.8	319.4	4,463	214	68.4
3.348	3,506	40	2.639	19.7	642.9	5,213	106	68.4
Note:								
* Include: Ftp = 100 psi, Downhole Delta P = 100 psi, and Gas graient = 0.05 psi/ft								
** to produce 50 BPD								

Gas Pump (Rule of Thumb) Gas Requirements

4" OD X 1/2" dip tube Chamber			Req'd Gas per Cycle (SCF)	P_{lift} pressure (psi)	BBLs/Cycle	SCF/bbl	AVG SCF/BBL
Depth	Length (ft)	Vol (gals)					
10,000	12	5.8	214	4,200	0.138	1,550	1,560
	20	9.8	360	4,200	0.233	1,543	
	40	19.7	745	4,200	0.469	1,588	
8,000	12	5.8	160	3,360	0.138	1,159	1,153
	20	9.8	268	3,360	0.233	1,149	
	40	19.7	540	3,360	0.469	1,151	
6,000	12	5.8	121	3,360	0.138	876	873
	20	9.8	203	3,360	0.233	870	
	40	19.7	409	3,360	0.469	872	



Example 5 HP High-Pressure Single-Stage Compressor Performance Capacity



Questions?



Gas Pump Test Well



Gas Pump Injection Valve



Gas Pump 10 HP Surface Control Skid

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