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13TH ANNUAL SUCKER ROD PUMPING WORKSHOP

RENAISSANCE HOTEL
OKLAHOMA CITY, OKLAHOMA
SEPTEMBER 12 – 15, 2017

SSI ARTIFICIAL LIFT
A TUNDRA Company

LONGEST STROKE AND HIGHEST CAPACITY RECIPROCATING SUCKER ROD PUMPING SYSTEMS

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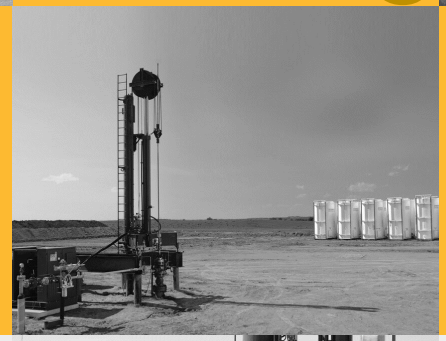

Comparison Long Stroke Skid Mounted Vs. Mechanical Vertical Long Stroke 6

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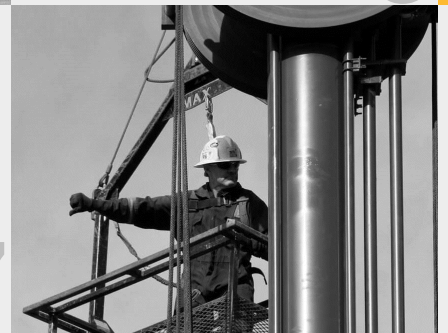

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SSI LIFT HISTORY

- Tundra Process Solutions **acquired Dynapump assets in 2011/2012** and re-branded as SSi Lift Systems in 2012
  - (**SSi** = **Sure Stroke Intelligent** Lift System)
- Manufacturing moved from California to Calgary
- Offices in Houston, Denver, Bakersfield, Dallas, Cairo, Egypt and Bogota, Colombia
  - Headquartered in Calgary, Canada
- Worldwide number of installations reached +1200 at end of 2016
- Designed and Built Dedicated Load Tester. All units load tested prior to shipment
  - Test capacity of 50,000 Lbs
- Patent on Autostroke Logic issued
  - Improved PLC functions and issued new patent
  - Implemented design changes and 200+ improvements post-Dynapump. Continuous improvement processes

ISO 9001:2015 Certified

SSI SYSTEM OVERVIEW

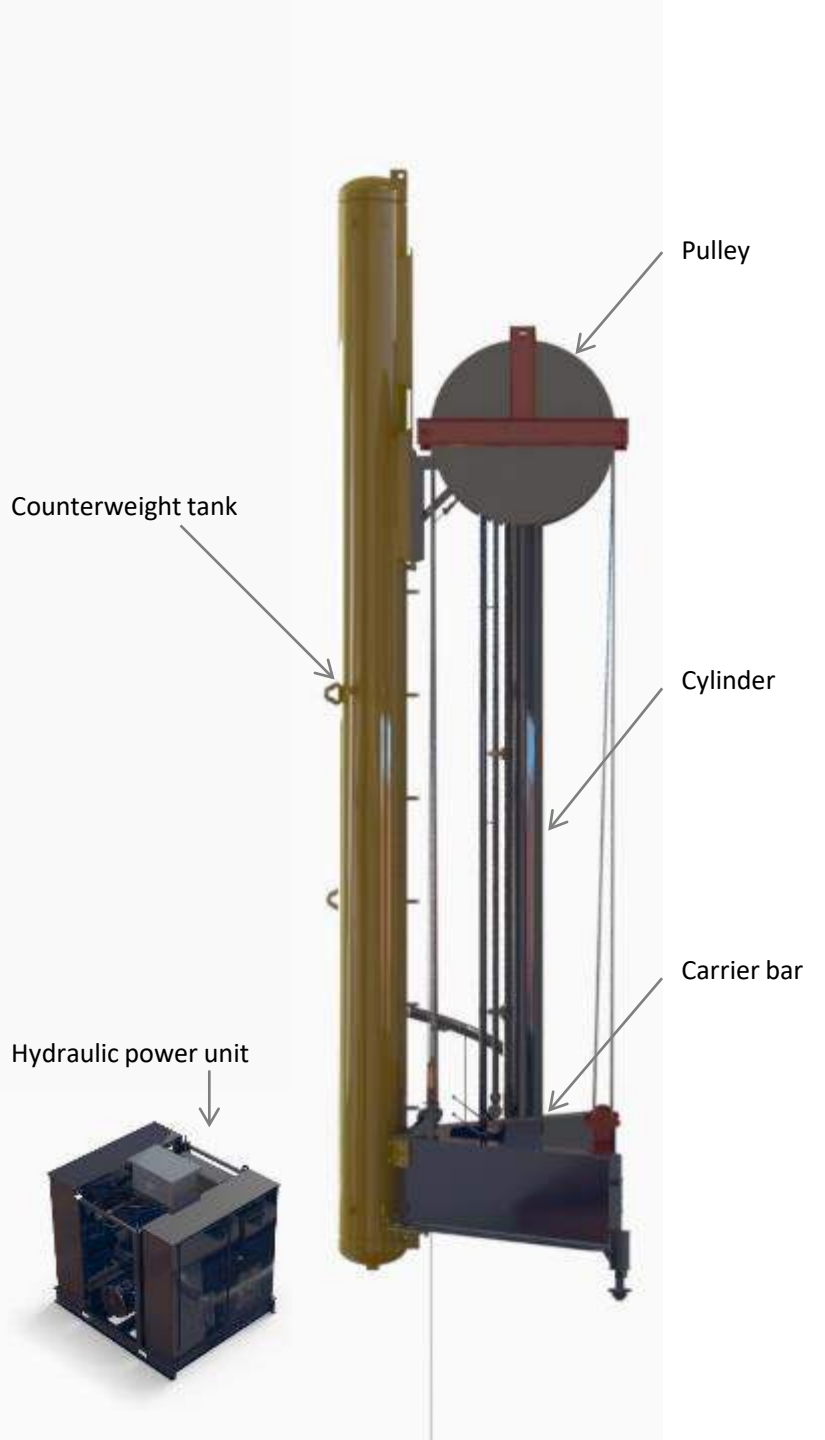
SSi is a computer-controlled, hydraulically driven, long-stroke, high capacity pumping unit

