

**A fresh approach to gas lift, delivering a step change in:**

**Well Integrity and Reliability**

**Operational Efficiency**

**Productivity**

**Lifecycle Economics**

Alan Brodie

The logo for PTC (Process Technology Company) is a dark blue oval with the letters "PTC" in white, bold, sans-serif font. It is positioned to the right of the name "Alan Brodie".

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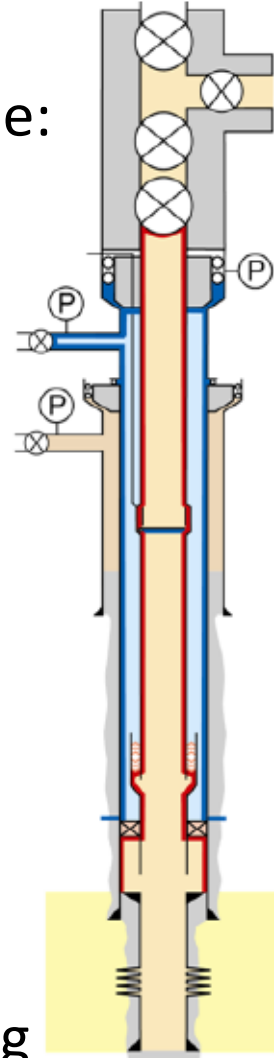
# Agenda: A fresh approach to gas lift

- Why did the industry need a fresh approach
  - Well integrity and equipment reliability issues
  - HSE risks re high pressure gas inventory in annulus
  - Operational inefficiencies
- What does the fresh approach involve
  - Gas lift valve redesign
  - The introduction of actuated surface annulus safety valves
- How have OPCO's benefitted
  - Case Histories
- Conclusions

# Why did the industry need a fresh approach

Well integrity & equipment reliability issues

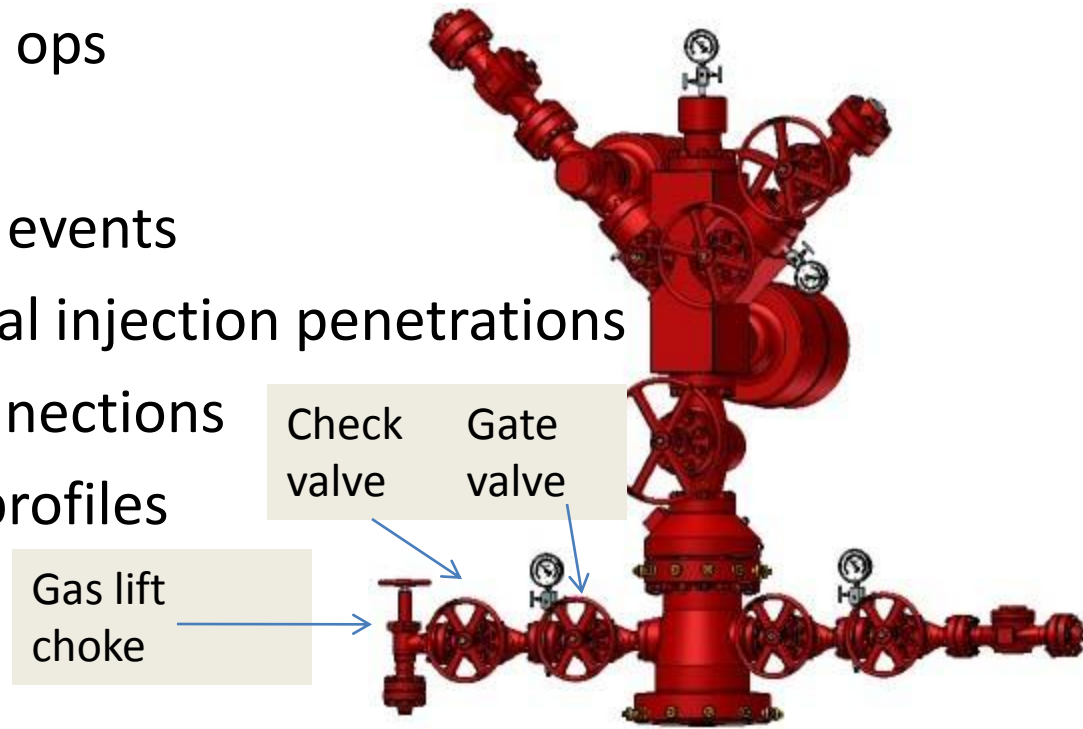
- Existing valves weak link in primary well barrier envelope:
- New valves needed with:
  - Same leak rate as permitted by packers / plugs
    - i.e. satisfying “V1 criteria” : 20 cc/ 10 mins
  - Operating check valve to close at a dp of 0 psi
  - Unloading valve to close in event of bellows failure
  - Designs to address the most common failures:
    - Seal face erosion during unloading.
    - Spring fatigue
    - Multiphase injection or wet gas erosion
    - Seat damage due to valve vibration and chattering



