SILVERJACK
LIFT SYSTEMS

DIVISION OF TCB MANUFACTURING || TAKING CARE OF YOUR BUSINESS

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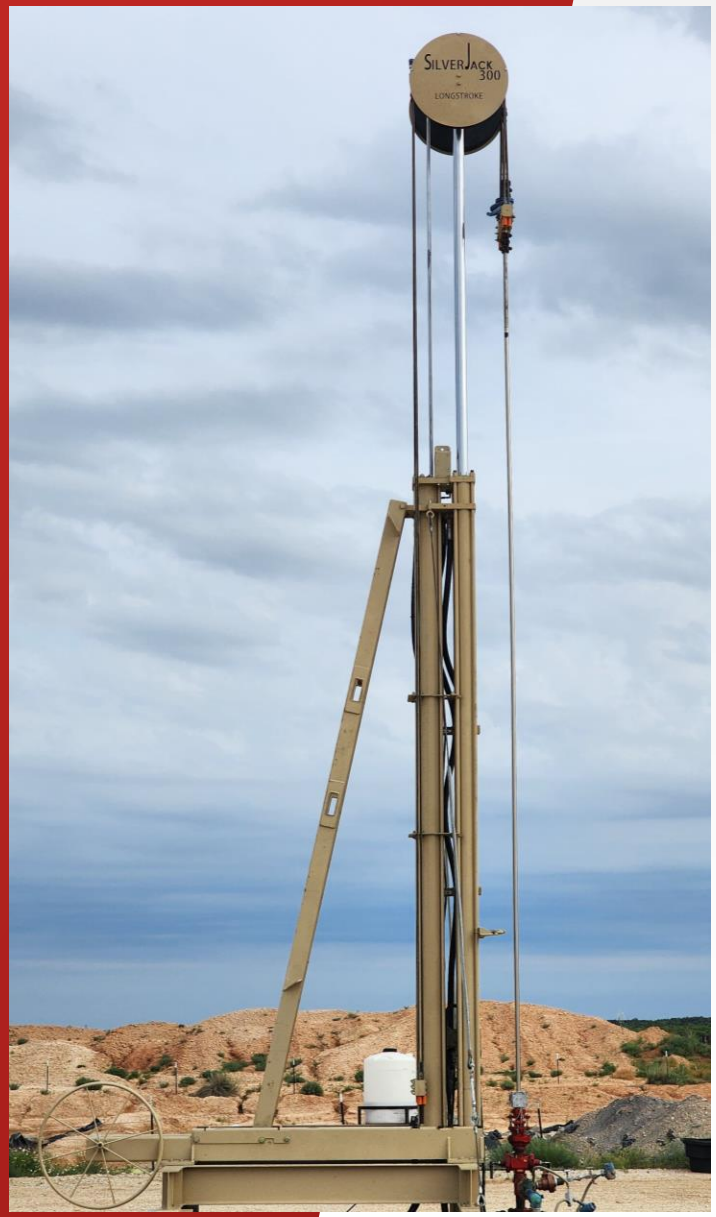


About SilverJack

Hydraulic Rod Lift Technology

- **Well Head Equipment**
  - Hydraulic Cylinders
  - Powerpacks
  - Optimization Controller
- **Remote Communications**
  - Remote Access Supported by Scada Access
- **Field Support & Maintenance Services**
- **Optimization Service (Available)**
- **Customer Support**

OUR DIFFERENCE

Technology Enhanced Hydraulic Solution

Key benefit of hydraulics is precise control.

Only a benefit if you fully utilize the capability:

SENSOR BAR

All SilverJack installs have sensor bar for position monitoring

OPTIMIZATION CONTROLLER

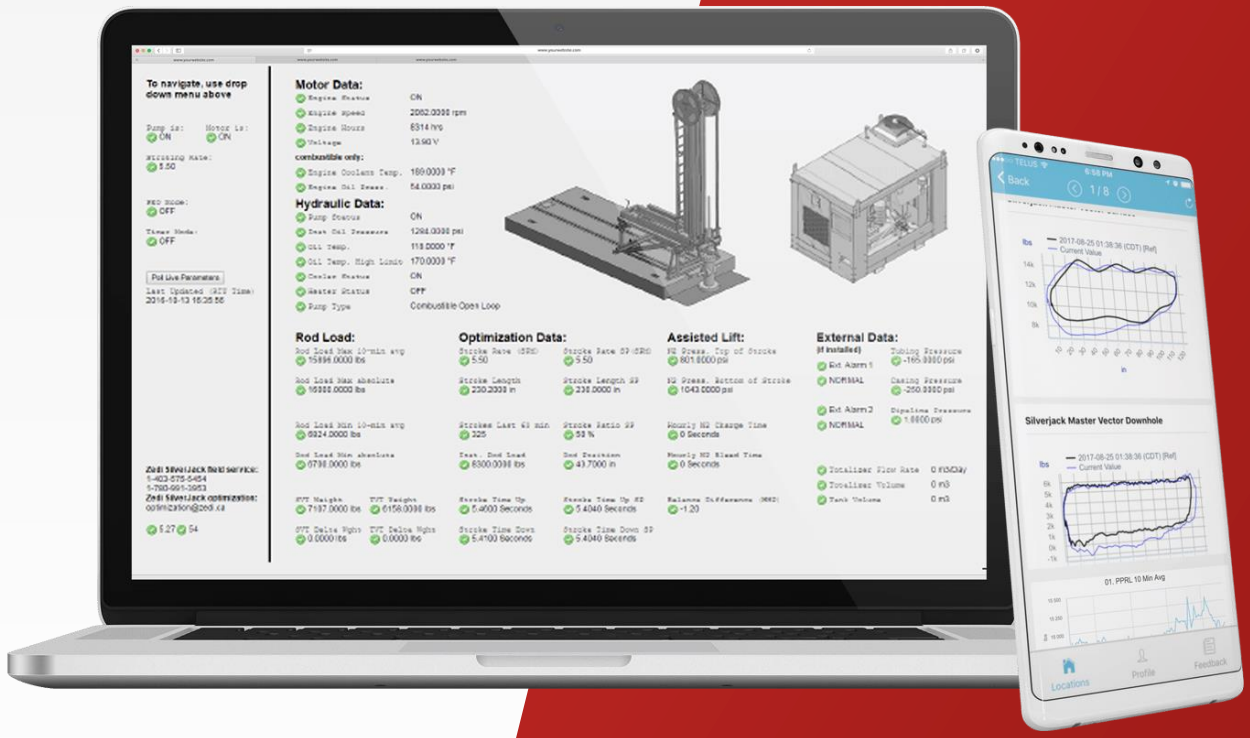
All SilverJack installs have purpose built, integrated optimization controller

OUR DIFFERENCE

Web Enabled

All SilverJack built to utilized remote access. Better manage operations and maximize operational safety.

- **Remote surveillance and control**
- **Long term data trending for alarming and troubleshooting**
- **Smartphone app for mobile user convenience**



OUR DIFFERENCE

Best in Class Optimization

Purpose built optimization controller, remote web host, hydraulically driven pumping unit all combine to provide best in class optimization capabilities

- **User Initiated Optimization**
- **Autonomous Optimization**
- **Focus on issue resolution not just issue identification**

SilverJack Application

High Production Rod Lift

Long Stroke Applications (300”)

- Transition from ESP’s or gas lift to rod pumping
- Deviated wells, slower stroke can move higher volumn with less wear
- Better performance with higher GOR (higher compression ratio)
- Wear distribution on rod string and tubing will maximize system life

SilverJack Application

Challenging Rod Lift Applications

Advanced Optimization Capabilities

- Fully featured controller integrated with remote access web host provides unparalleled visibility into pump status and performance
- Leverage flexibility of hydraulics to change any portion of pump stroke profile

SilverJack Application

High Decline Rates

Ability to auto adjust with declining wells

- Remotely change stroke rate/length. No mechanical changes, site visits or downtime.
- Eliminate need for counterweight changes as well pumps off
- Eliminate gear box loading issues as well characteristics change

SilverJack Application

Space Constrained

and land owner challenged installations

- Multi-well pads with tight well spacing
- Safety advantages in more populated areas

SJ150 Model

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Hardware Overview

SJ150

< 40m³/day

< 250 bbl/day

30,000lb peak polish rod load

Up to 150” stroke length

Direct well head mount

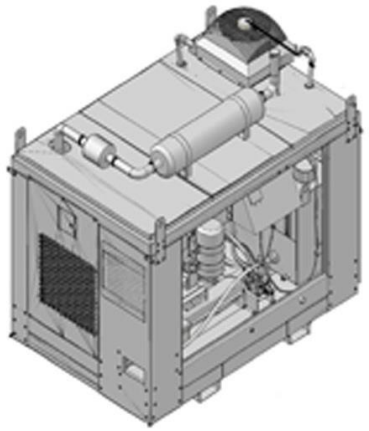
AC & gas powerpacks. Various configurations.