Comprised of two main components:

- The pumping unit
- Power unit

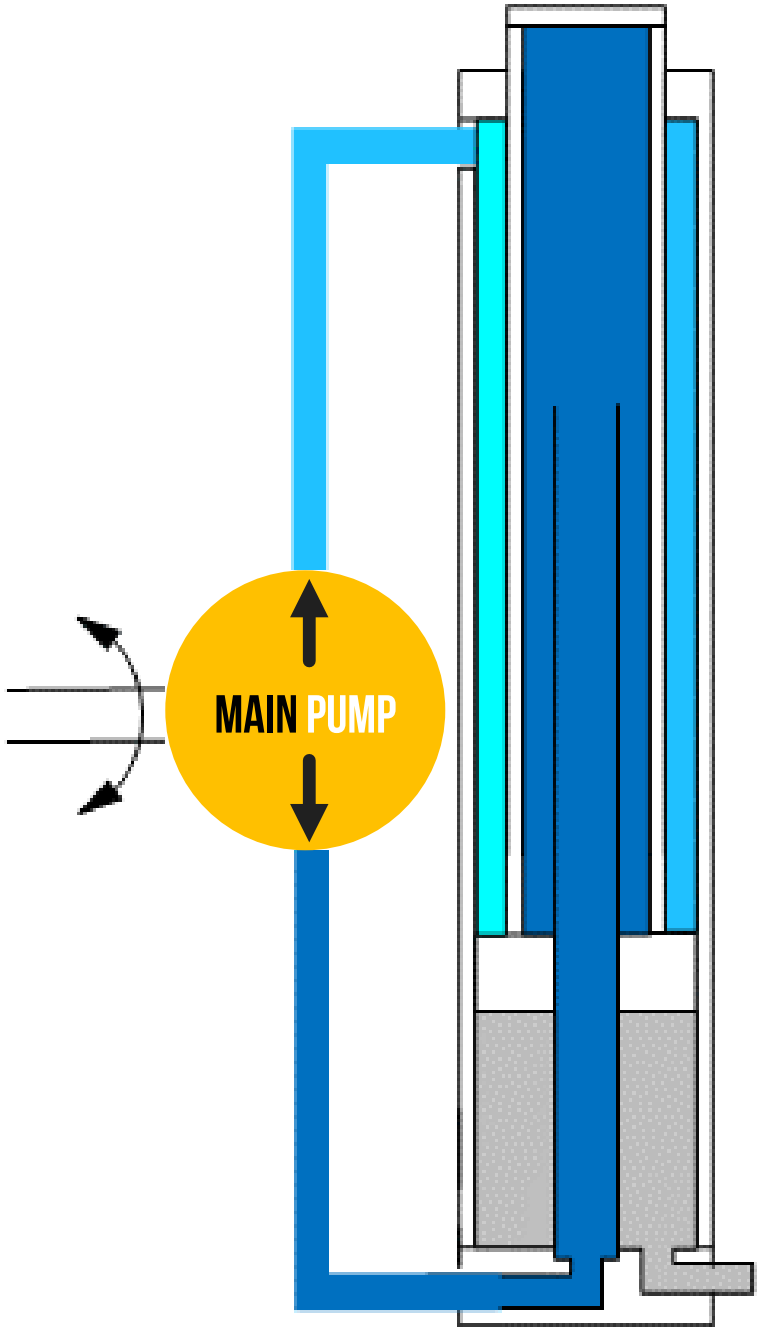
Unit Model	150	250	350	400	400LS	600	800
Stroke Length (Inches)	168	240	*372*	288	336	336	360
Load (x1000 lbs)	15	25	35	40	40	60	80