# Why did the industry need a fresh approach

HSE risks re high pressure gas in annulus

- Biggest source of risk for gas lifted wells is falling objects
  - Colliding with the annulus line and valves
  - Creating hydrocarbon release at the inlet to the wellhead
- Risk identified during
  - Wellwork / Well bay ops
  - Weather related
  - Proximal incidents / events
- Similar risks with chemical injection penetrations
  - Usually just NPT connections
  - Set in wellhead VR profiles



# Why did the industry need a fresh approach

## Operational inefficiencies

- As rig rates increase, everything must be done to reduce :
  - Completion installation time
  - Well commissioning time
- To optimise production uptime also good to reduce
  - Gas lift valve change out time
  - Gas lift valve inflow testing time



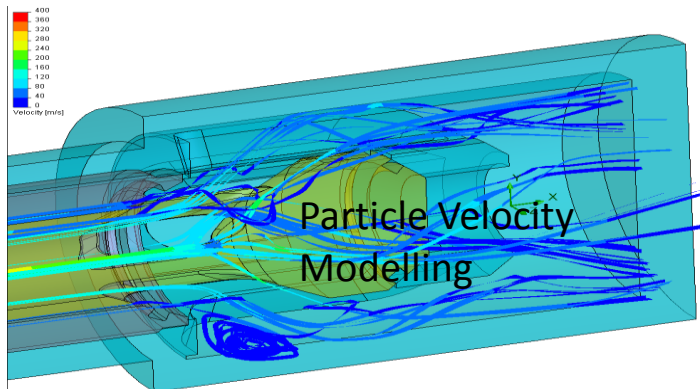
# Gas Lift Valve Redesign

Designed for retrofit in standard 1" – 1.75" SPM's

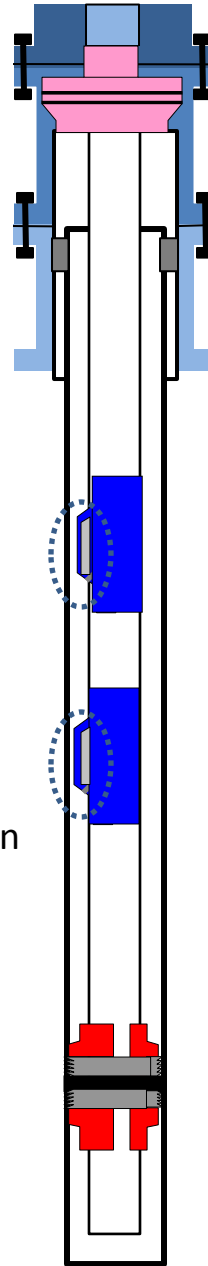
- Unique in almost all other respects
  - Patented orifice dart linkage
  - No internal elastomers
  - Spring location, size & utilisation range
  - Flow Path Geometry
  - Materials and Coatings
  - Bellows working dp 10k psi
  - Bellows tested to 3500 cycles
  - Shear system which does not impact on orifice size after shear

- Many unique advantages

- No valve chatter and vibration
- A true metal / metal seal
  - Vo option available
- Fatigue is minimised
- Valves would fail in closed position
  - Unloading valve held by spring
  - Orifice valve closed w 0 psi dp
- Valves suitable for wet lift gas or lift gas with entrained chemical injection
- Higher gas flow rates at maximum orifice size
- Deeper more reliable unloading valves
  - Increased production
- Completion operational efficiency