Small footprint. Install in confined spaces

SilverJack Hardware

Powerpack Types

- **Installation Savings**
- **Running Cost Savings**
- **Carbon Tax Savings**
- **Property Tax Savings**

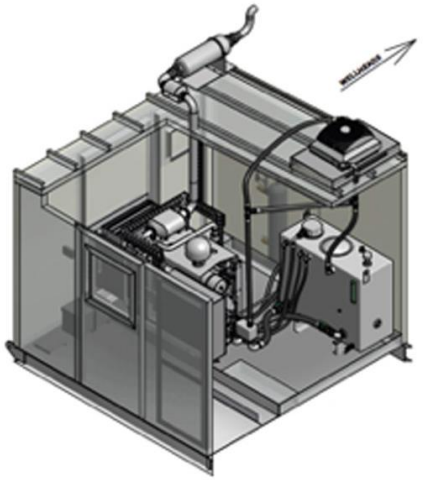


Single Equipment Enclosure

- AC (460V 3 Ph)
- Natural gas/propane

Tandem (Walk-in)

- AC (460V 3 Ph)
- Natural Gas/Propane
- **SJ150 only**



SJ300 Model

Long Stroke

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Hardware Overview

SJ300

LONG STROKE

< 1,250 + bbl/day)

< 200m^3/day

Up to 50,000lb peak polish rod load

Up to 300” long stroke length

Solid and secure base structure

AC powerpacks. Full enclosure configuration

AI adjusting N_2 Lift Assist

SJ300

Longer Stroke Length

Up to 300”

- Utilizing a Bridal System for Polish Rod Attachment Point and External Stuffing Box
- Anchored Cable and Pulley System 1 to 2 Movement Ratio
- 300” Stroke Length Only Requires ~150” Cylinder Length

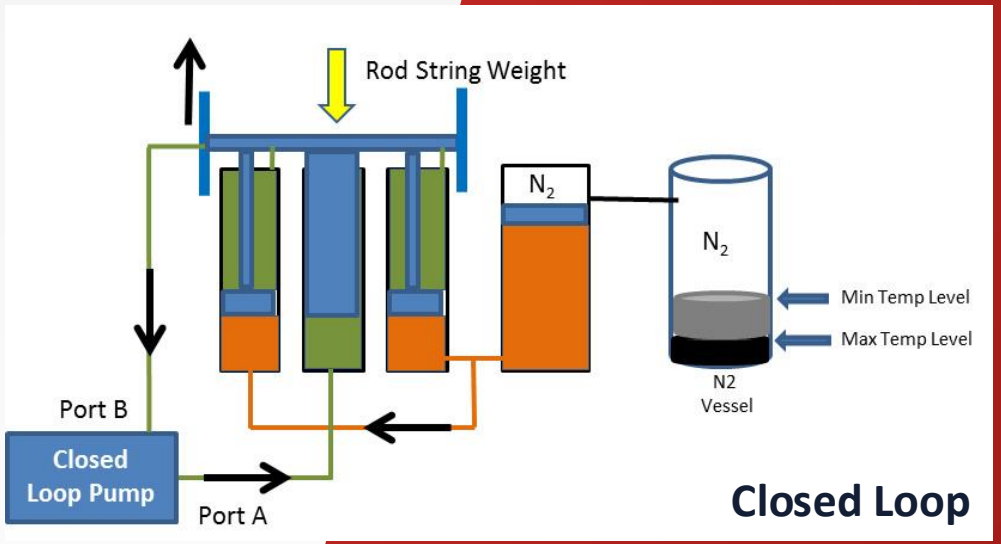
KEY DIFFERENCES

SJ300

Closed Loop Hydraulics

Closed Loop Hydraulics

- Two port pump. Moves oil between chambers without losing pressure
- No valve required. Pump changes output flow rate.



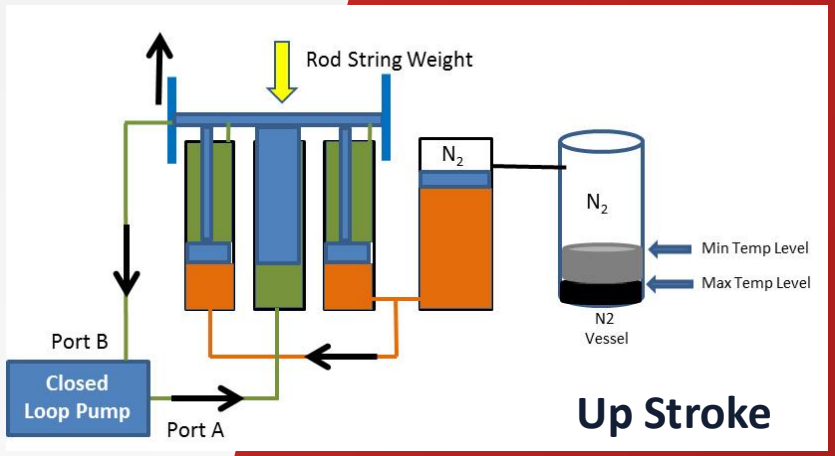
Closed Loop design for SJ300 improved efficiency and reduced heat generation