ALL UNITS ARE LOAD TESTED PRIOR TO SHIPMENT



SSI LIFT HISTORY

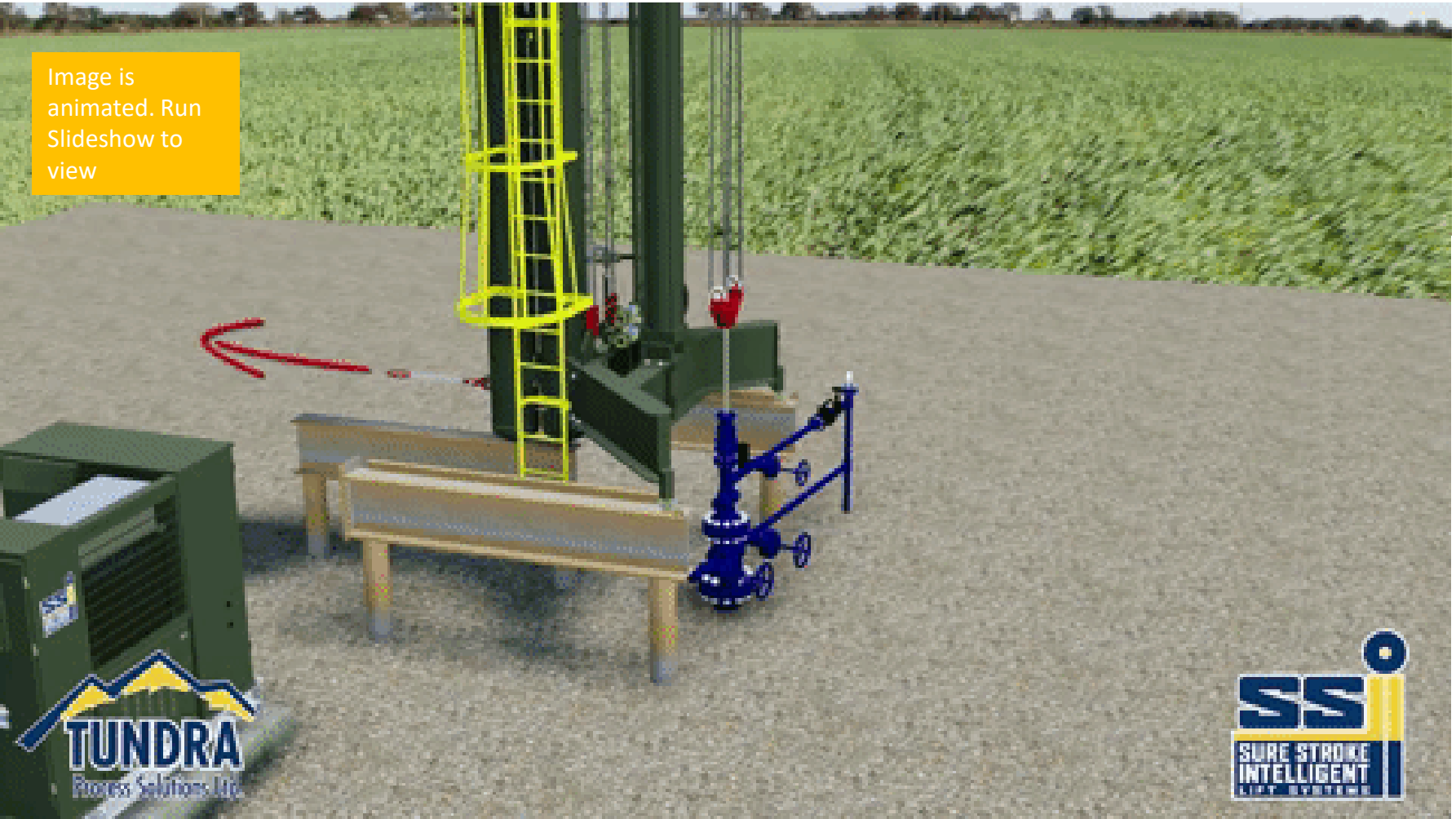
- Patented triple cylinder pump unit
  - 2 oil chambers, 1 nitrogen chamber
- Nitrogen chamber offsets 100% of the rod load and 50% of the fluid load
- 2:1 pulley design doubles the polished rod velocity (vs. cylinder speed)
- Cylinder movement and direction of travel is determined by the Main Pump rotation
  - Eg. clockwise/counter-clockwise, pump RPM
- Stroke length and reversals are controlled by the settings in the controller, position sensor, and Variable Frequency Drive (VFD)
- Resulting in soft turnaround of up/down stroke

