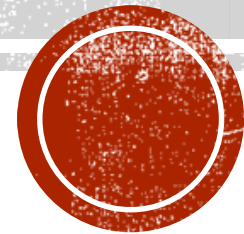


A PRAGMATIC APPROACH TO UNCONVENTIONAL AI DESIGN

Matthew Wortmann

NP Resources, LLC

5/22/2018



UNCONVENTIONAL ARTIFICIAL LIFT METHODS

	Gas Lift	ESP	Jet Pump	PCP / ESPCP	Rod Pump	Plunger Lift
Volume (BFPD)	200 – 30,000	200 – 30,000	300 – 15,000	5 – 4,500	1 – 1,000	1 - 50
FBHP (PSI)	10,000 - 500	10,000 – 150	10,000 – 50	5,000 – 150	5,000 – 50	2,000 – 100
Depth (FT)	5,000-16,000'	1,000' - 15,000'	15,000	2,000 – 6,000	100' – 16,000	8,000' – 16,000
Workover Cost	Low	High	Low	High	Mid	Low

- Organizational Capability is another consideration that can impact AL selection, reliability and efficacy



BENEFITS OF INITIAL FLOWING PERIOD

- Maximize fluid recovery before AL install
- Higher fluid velocity improves solids recovery
- Tubing / velocity string / N2 bubble lift can be used to improve flowing recovery
- Improved data gathering
- Reduce post completion clean out probability



