

Intelligent Rod Lift System Reduces over 430,000 lbs of CO<sub>2</sub> Emission Per Year, A Permian Basin Case Study M Mousavi, Ph.D, P.Eng. **ALRDC Artificial Lift Workshop** February 28<sup>th</sup> – March 3<sup>rd</sup>, 2022

M Mousavi (SSi), F. Kemp (Riley), B. Kleiner (SSi) SSi Artificial Lift, Riley Exploration Permian



### Permian Basin Case Study: ESP/Beam Pump/Intelligent Long-Stroke Unit

### Objective

 Measure Electricity Usage and calculate CO<sub>2</sub> emission in three Artificial Lift Methods with the purpose of determining an Energy Conscious approach when Producing High-Rate Oil Wells

### Method

- Analyze Similar Permian Wells, utilizing three different forms of Artificial Lift
- Measure Electricity Usage per well\*
- Calculate CO<sub>2</sub> emissions from measured electricity consumption using a publicly available CO<sub>2</sub> emissions factor provided by the *International Energy Regulator (IER)*

\*All data was measured by the Producer using partially normalized data and verifiable calculations

#### Assumptions

- Within the United States, making one Kilowatt hour (KW\*h) of electricity by using natural gas is equivalent to 0.92 lbs. of CO<sub>2</sub> emission \*International Energy Regulator.
- Specific Assumptions for each form of Artificial Lift to follow



### Permian Basin Case Study: ESP/Beam Pump/Intelligent Long-Stroke Unit

#### **Findings**

- Well 1 utilizing the Intelligent Long-Stroke Unit, saw 57% reduction in electricity usage as compared to well 3 in which ESP is running.
- Based on the reduction in electricity usage, 57% reduction in CO<sub>2</sub> emission can be inferred.
- A corresponding reduction of 430,663 lbs (195 tonnes) of CO<sub>2</sub> emission in one year due to less electricity usage is estimated when comparing BFPD produced and KW\*H per Barrel.
- Utilizing Rod Lift Earlier in the Well's Life Cycle can Increase Production & Decrease Overall Costs



## **Artificial Lift Selection Theory**



### Assumptions

ESP

- Common and preferred form of primary Artificial Lift
- Can produce between 100 to 30,000 bbl/day
- High electrical consumption
- Expensive workovers
- Temp and gas can be an issue
- Can be deployed in horizontal section

## Intelligent Long Stroke Unit

- Secondary form of Artificial Lift
- Midrange to high production depending on down hole pump and stroke length
- Low electrical consumption
- Moderate speeds to achieve high production
- Long stroke length capabilities
- Reduced workover events due to low speed

### **Beam Pump**

- Commonly used secondary form of Artificial Lift
- Midrange production depending on down hole pump
- Moderate electrical consumption
- High speeds to achieve high production
- Moderate stroke
  length capabilities

5

Artificial Lift R&D Council



# **Intelligent Features and Optimization**

#### How Intelligent Features Optimize Operation:

Intelligent Long Stroke Unit had all the following intelligent features built in in its software. This means that a separate pump off controller or a well managing system was not required.

#### The following intelligent features were active for the study:

- 1. <u>Upstroke rod sticking control</u> to constantly monitor rod load and If a downhole issue causes a spike in the load anywhere during upstroke, the unit changes the direction of movement to downward and continues to pump with a shorter stroke.
- 2. <u>Rod hang up and carrier bar separation control</u> to slow the unit down if the load drops below a set point anywhere during downstroke. The unit speeds up again if carrier bar separation disappeared.
- 3. <u>Casing/Fluid level control</u> was set to slow down the unit in case of Fluid Over Pumping (FOP)
- 4. <u>Auto Optimization to monitor the Dynacard and to try to make it rectangular as much as possible.</u>

#### The following intelligent features were inactive for the study:

- <u>Chemical injection control</u> to turn on and off the chemical injection skid based on the measured load to only inject chemicals when it is needed to save money and energy.
- 2. <u>Rod Stretch control</u> to pause the pumping unit at the bottom of every stroke and let the rod to relax before starting the next up stroke.



## **Comparative Well Data**

Well Location	Well 1 Intelligent Long- Stroke Unit	<b>Well 2</b> Traditional Pumpjack
Pumping Unit	SSi-400-200-336	C912-365-192
Well Depth (m)	4717	4686
Bore Size (in)	2.75	2.25
Stroke Length (in)	336	192
Surface Max Load (lbs)	30155	21944
Max Load (% of Rating)	75.39%	60.12%
Surface Min Load (lbs)	6985	6074
Average Pumping Speed (SPM)	3.8	4.8
No of daily cycles	5472	6912
Estimated # of Months to rod failure	121.8	96.5
In-balance Max Torque (m in-lbs)	N/A	799.0
In-balance Gearbox Load	N/A	87.61%
Production rate (BFPD)	750	400

### Well 1 – Dynacard Intelligent Long Stroke Unit

- Total produced fluids with Rod Lift avg 750 BFPD
- Auto Optimization on every stroke
- Long Slow Strokes allows gravitational gas separation
- Faster Upstroke, slower downstroke provides full pump fillage
- Uptime in excess of 99.8%
- Increased longevity of downhole equipment due to longer stroke and slower speed





## **Findings Summary**

Well	Model	Average Production	PPRL (lbs)	Bore Size (in)	Electricity Consumption (KW*H/day)	Electricity Consumption (KW*H/bbl)	CO <sub>2</sub> Emission (lbs/bbl)
Well 1	SSi 400LS	750 BFPD	30155	2.75	975	1.30	1.196
Well 2	C912	400 BFPD	21944	2.25	462	1.16	1.058
Well 3	ESP 1750	800 BFPD	N.A	N.A	2410	3.01	2.769

\*The electrical consumption was measured by the Producer at each well location.

\*The overall efficiency of pump and motor excluding cable losses for ESP 1750 is 43% for 800 BFPD while the max. possible is 59%.

\* Within the United States, making one Kilowatt hour (KW\*h) of electricity by using natural gas is equivalent to 0.92 lbs. of CO<sub>2</sub> emission. *\*International Energy Regulator* 

#### Findings

- Well 1 utilizing the Intelligent Long-Stroke Unit, saw 57% reduction in electricity usage compared to the ESP well on well 3. Therefore, 57% reduction in CO<sub>2</sub> emission can be inferred.
- A corresponding reduction of 430,663 lbs (195 tonnes) of CO<sub>2</sub> emission in one year due to less electricity usage is estimated when comparing BFPD produced and KW\*H per Barrel.
- Utilizing Rod Lift earlier in the well's life cycle can increase production & decrease overall costs.
- Comparing Intelligent Long Stroke Unit with Beam Pump, equal energy consumption can be seen while PPRL is 40% more in Intelligent Long Stroke Unit, bore size is larger and production is almost doubled.

# Thank You!

Questions?



# Copyright

Rights to this presentation are owned by the company(ies) and/or author(s) listed on the title page. By submitting this presentation to the Gas-Lift Workshop, they grant to the Workshop, the Artificial Lift Research and Development Council (ALRDC) rights to:

- Display the presentation at the Workshop.
- Place it on the <u>www.alrdc.com</u> website, with access to the site to be as directed by the Workshop Steering Committee.
- Links to presentations on ALRDC's social media accounts.
- Place it on a USB/CD for distribution and/or sale as directed by the Workshop Steering Committee.

Other uses of this presentation are prohibited without the expressed written permission of the company(ies) and/or author(s) who own it and the Workshop Steering Committee.



## 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.