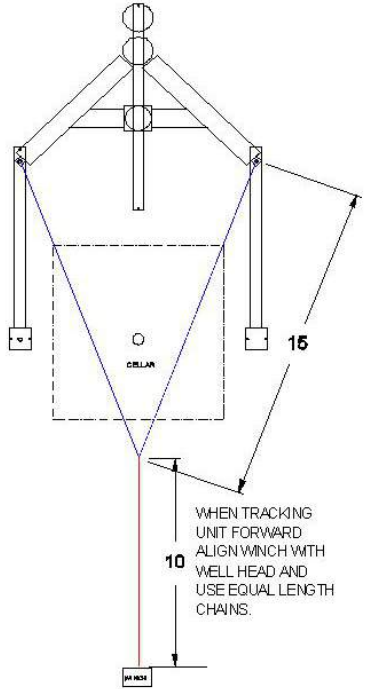


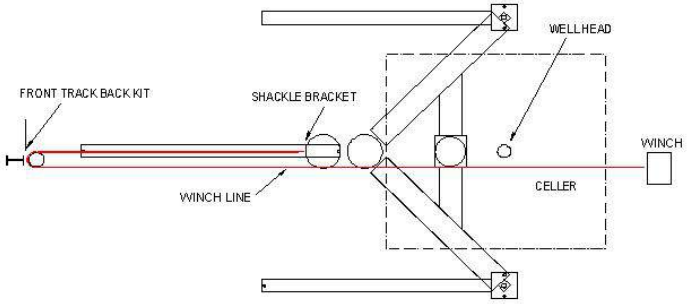
TRIPLE CYLINDER

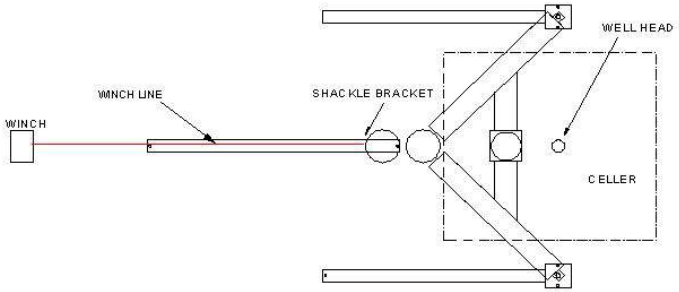
SSI UNIT COMPONENTS:
TRACK SYSTEM

Image is animated. Run Slideshow to view

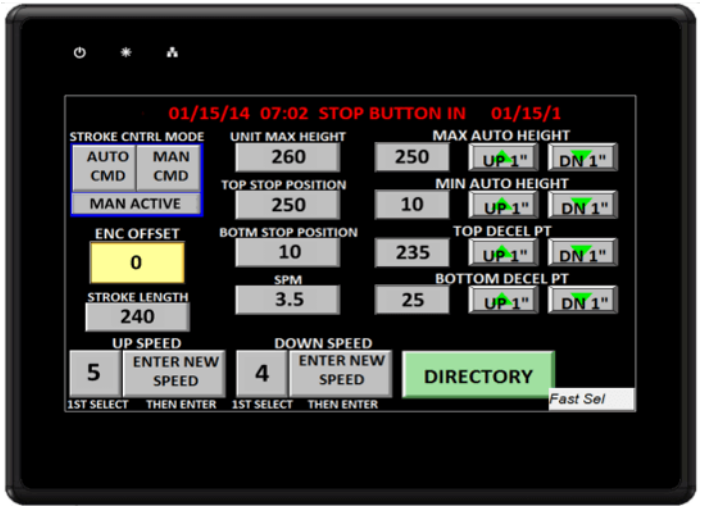


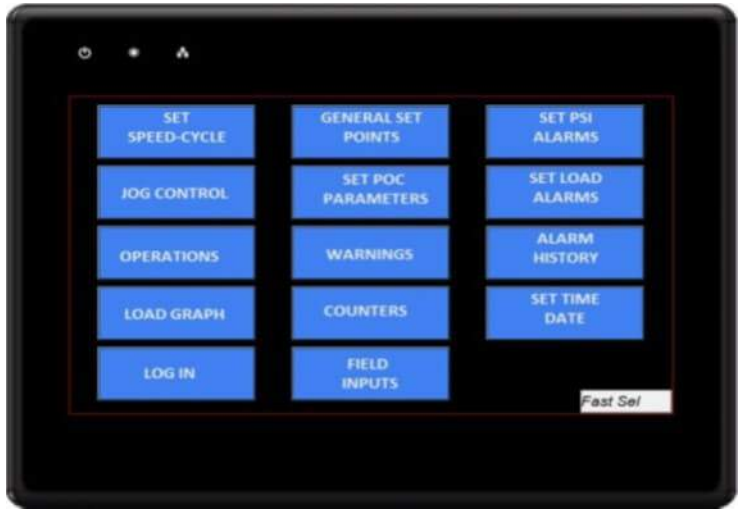