BAKKEN ARTIFICIAL LIFT LIFE CYCLE

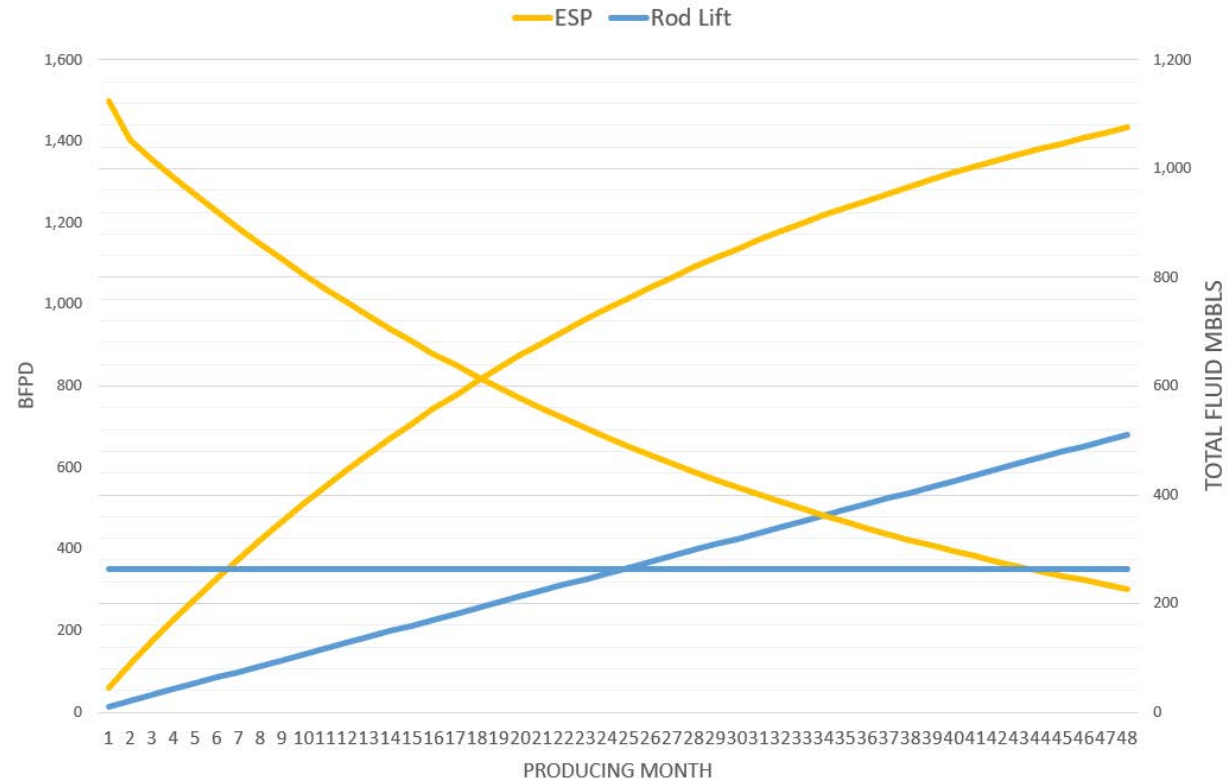
**ESP /
Gas Lift**

>500 BFPD

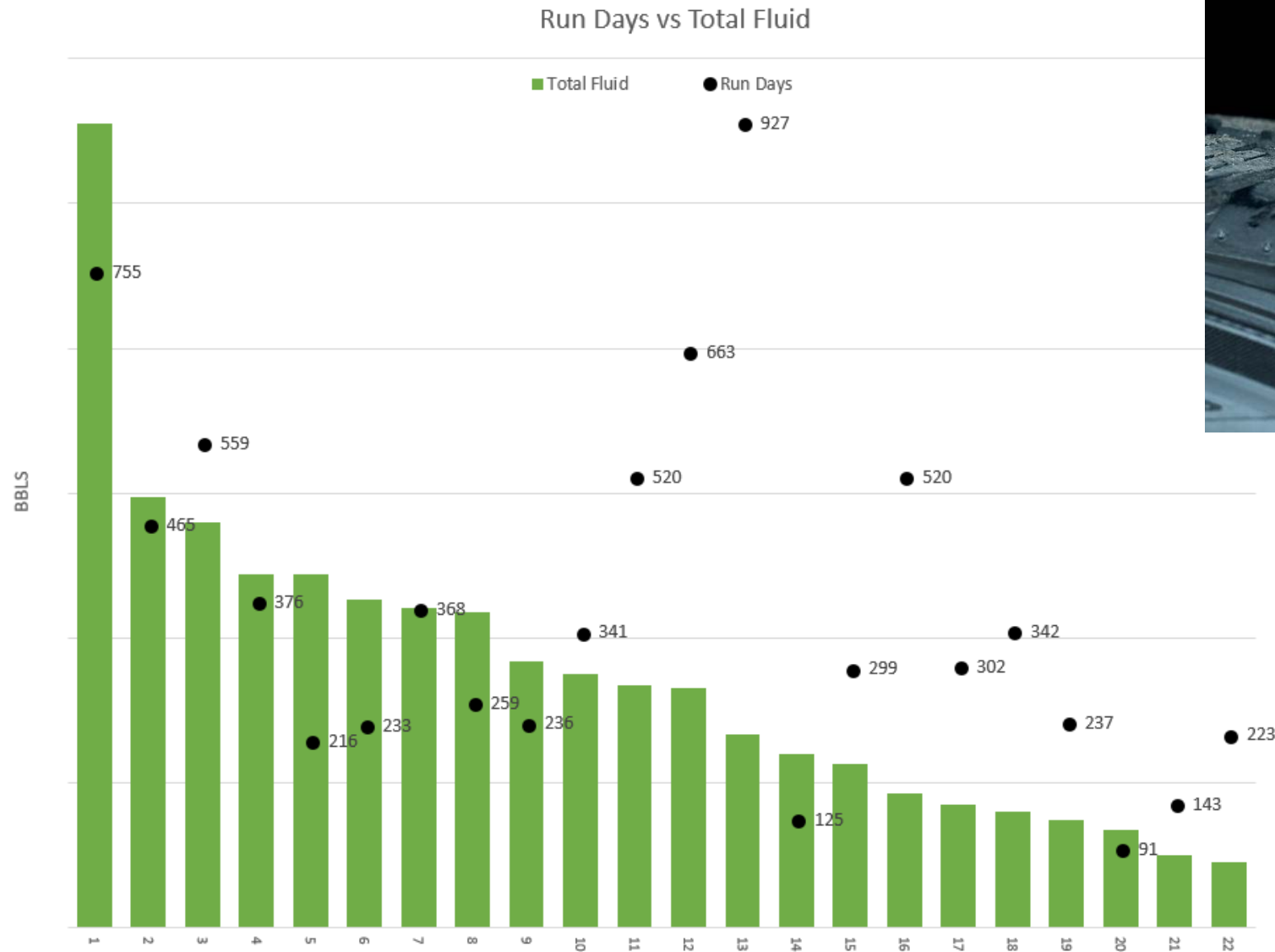
PUMPED OFF

**Rod Lift
System**

ESP vs Rod Lift



BENCHMARKING PERFORMANCE OF ESP SYSTEMS



Run Days

Evaluating pump performance by volume of fluid moved can be compared to the tread on your tire.



