Artificial Lift R&D Council

Jet Lift: Bridge the Gap Between Various Forms of AL

Presenter: John Massey
Authors: Mauricio Monzon, Apache Corp.
John Massey, ChampionX

Agenda

- Challenge
- Solution
- Jet lift system design
- Results

Challenge

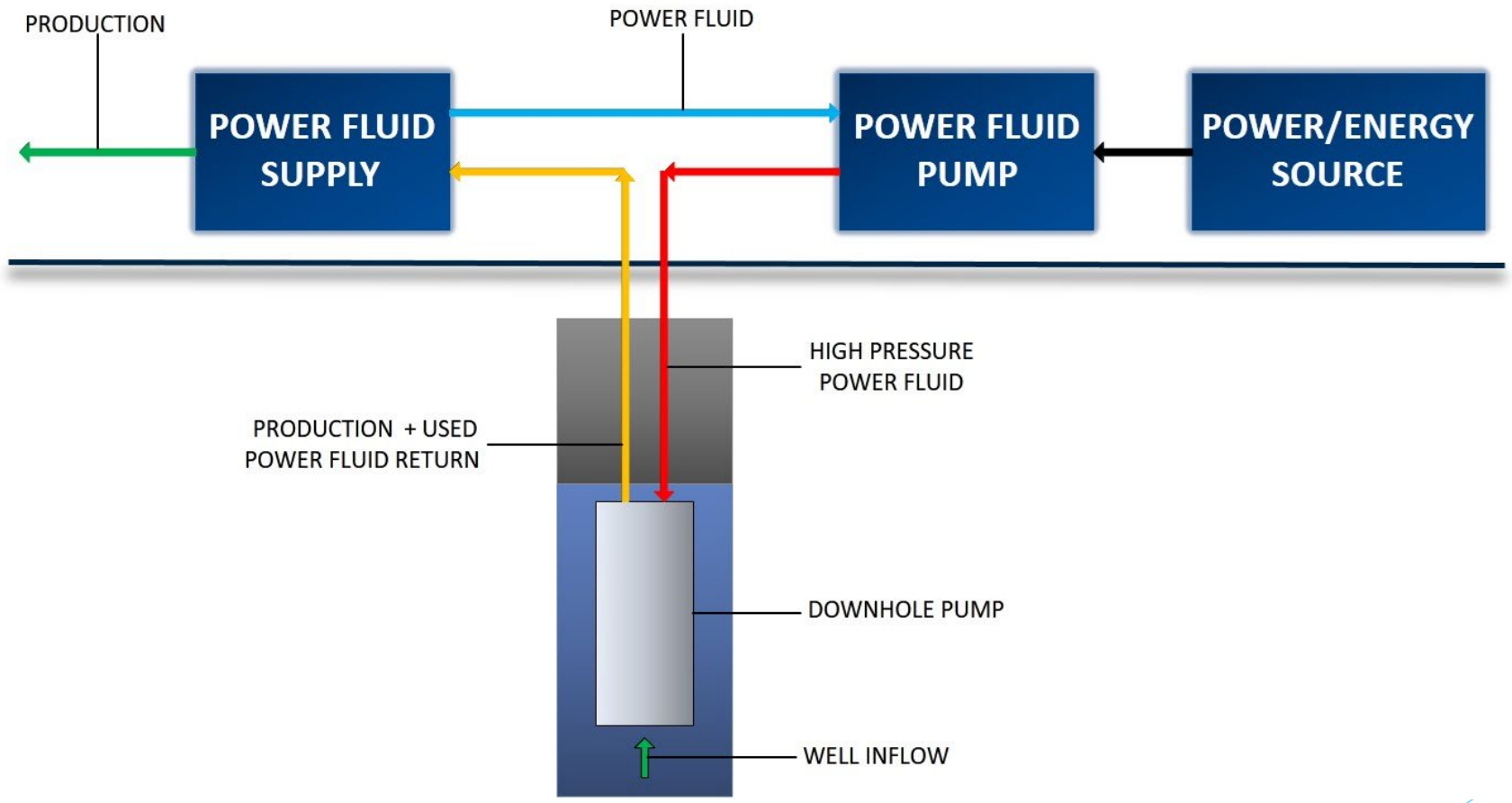
- Initial strategy was to commence post-flowback production from fractured wells with ESPs, and then transition to rod lift as rates declined over time
- However, as the wells approached the transition window between ESPs and rod pumps, high sand content and gas-to-liquids ratios caused frequent downtime for both types of lift, negatively impacting well performance