SSI UNIT COMPONENTS:
OPERATOR INTERFACE SCREEN





OPERATOR INTERFACE SCREENS

SSI UNIT COMPONENTS:
OPERATOR INTERFACE SCREEN

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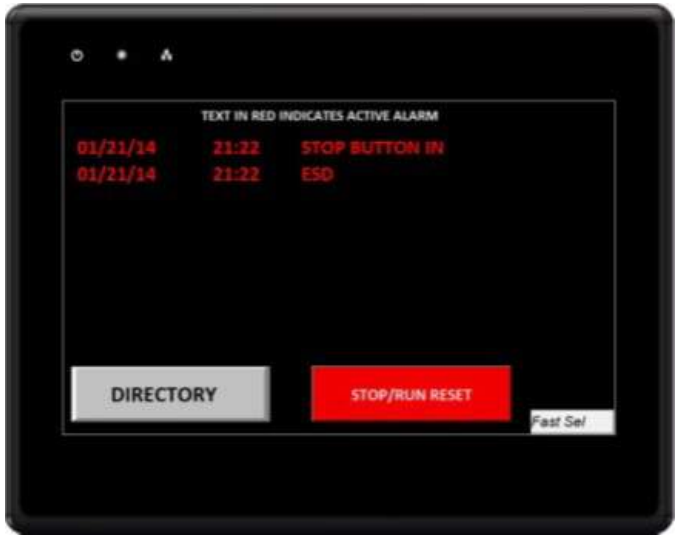
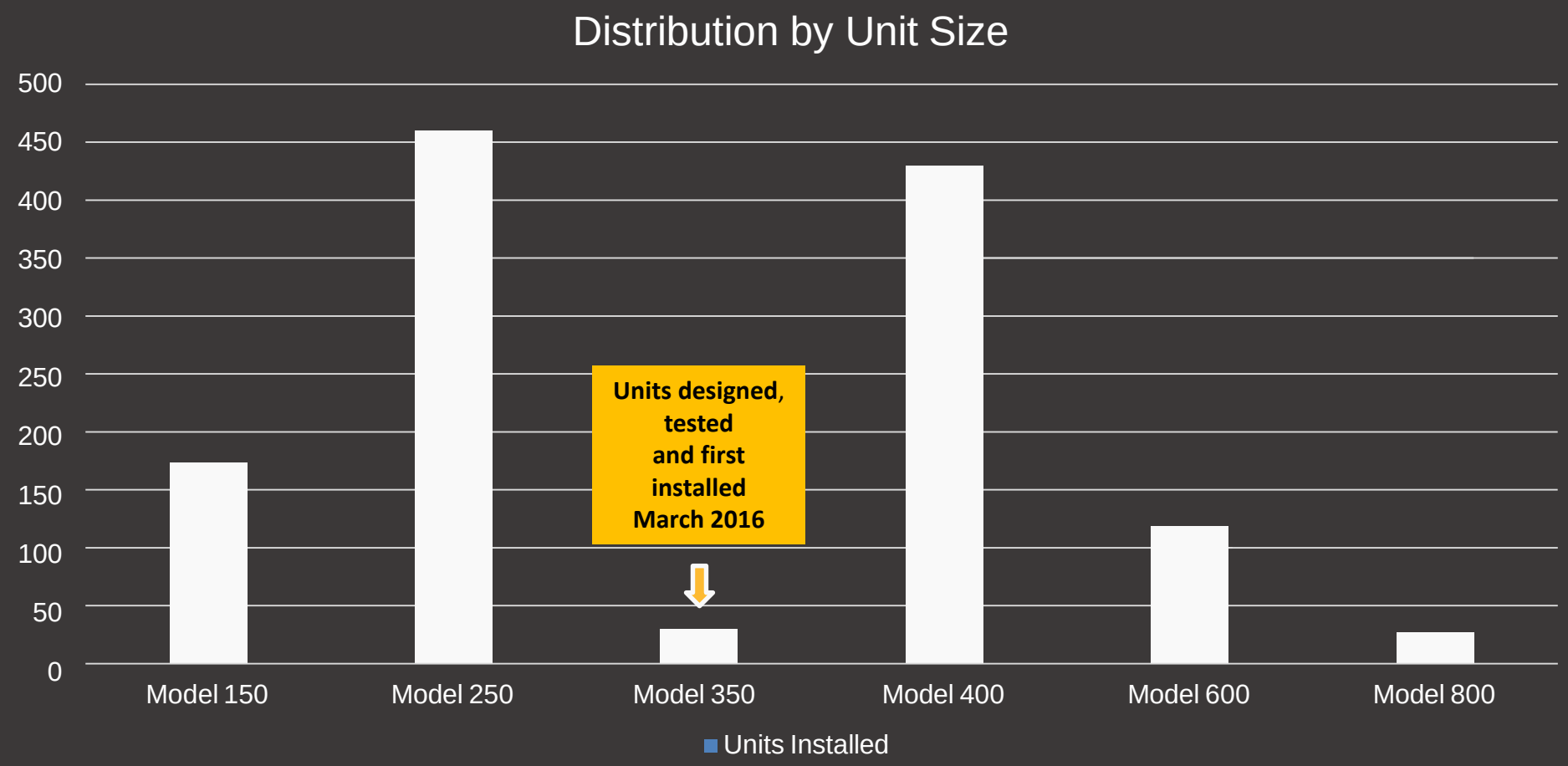
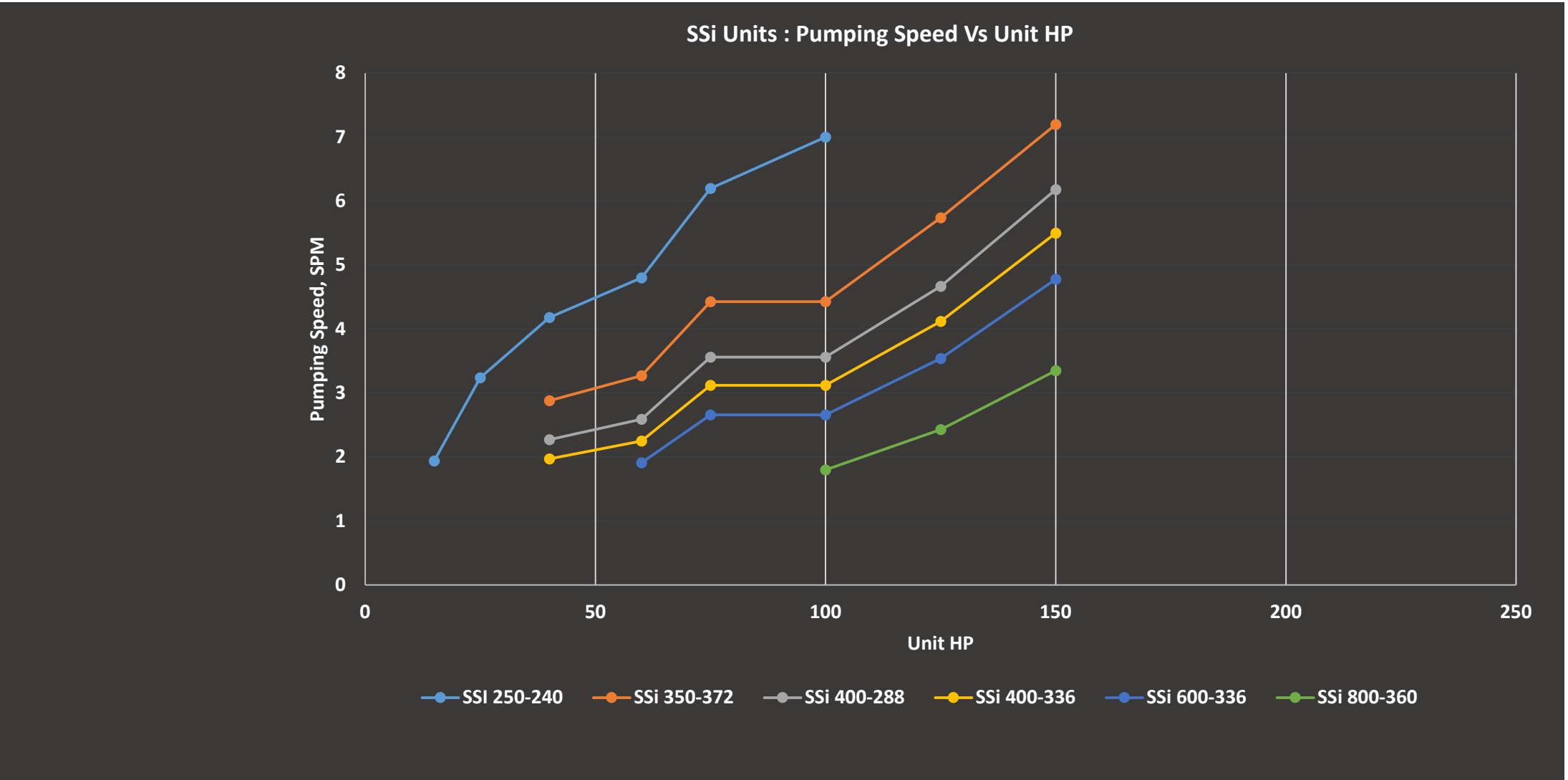