Aberdeen



Houston

# New Gas Lift valve erosion performance

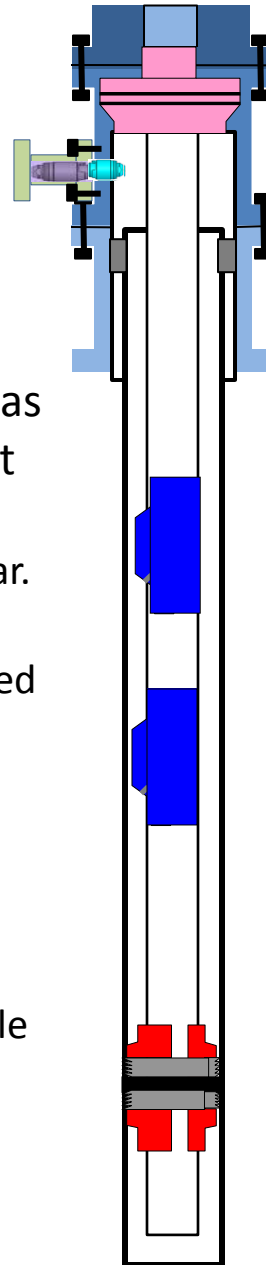
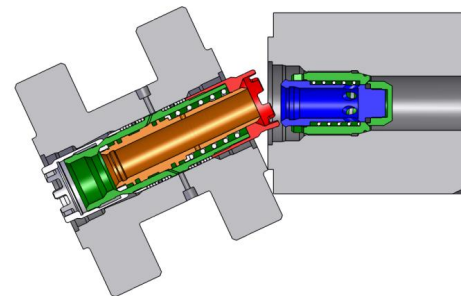
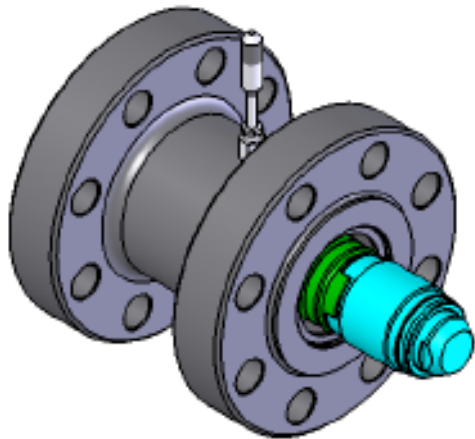
Test	Water erosion test	API GLV requirement	1" SafeLift	1.5" SafeLift	1.75" SafeLift
1	Pump rate bbl/min	1.00	1.25	1.5	1.5 std 3 max
	Volume pumped bbl	400	600	600	600
	Test media	N2	N2	N2	N2
	Leak rate scf/D	< 35	0	0	0
2	<b>Gas flow Test</b>				
	Rate steps	---	20	20	20
	Max gas rate mmscf/D	---	3,53	6,7	17
	Flowing time, hrs	---	148	145	145
	Leak rate scf/D	---	0	0	0
	Fatigue test, cycles	---	100	100	100
3	<b>Final function test</b>				
	Max temp, dec C	---	185	165	165
	No of cycles	---	6	6	6
	Leak rate, scf/D	---	0	0	0
4	<b>Extensive erosion test</b>				
	Test fluid	---	Tap water	Brine w/Barite	Water with barite
	Particle content, lbs/bbl	---	0	0,70	1,40
	Pump rate bbl/min	---	1,00	A)1,0 B)1,2 C)1,5	A)1,5 B)3,0
	Volume pumped, bbl	---	4000	600 in each step	A)1200 B)600
	Leak rate, scf/D	---	ZERO	ZERO	ZERO

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# Surface Annulus Safety Valves (SAS)