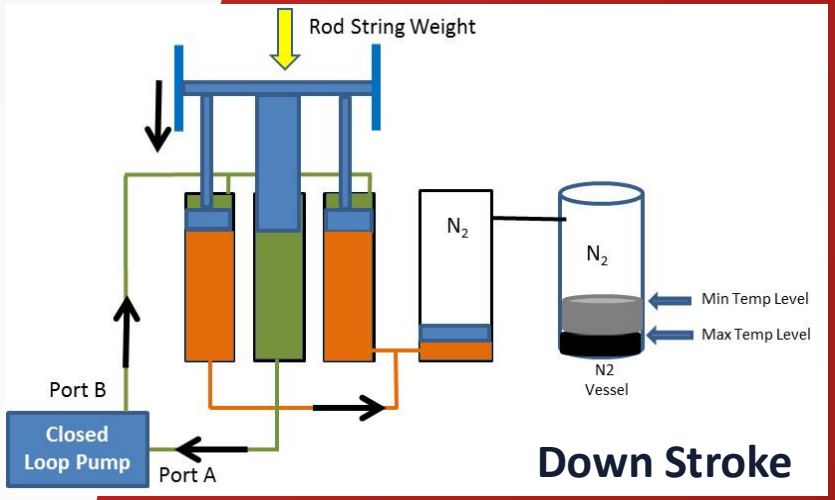
KEY DIFFERENCES

SJ300

N_2 Lift Assist

1. Automation to balance N2pressure with temp change –No field visit needed
2. Patented config minimizes N2/ oil interface area.
3. Lower HP Requirements





KEY DIFFERENCES

Addition of Assisted Lift

- Not economical to just increase HP
- Need solution to use motor HP more efficiently and utilize energy from dropping rod string
- Pump jacks: Assisted Lift = counter weights
- Hydraulics: Assisted Lift = nitrogen compression
    - SJ300 Lift System is completely different design

SilverJack Hardware

Powerpack Types

- Installation Savings
- Running Cost Savings
- Carbon Tax Savings
- Property Tax Savings

SilverJack Improvements

New Changes

Quality Improvements

8 CABLE DESIGN W/ IMPROVED MATERIAL

Changed from a 4-cable design to a 8-cable design to make sheaves and cables last longer

HALF MOON REMOVED

Removing failure point and replacing with robust system with backup nuts

ALUMINUM BRONZE GLAND

The gland material is aluminum bronze rather than steel that could potentially rust and cause contamination

WELDED PORT REMOVED

The welded port is gone on cylinders reducing wait time on parts.

LESS CONNECTIONS
PREVENTING SPILLS AND LOST N_2

Fastest and Safest Equipment to Rig-In/Out

SilverJack Safety & Service

Rig Servicing Improvements

Perfect Alignment

Pile design allows perfect alignment –Customers have seen 50% reduction in maintenance costs over concrete base.

Slide Mechanism

During well servicing, unit has proper slide mechanism that allows one person to remove 6 bolts and slide unit back in less than 5 minutes.