UNITS INSTALLED



SSI UNITS: PUMPING SPEED VS. UNIT HP

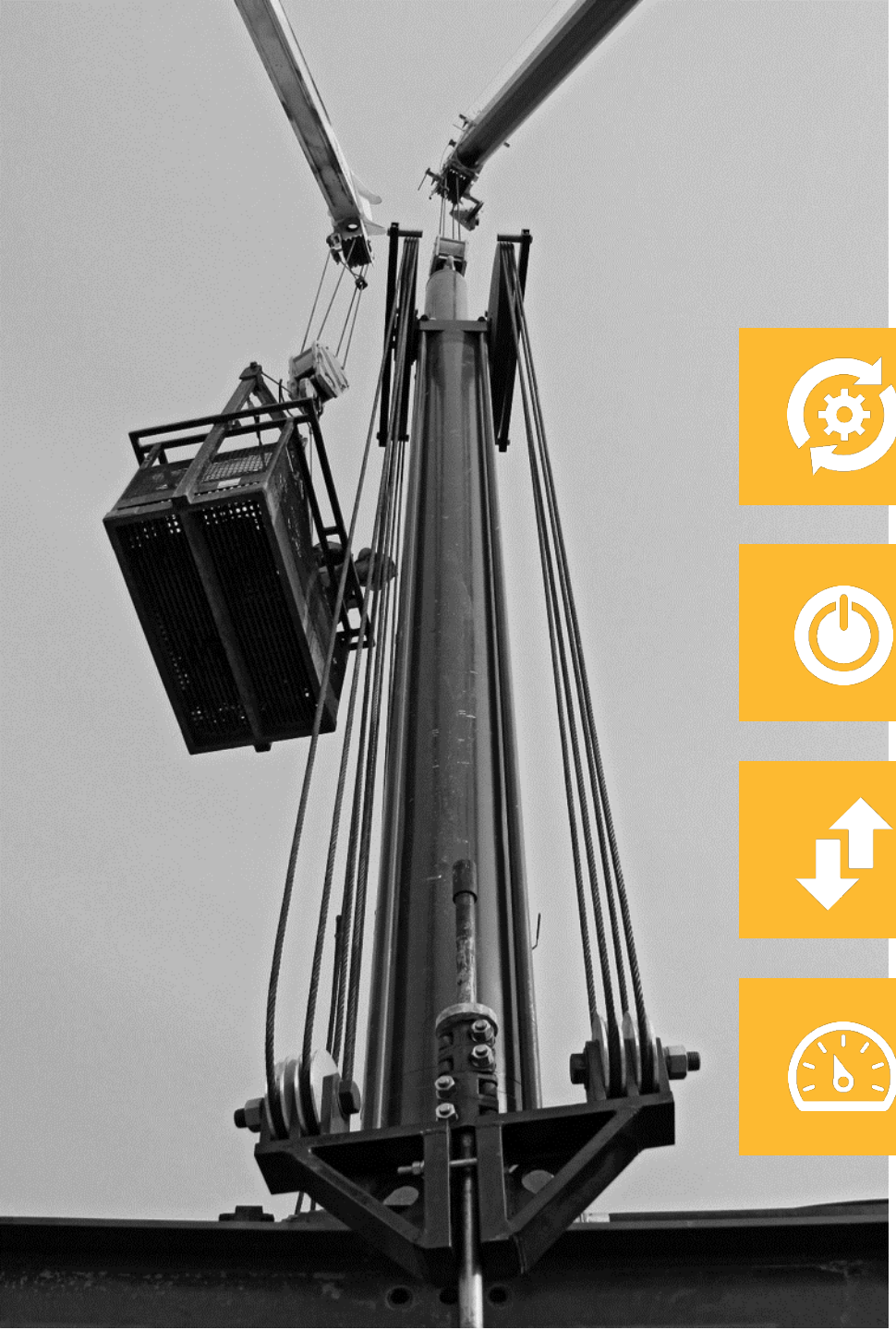


Consult SSi regarding higher SPM capability for units >150HP

SSI UNIT - KEY ADVANTAGES

- Well optimization
- Integrated pump-off control
- Up and down stroke speed is independent
- Instantly control stroke length variable speeds

  while the unit is running



SSI UNIT - KEY ADVANTAGES

- Variable Speed Up/Down
  - Eight independent speeds for up and down stroking
- Acceleration and deceleration transitions are independently controlled during rod reversal
  - Substantially reduces rod stresses
- Slower down stroke ability reduces the compressive load (which can cause buckling of the rods)
  - Fewer rod and tubing failures

SSI UNIT - KEY ADVANTAGES (SAFETY)

- Operation adjustments performed at the Power Unit
  - No routine operations are required at the pumping unit
- Braking system is inherent in the system
  - No mechanical intervention is required
- Counterbalance is nitrogen
  - Easily adjusted very accurately without stopping the unit
  - No large heavy steel weights required
- No guy-wires required
  - vs. wellhead-mounted hydraulic pumping units
- Few pinch points
  - 4-6 times safety factor on lifting cables