ESP SYSTEM DESIGN CONSIDERATIONS IN BAKKEN WELLS

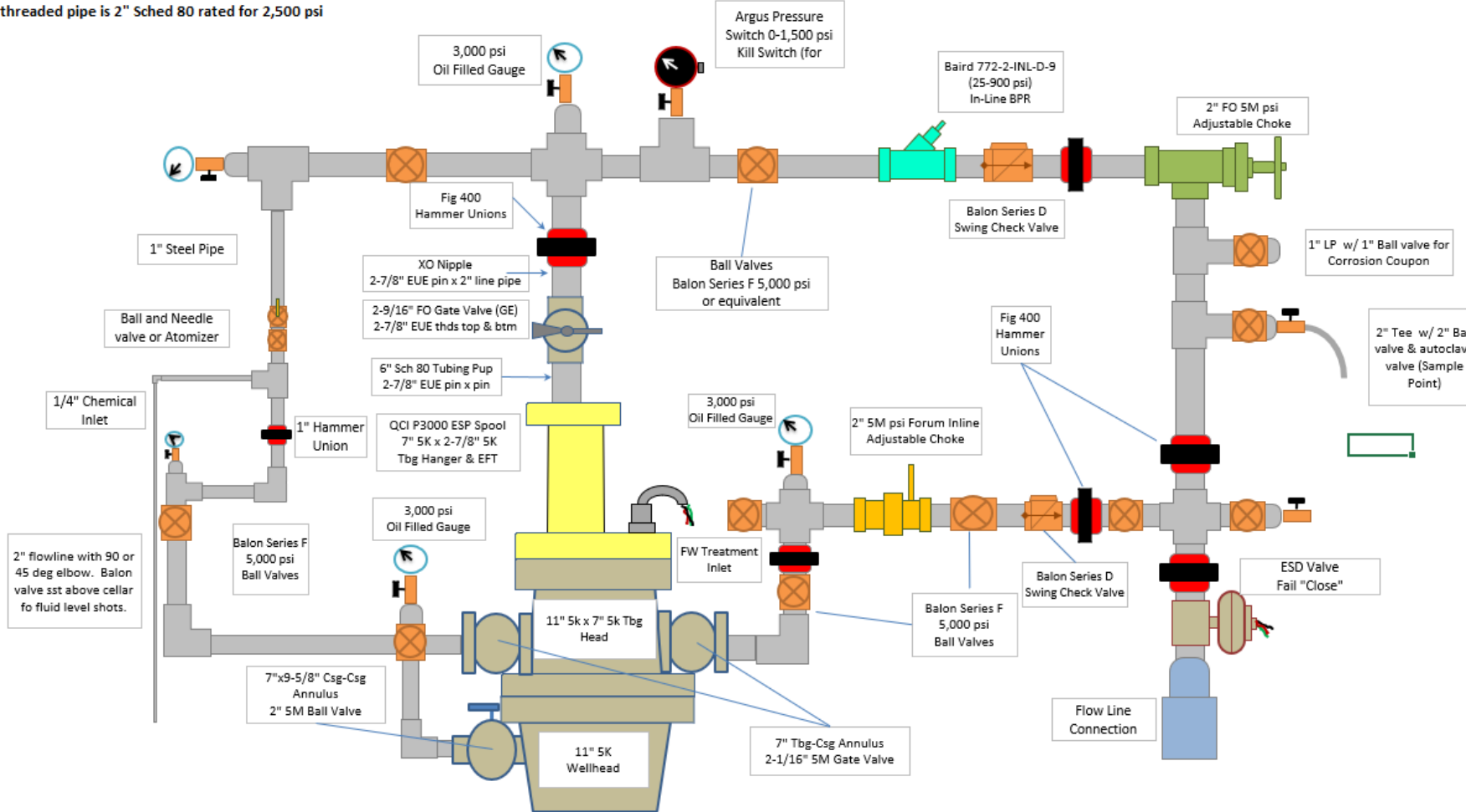
- Climate Considerations
- Power Supply (Line Power vs. Onsite Generation)
- Solids management systems
- Downhole Chemical Treatment
 - Slip Stream / Batch / Cap Strings
 - Scaling tendencies and partial pressures can change
- Managing ESP components as a commodity
 - Avoid becoming Dr. Frankenstein.....
 - Smart components (drive/sensor) and Pumps/Gas Seps should be paired consistently
 - Motors/cables can be mixed and matched
- Well surveillance and optimization



ESP WELLHEAD DESIGN AND OPERATION

PRODUCING WELLHEAD - ESP ARTIFICIAL LIFT

Wellhead rated for 5,000 psi, Sweet Service
All threaded pipe is 2" Sched 80 rated for 2,500 psi



Design Considerations

- Annular/Slug Flow
- Chemical Treatment
- Installation
- Downhole Gas Separation



ROD LIFT CONVERSION CONSIDERATIONS

- Timing and volume at AL conversion point are always a consideration
 - Cost of conversion
 - Impacts to flow rate
 - Ultimate impact to economics
- Impacts of wellbore deviation on rod load and unit selection
- Abandonment pressure considerations
- Scaling and Corrosion Tendencies
 - Treatment Options (Slip Stream / Batch / Cap Strings)
 - Account for PH and partial pressures when evaluating pumped off scaling tendencies and corrosion
 - Scaling tendencies can and do change
- Impacts of design on workover frequency