Solution

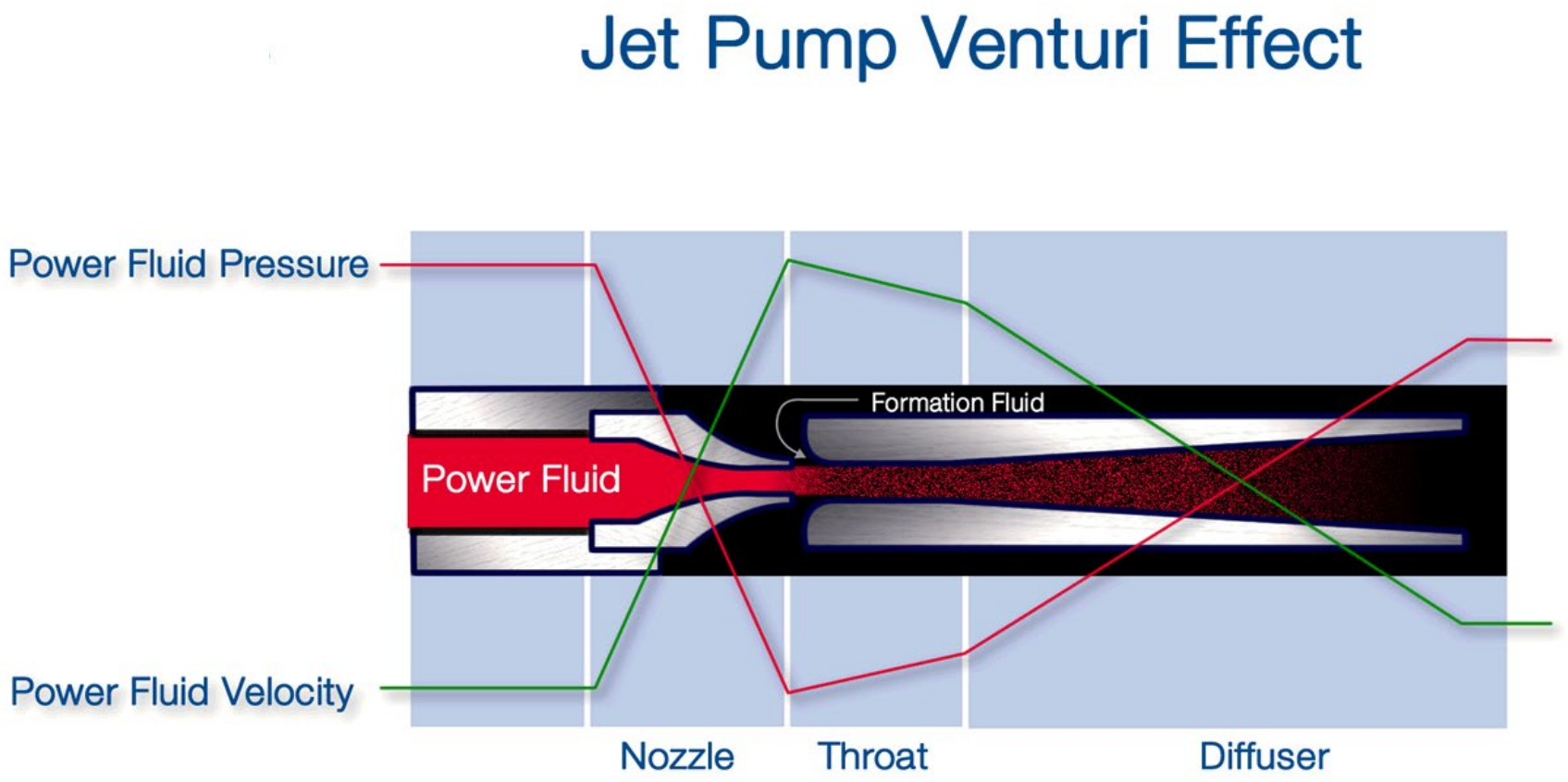
- Effectively bridge the application gap between high-rate ESPs in early well life and lower-rate rod pumps later in the lifecycle and accommodate the solids, wellbore deviation and GORs
  - Reduce the amount of well intervention to reduce downtime and capital expense
  - Maintain production rate