SSI UNIT VS. MECHANICAL VERTICAL LONG STROKE

	SSi	Mechanical Vertical
Stroke Lengths	0 – 372”, depending on model, fully variable	fixed stroke 288”, or 306”, or 366”
Maximum Polish Rod Load	15,000 lbs to 80,000 lbs	36,000 lbs or 50,000 lbs
Stroke speed	0 – 7 spm, fully variable	0.8 – 4.5 spm
Speed changes	While in operation	Shut down, change drive sheaves, or, install VFD
Intelligence	Pump off controller built in , alarms and communication. Variable up/down speed,	
Drive system	Hydraulic piston, very few moving parts, low wear	Gear reducers, chain drive, belt carrier
Counterbalance	Pressure balance with nitrogen, variable by changing pressure	40,000 lbs of steel weights, requires pickers/cranes to modify
Dimension of largest unit	8’ long, 5’ wide, 41.25’ tall, plus hydraulic skid 6’ x 8’ x 8’	23.6’ long, 8.5’ wide, 49.3’ tall
Base	Pile supported I-beams, approx 8’ x 10’, approximately 3000 lbs	Pile supported concrete pad, 24’ x 8.5’, 29,000lbs
Shipping weight of largest unit, including counterbalance	22,810 lbs for pumping unit, 8400 lbs for hydraulic drive unit	53,880 lbs for unit, plus 40,000 lbs for counterweights, plus base
Shipping and set up	One truck trailer, picker, 4 hours on site	More than one truck, large picker/crane

SSI UNIT VS. CONVENTIONAL BEAM UNIT

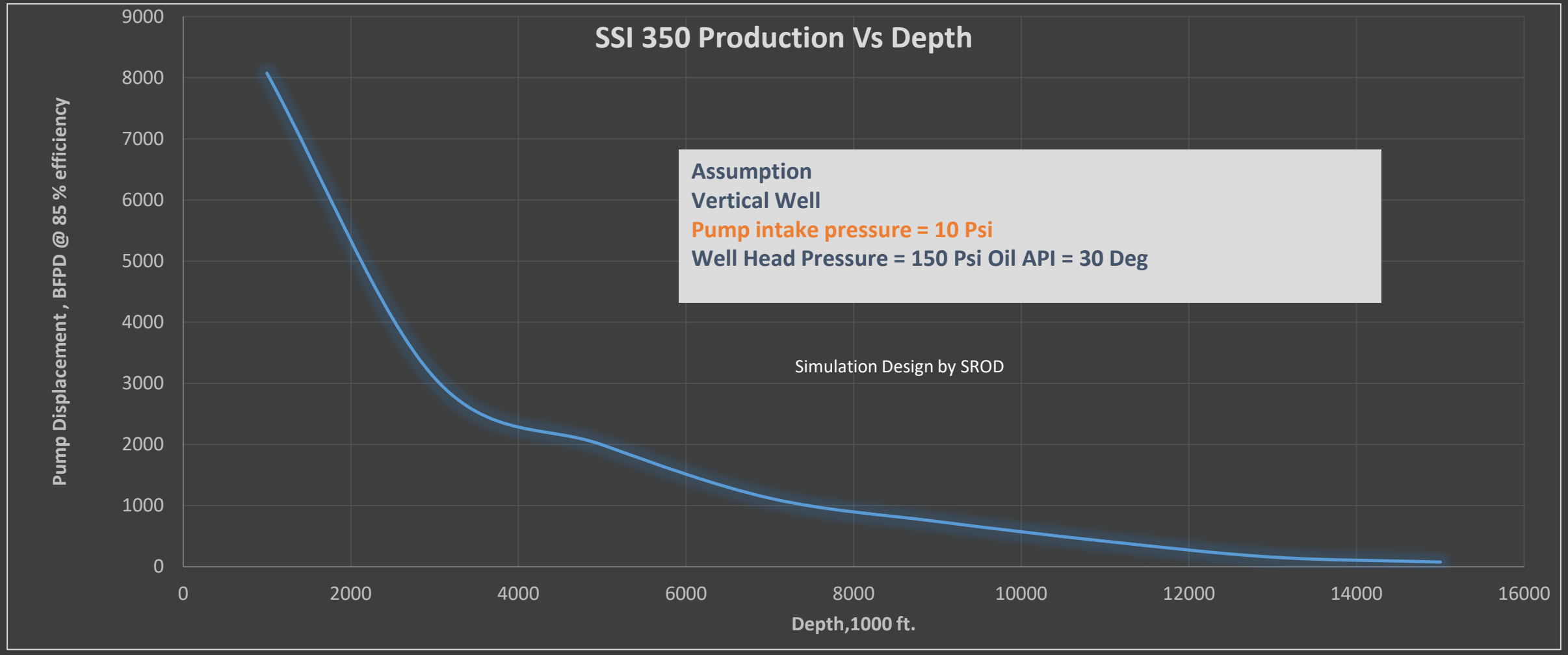
SSI UNIT VS. BEAM UNIT

CONTENTS	SSi	BEAM PUMP
Cost of the Unit	Overall cheaper than beam pump	Only Chinese product cheaper than SSi
Operational Cost	Electricity cost is up to 20-30% less	Power supply by diesel engine or electric motor
Stroke	longer stroke up 1 to 372'', cuts down on well workover cost & allows longer run time on the sucker rods, tubing & bottom hole pump	Longest stroke length available is 240". Beam pumps have to move a lot faster to make the same production as the SSi long stroke.
Efficiency	In addition to consuming 30% less electrical energy than the conventional beam pumps, overall superior system efficiency is due to the long slow stroke of the SSi unit.	Less energy efficient. The shorter rapid stroke leads to higher costs in workover, shorter run life on the sucker rods, tubing and bottom hole pumps.
Production	At the same number of strokes per minute, the production is higher unit due to the longer stroke.	Lower production at the same number of strokes per minute.
Lifting Capacity	15,000 LB to 80,000 LB depending on model	Maximum capacity is 42,700 LB
Gassy Wells	Higher pump compression ensures better pump performance in gassy wells	Very poor performance on gassy wells. Not able to vary speed without add-on equipment. Creates tubing and sucker rod stretch. Very difficult to keep in balance due to changing loads.
Well depth	Up to 17,000 Ft	Restricted on production and pump size.
Durability	With proper maintenance can operate a very long time.	More moving part can cause shorter run life than the SSi and requires more maintenance.
Physical Dimension	Up to 5 times lighter and a very compact unit, it is requires a very small area.	Requires a vey big area to operate.
Installation	Can easily install 2 to 3 units per day	Requires heavy machinery and longer time to install
HSE	There are no dangerous or heavy counter weights to keep the SSi in balance.	Having heavy moving components and counterweights could create HSE issues during operation & maintenance.