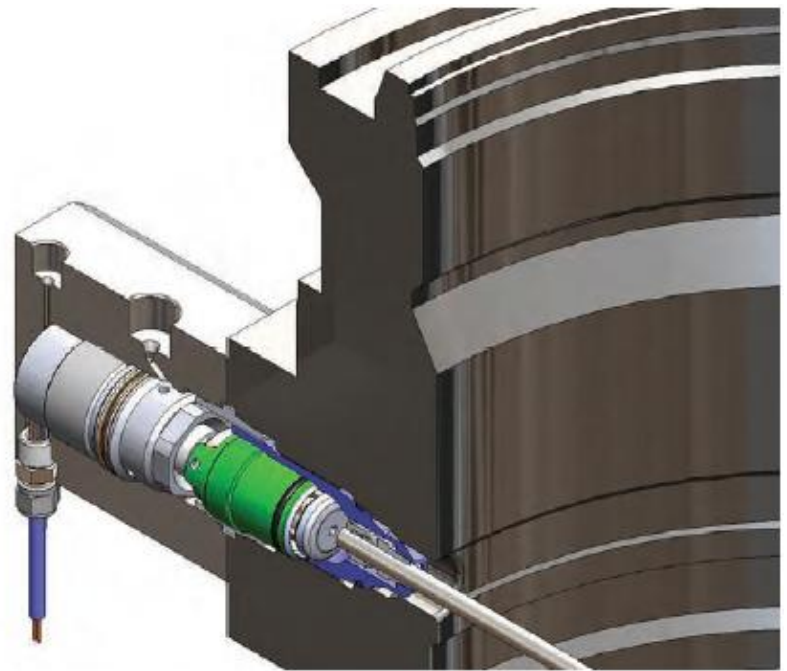
Set in wellhead VR profile

- Unique Features
  - Valve design
  - Temp rating -46 – 170 Deg C
  - Actuator module option M-SAS
- Many unique advantages
  - A true metal / metal seal
    - Uniquely  $V_0$  fire tested w gas
  - Caters for Joule Thomson effect
  - Valve held open in normal ops
    - Further reducing wear and tear.
  - In the event of a facilities ESD:
    - HP lift gas in flowlines will bleed off to the annulus
    - HP gas in the annulus can be bled to the facilities
  - Gas lift inflow tests confirmed without temporary rig up
  - Disconnects in event of impact
    - Leaving closed SAS in VR profile



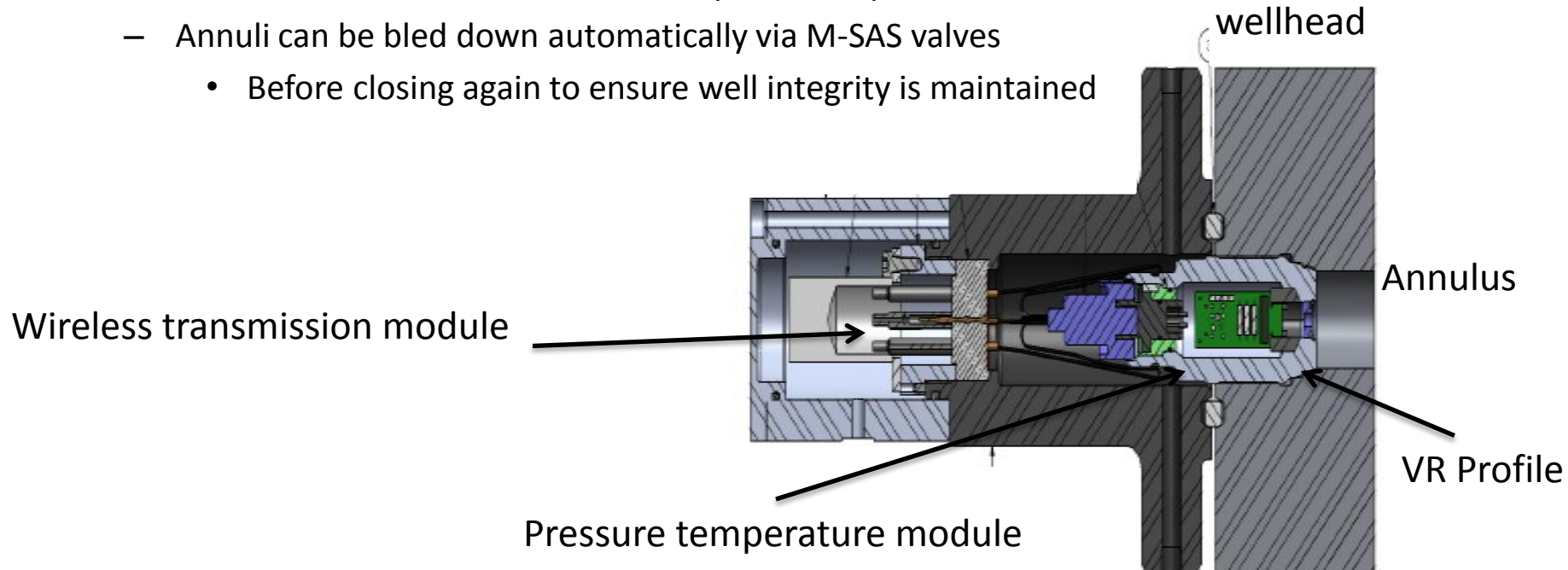
# Surface annulus safety valve derivatives (1)