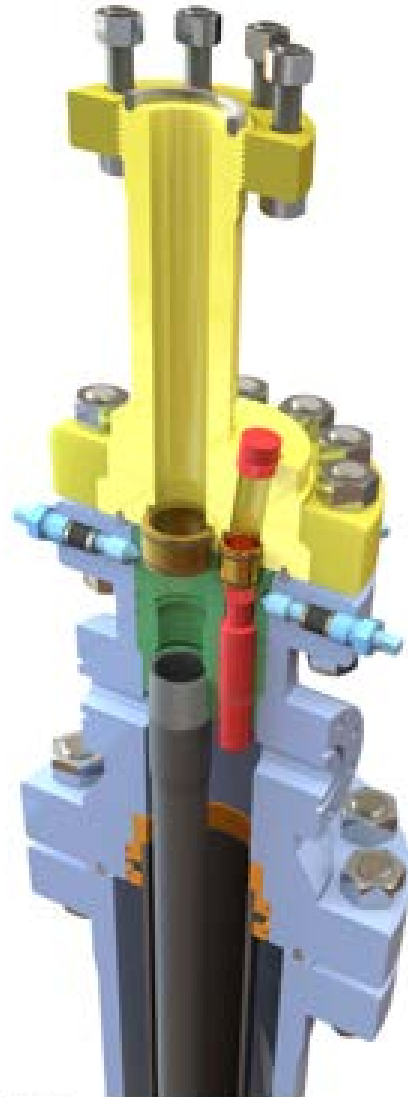
QUESTIONS?



BACK UP SLIDES

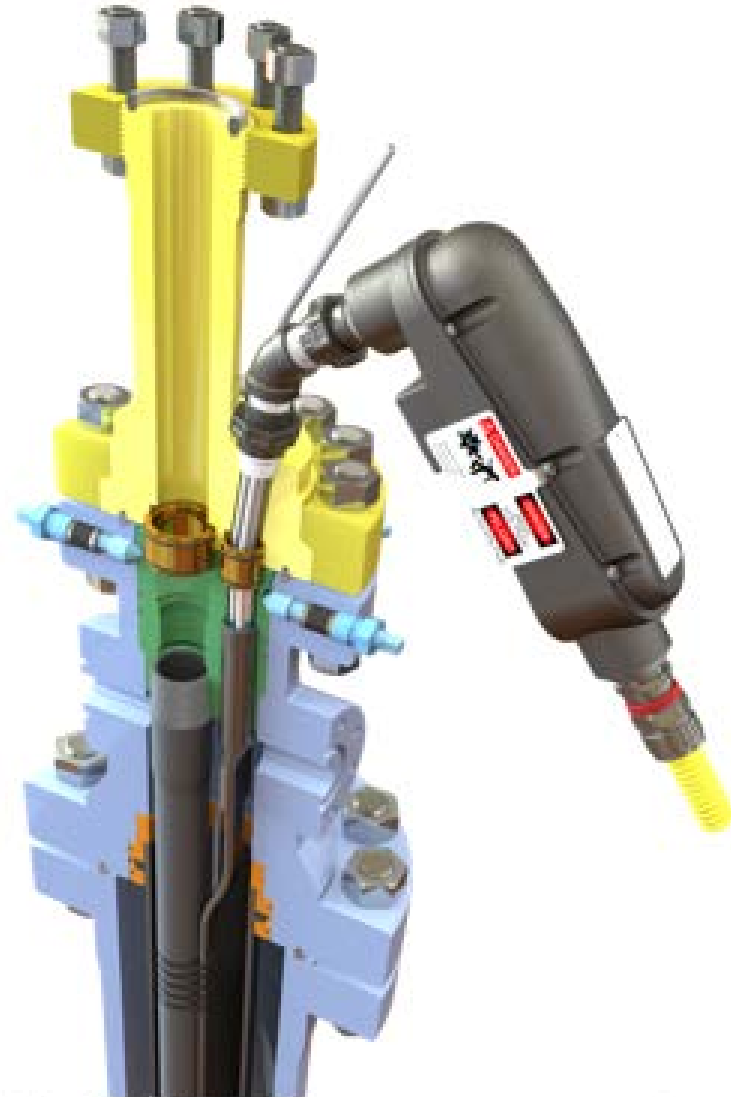


Gas Lift Completion



© 2017

ESP Completion



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P3000-2F Penetrator System Components

Maintaining well control and providing dependable power is at the core of our P3000-2 Penetrator. The field attachable design eliminates timely splices and exposed plug in connections.