SSI UNIT VS. CONVENTIONAL BEAM UNIT

Well Depth, ft	5,000		10,000	
Motor	100 HP		125 HP	
Pumping Unit	L C1280-365-192	SSi 350-372	L C1280-427-192	SSi 350-372
Surface Max Load (lbs)	28894	27347	40661	34873
Surface Min Load (lbs)	4854	5995	13357	14173
Average Pumping Speed (SPM)	8.18	3.84	8.79	4.61
No of daily cycles	11779	5529	12657	6638
No of Months to rod failure	55	118	51	99
Polished Rod Horse Power (hp)	46.36	43.65	59.03	56.24
Computed Surface Stroke (in)	193.4	372	193.4	372
In-balance Max Torque (m in-lbs)	1117.9		1345.5	
In-balance Gearbox Load	87.3		105.1	
Pump Diameter (in)	2.5		1.75	
Net Pump Stroke	167.7	357.7	191.2	365.1
Net bpd at 100% pump eff.	1000		600	
Rod Type	N97			
Rod API Size	87		86	
Rod Loading %	74	68	103	79
Service Factor	0.9			
Fluid Gradient psi/ft	0.4			
Pump intake pressure, psi	100			
well Head pressure , psi	150			

CASE STUDY: PRODUCTION VS. DEPTH



CONCLUSIONS & RECOMMENDATIONS

1. Advantages of long stroke units with reduced SPM will increase MTBF and reduces Well Intervention by:
   - 1.Lowering peak polish rod load
   - 2.Reducing the loading by creating higher minimum polish rod load
   - 3.Decreasing buckling tendencies
   - 4.Decreasing side loads and drag loads

2. Adjustable upstroke and downstroke speeds allow for more pump fillage

3. Flexibility of control accelerations and decelerations

4. The Skid Mounted units are designed for ease of balancing the well, changing SPM and/or lengths based on the changing well conditions and this is easily achieved without ever shutting down the well

5. For high safety and less hazard related to well operation for persons and equipment, the Skid Mounted units are proved to be the best choice. Where all well operation can be done from the power skid

SSI SYSTEMS SUMMARY

- **Sure Stroke Intelligent Lift System Advantages**
  - Lower Per Barrel Lifting Cost
  - Controlled Variable Speeds
  - Integrated Pump off Controller
  - User Friendly Touch-Screen Interface
  - Green Solution – Lower Power Consumption
  - Much Lower Transportation and Installation Costs
  - Approx. 1/10th the Weight of Comparable Beam Units

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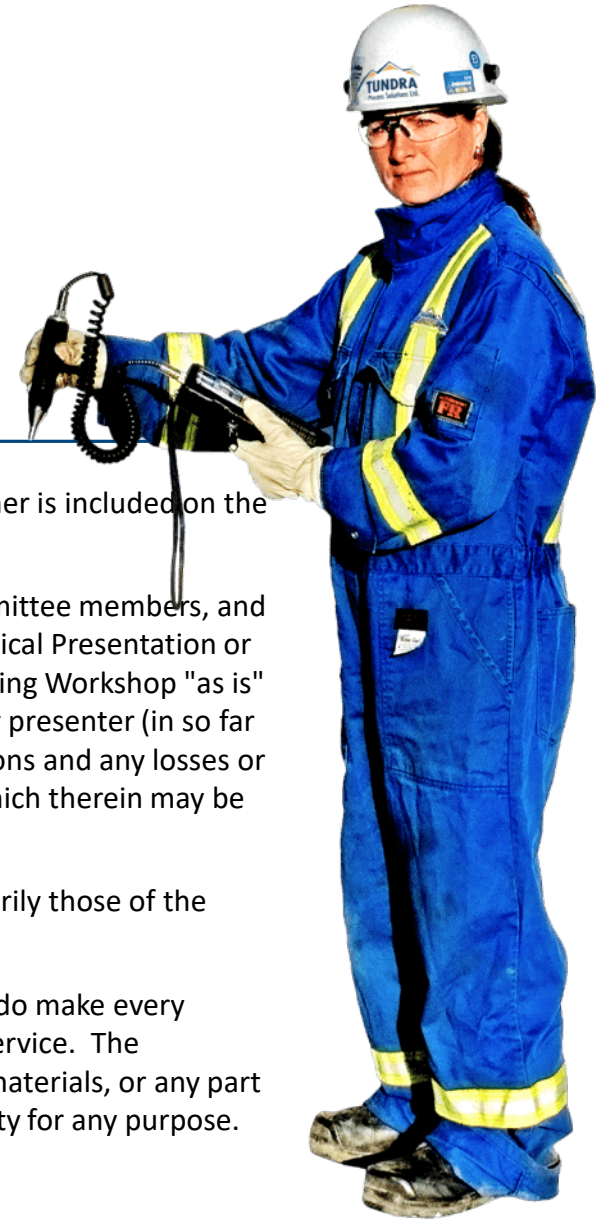

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