- Chemical injection system surface safety valves
  - Developed in response to concerns re chemical injection line integrity
  - Potential for a hydrocarbon release via the chemical injection line
  - Solution was to develop a M SAS - CIV



# Surface annulus safety valve derivatives (2)

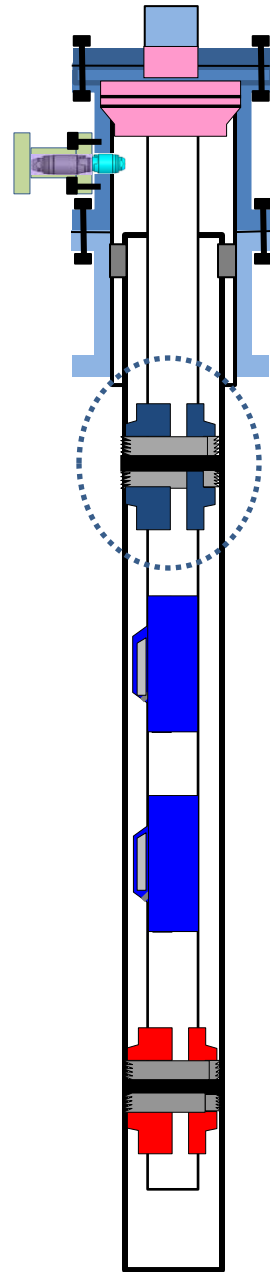
- Maximum Allowable Annulus Surface Pressure (MAASP ) Mgt system
- System based around unique VR Plug sensors
  - Continual annulus pressure and temperature measurement
  - Data can be remotely monitored
    - Via wireless (HART protocol) or wired link to control room
    - Wireless module detaches safely under impact
  - Annuli can be bled down automatically via M-SAS valves
    - Before closing again to ensure well integrity is maintained



# Case Histories (1)

## DH ASV workover cost savings

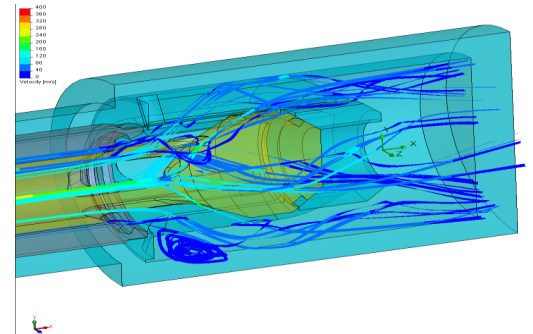
- Wells with failed DH ASV's
  - Now being kept on production following :
    - Installation of well barrier accredited gas lift valves
    - Installation of actuated surface annulus safety valves
  - Over 100 such installations already in Norwegian sector
    - \$ significant cost savings in each case.