- Install a jet lift concentric string system
  - Allows gas to flow up the casing annulus similar to rod lift reducing the gas interference in the downhole jet pump
  - Jet pumps have the capabilities to handle solids and be set lower in the wellbore while still maintaining the production target

Jet lift system overview



Jet lift system overview



Jet lift system overview

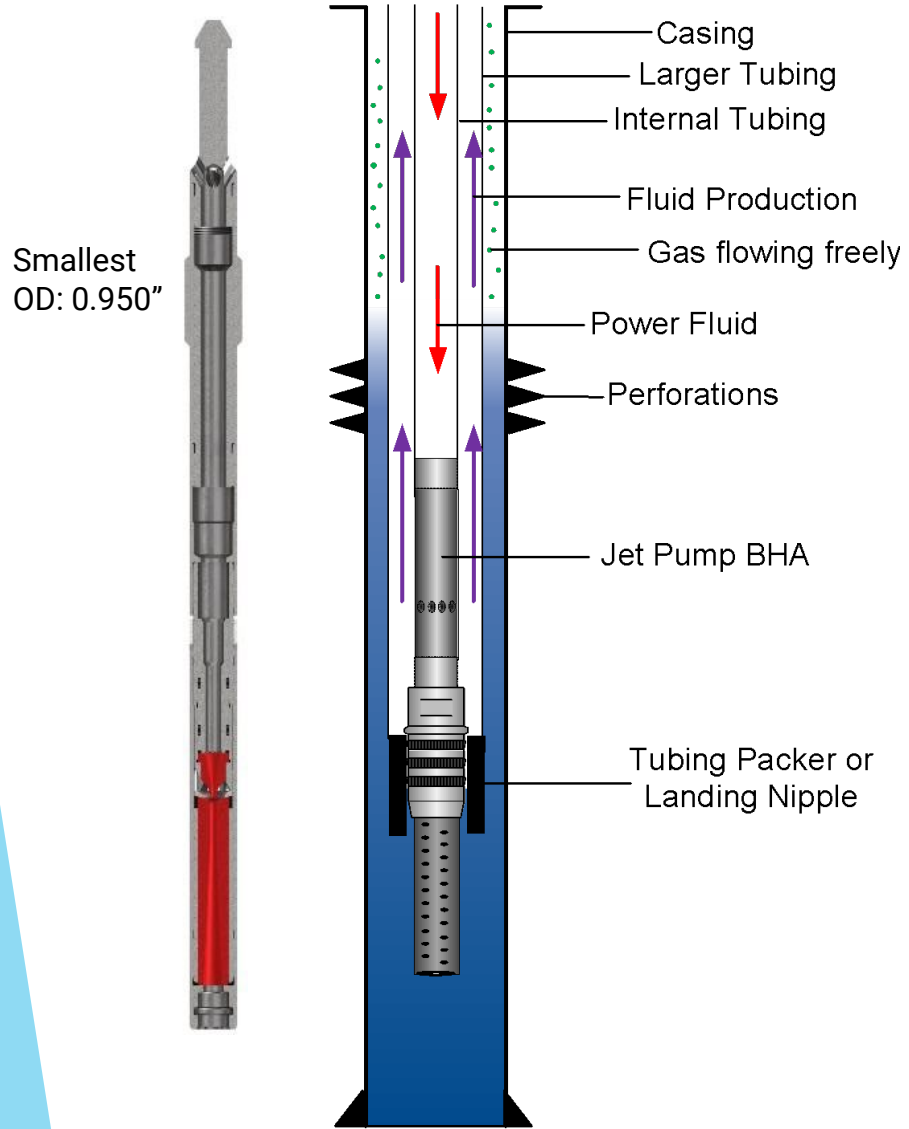
Tubing Size	Jet Pump Size	*Maximum Capacity*
CT 1-1/4” or Larger	1-1/4” JP	~500 BPD
2-3/8”	1-1/2” & 2” STD JP	~1500 BPD
2-3/8”	2” High Volume JP	~3000 BPD
2-7/8”	2-1/2” STD JP	~3000 BPD
2-7/8”	2-1/2” High Volume JP	~6000 BPD
3-1/2”	3-1/2” High Volume JP	~12000 BPD

