Intelligent Long Stroke Hydraulic Pumping System Reduces Well Intervention Costs While Maximizing Energy Efficiency

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DynaPump
What is a DynaPump?

DynaPump is an Intelligent Long Stroke Hydraulic Sucker Rod Pumping System (ILSHSRPS)

- The first ILSHSRPS were invented and tested in the 1990’s.
- They were commercially introduced to the market in 2001.
- The DynaPump Corporation completely restructured in 2007 leading to the “Second Generation DynaPump”.
- There are currently close to 500 units operating worldwide.
ILSHSRP Diagram

**Power Unit:**
- Provides the driving force and control for the Pumping Unit.
- Determines the maximum SPM the Pumping Unit can run.

**Pumping Unit:**
- Provides the lift capacity, the same as a crane.
- Determines stroke length based on model.
ILSHSRPS Advantages

• Increased Production Capacity
  – Operates with up to a 360” stroke length.
  – Maximum peak polish rod load capacity of 80,000 lbs.
  – Superior lift and production capability compared to conventional beam units.

• Energy Efficiency
  – Unique Counterbalance System minimizes inertia losses.
  – Variable Frequency Drive and Computer Logic adjust to changing well conditions maximizing efficiency.
  – Adjustable upstroke and downstroke speeds allow for more pump fillage and less slippage.
  – Reduction of accelerations and decelerations allows for use with larger bottom hole pump which reduces pressure drop.
Energy Savings in Operation

- A much longer stroke and controlled acceleration and decelerations brings several energy benefits:
  - Lower losses of stroke as a percentage of the total stroke, making the system more efficient.
  - Manipulation of the acceleration and deceleration to improve downhole stroke.
**Bottom Hole Stroke Length**

Surface stroke = 240°
Bottom stroke = 120°

Stroke Loss = 120°

- 6,000' deep, FAP <200'
- Rod string = 95'
- Bottom Hole Pump = 3.75'

Increased Bottom hole stroke
240/120 = 200%

Surface stroke = 360°
Bottom stroke = 240°
(equal loss?)
ILSHSRPS Advantages (Cont.)

• Reduced Well Intervention
  – Reduced strokes per minute have significant runlife impact on rod and tubing strings.
  – “Soft” transition between upstrokes and downstrokes reduces stress on rod string.
  – Adaptability to changing well conditions eliminates need for workover rig and crew.
  – Integrated Pump off Controller slows unit down instead of shutting unit down in pumped off condition reducing stuck and parted rods.

• Smaller Footprint
  – ILSHSRPS have approximately 1/10th the weight of comparable beam units reducing transportation and installation costs.
  – Compact size allows for placement in tight working areas.
Advantages of Reduced SPM

• Reduces Well Intervention by:
  – Reducing peak polish rod load
  – Creating higher minimum polish rod load
  – Decreasing buckling tendencies
  – Decreasing side loads and drag loads
  – Decreasing rod loading
Advantages of Reduced SPM (Cont.)

- Lower Peak Polish Rod Load
  - PPRL decreases with lower SPMs as demonstrated by following equation. Note the extra influence of the squared power:
    - PPRL = W_f + W_r + W_rα *
      - Where
        » W_f = fluid load
        » W_r = rod weight
        » W_rα = acceleration load = W_rSN^2/70500

- Conversely, doubling the SPMs would quadruple the acceleration load and increase the PPRL in the above equation.

*plus several frictional components
Advantages of Reduced SPM (Cont.)

• Lower Peak Polish Rod Load
  – Decreased side loads and drag loads due to decreased rod tension (F) across deviated sections. This necessarily decreases friction ($q_n$) and decreases rod-tubing wear.

*Figure 1. Schematic of Rod Element in a Deviated Well (3-D model)*
Advantages of Reduced SPM (Cont.)

- Higher Minimum Polish Rod Load
  - MPRL increases with lower SPMs as demonstrated by following equation. Again note the extra influence of the squared power.
    - MPRL = \( W_r - W_r \alpha - 0.127 \ W_r G \) *
      - Where
        » \( W_r \) = rod weight
        » \( W_r \alpha \) = acceleration load = \( W_r S N^2 / 70500 \)
        » 0.127 \( W_r G \) = buoyant force

- This time the acceleration force term is a negative component and increasing the SPMs decreases the MPRL.

*plus several frictional components*
Advantages of Reduced SPM (Cont.)

• Higher Minimum Polish Rod Load
  – Decrease buckling tendencies, especially near bottom of rod string. Higher minimum polish rod loads translates to increased tension in rod string during unit downstroke. This translates to less friction and drag against tubing as the rods fall.
ILSHSRPS Advantages (Cont.)

- Environmentally Friendly Solution 🌍
  - Virtually undetectable from a distance, ILSHSRPS’ small footprint, vertically slow stroke, and reduced noise features blend well into any landscape. Superior electrical efficiency and reduced well intervention make the ILSHSRPS the most “Environmentally Friendly Solution” available.
ILSHSRPS Comparison

- Permian Basin Operator Compares ILSHSRPS, Beam Units, and Electrical Submersible Pumps (ESP)
  - 4 ILSHSRPS averaged 0.70 KWH/Barrel produced compared to 6 Beam Units at 1.36 KWH/Barrel produced and 5 ESP at 4.16 KWH/Barrel produced (all data collected under similar operating conditions).
  - Operator replaced a Beam Unit with a ILSHSRPS on a deviated well and reduced rod failures from 5/year to 0 in the first year of operation.
  - The 4 ILSHSRPS average uptime was 98.5% during the first year with the wells operating at or near pump off condition.
  - The operator added 12 additional ILSHSRPS the following year based on these results.
Power Consumption Comparison

Power Consumption Data

Production, BPD

Power Consumption, KWH/Day

DynaPump
BEAM
SUB
DynaPump Models

Pumping Unit Specifications

DynaPump has a full range of Power Units to match each application of Pumping Unit from 10 HP to 150 HP. Pumping and Power Units can be matched to optimize flow potential while minimizing power consumption.

1 ¼” rods are available to support the larger load capabilities of the DynaPump.
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