## Case Histories (2)

Completion installation and commissioning cost savings

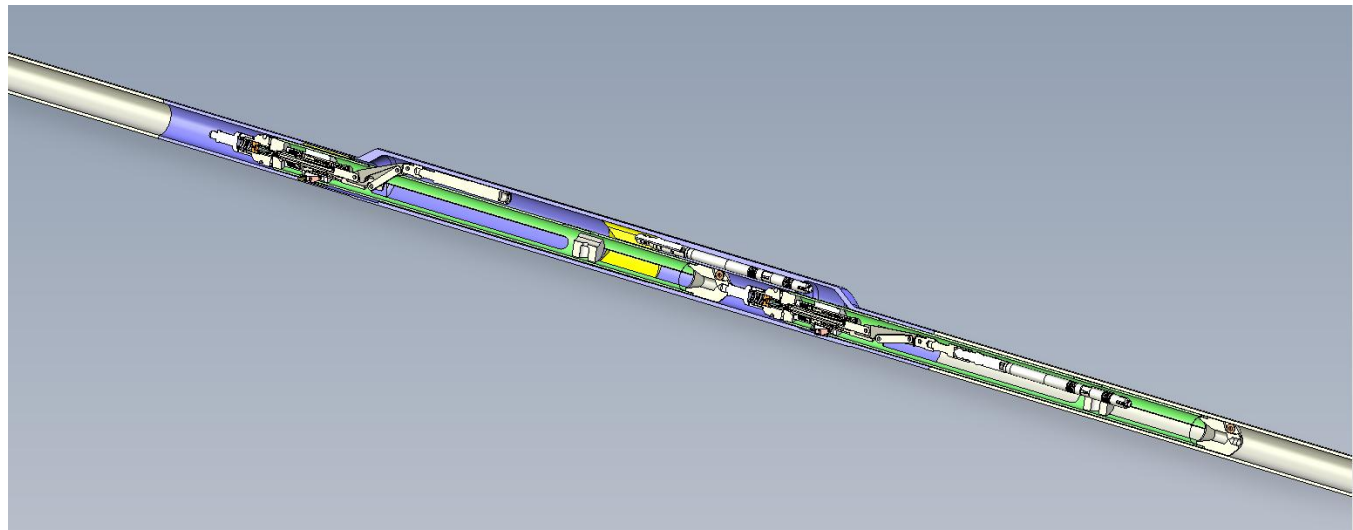
- Typical well
  - 1 -2 rig days saved and production 2 – 4 days early
  - High unloading rate valves
    - 300 l /min vs typical 30 l / min
    - Unloading time reduced by 1 -2 days
  - Shearable valves
    - No requirement to run dummy valves
    - Saving 1 -2 days per completion installation
- Unusual well
  - Upside down running tool
    - For pulling a dummy valve from upside down side pocket mandrel
    - Saving full workover to replace mandrel



# Case Histories (3)

Completion lifetime cost savings and well uptime benefits

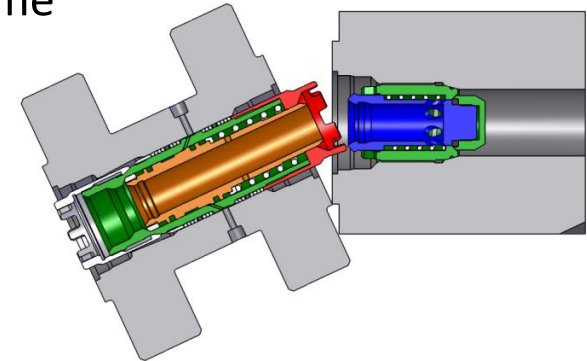
- Valve reliability
  - New design valves now significantly out lasting traditional valves
    - Valve longevity increased form <4 mnths to > 2 years in 1 field
      - OPCO saved ca \$11 million in valve change out costs
- Valve change out costs
  - Single trip valve pulling and running tool being developed
    - Will reduce associated well intervention time & cost significantly



# Conclusions

New gas lift equipment delivering a step change in:

- Well Integrity and Reliability
  - Downhole valves well barrier accredited  $V_0$  performance
  - Downhole valves fail in closed position
  - Valves are all wet lift gas tolerant
  - $V_0$  performance ( wellhead valves tested with fire)
  - Wellhead valves fail safe on accidental disconnection
- Operational Efficiency
  - Reduced completion installation and unloading time
  - Reduced gas lift valve integrity testing time
- Production performance
  - 10k downhole valve spec enables deeper gas lift
- Lifecycle economics
  - Influenced by all of the above
  - New downhole and surface valves now being used in tandem
    - To maintain uptime in wells with failed DH-ASV's



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