*Casing sizes must be considered

Jet lift system overview

Category	Typical Range	Extreme Range
Depth (TVD)	2,000'-15,000'	20,000'
Producing Rate	25-2,000 BPD	10,000 BPD
Producing BHP	25-200psi / 1,000' of Lift	Near Pump Off
Temperature	250° F	450° F
Setting Deviation	40°-60°	90°
DLS	0-15° / 100'	20° / 100'
Gas Handling	100-1500:1 GLR	>1500:1 GLR
Produced Solids	1-5 lbs. / Bbl.	>25 lbs. / Bbl
Fluid Gravity	20° - 50° API	8° API

Concentric string completion (vertical)



- **Advantages**
  - Can be installed below the perforations and into the lateral
  - Allows gas to flow up the casing annulus while keeping the pump submerged (Prod. Csg = 7”; Prod. Tbg = 2-7/8”; Inj. Tbg =1-1/4”)
  - Jet pump can still be pumped in and out
- **Disadvantages**
  - Limited to 500 BPD maximum production

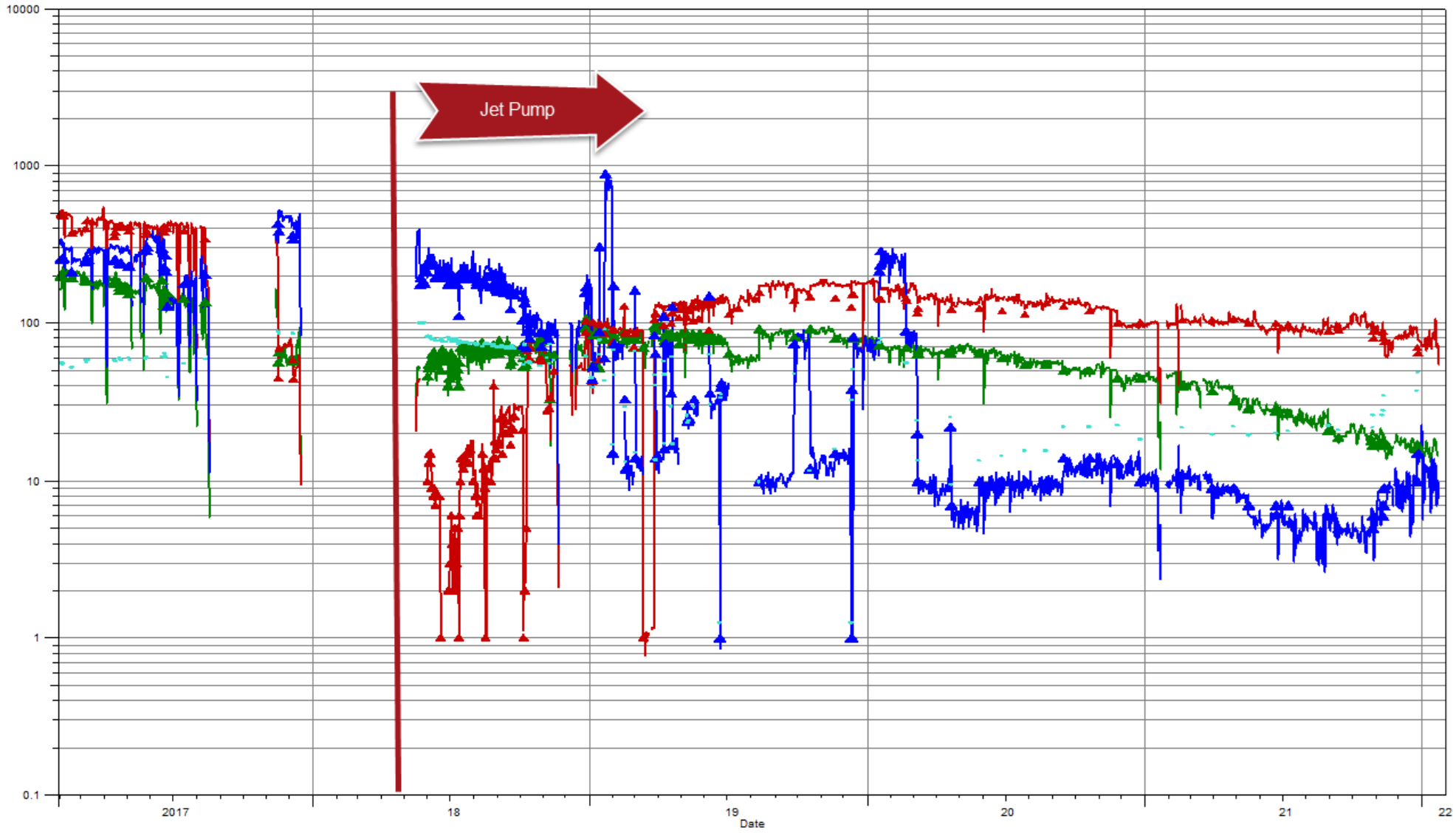
Concentric design

Results (horizontal well configuration)

- Set pump at 70˚, which allowed the system to maintain the same bottomhole pressure as the ESP system
  - Sub 450 psi producing BHP @ ~200 BPD
- Three wells produced from one surface pump
  - Spread maintenance and rental costs across three wells
- Three-year run time with no workover rig
  - Previous artificial lift systems had at least one pull per year

Artificial Lift R&D Council

Results (horizontal well configuration)



Conclusion

- Jet lift system reduced downtime due to solids and gas interference
- Concentric installation allowed for gas ventilation
- Pump Intake at the base of the curve (~300’ deeper than previous lift system)
- Multiple wells ran from a singular surface pump
- Maintained previous ALS production with less downtime

Thanks and questions

- **Acknowledgments**
  - Mauricio Monzon, Apache Production Engineer
  - ChampionX Artificial Lift and the Prime Pump Solutions operations team

Copyright

Disclaimer

The following disclaimer shall be included as the last page of a Technical Presentation or Artificial Lift Learning Course. A similar disclaimer is included on the Artificial Lift Workshop webpage.

The Artificial Lift Research and Development Council and its officers and trustees, and the Artificial Lift Workshop Steering Committee members, and their supporting organizations and companies (here-in-after referred to as the Sponsoring Organizations), and the author(s) of this Technical Presentation or Artificial Lift Learning Course and their company(ies), provide this presentation and/or training material at the Artificial Lift Workshop "as is" without any warranty of any kind, express or implied, as to the accuracy of the information or the products or services referred to by any presenter (in so far as such warranties may be excluded under any relevant law) and these members and their companies will not be liable for unlawful actions and any losses or damage that may result from use of any presentation as a consequence of any inaccuracies in, or any omission from, the information which therein may be contained.

The views, opinions, and conclusions expressed in these presentations and/or training materials are those of the author and not necessarily those of the Sponsoring Organizations. The author is solely responsible for the content of the materials.

The Sponsoring Organizations cannot and do not warrant the accuracy of these documents beyond the source documents, although we do make every attempt to work from authoritative sources. The Sponsoring Organizations provide these presentations and/or training materials as a service. The Sponsoring Organizations make no representations or warranties, express or implied, with respect to the presentations and/or training materials, or any part thereof, including any warrantees of title, non-infringement of copyright or patent rights of others, merchantability, or fitness or suitability for any purpose.