No Hoses Get Disconnected During Servicing

Reduced Footprint

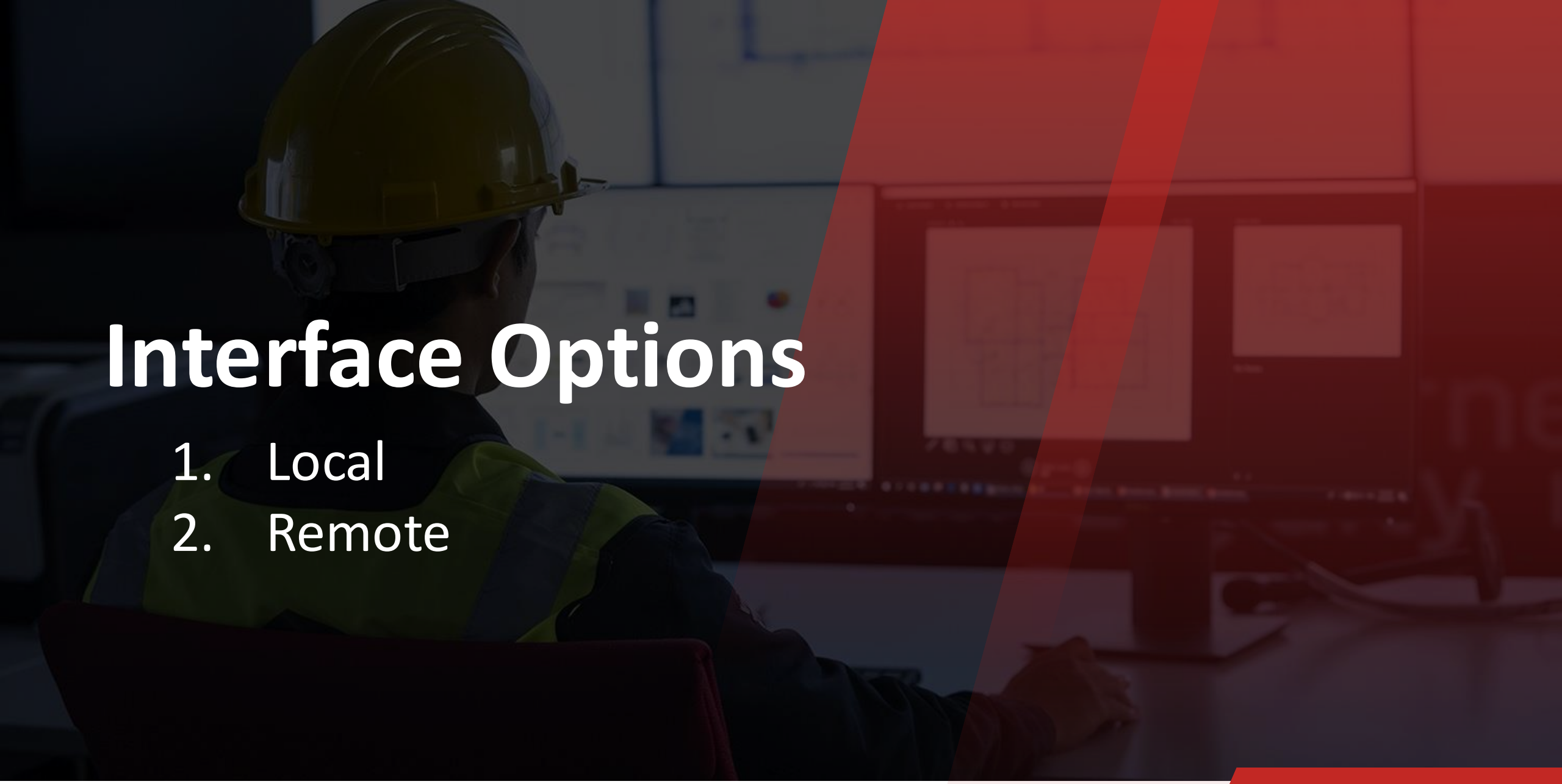
Even though the unit has longer stroke it has lower footprint.

Stability

The ladder acts as stabilizer for any motion and makes unit more rigid.

Clutter Free Tubing

The structural design allows tubing to be stood in tubing board with no obstacles.



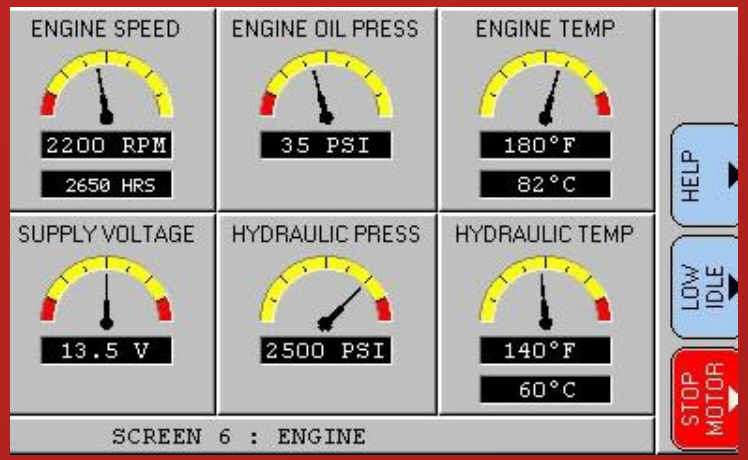
Interface Options

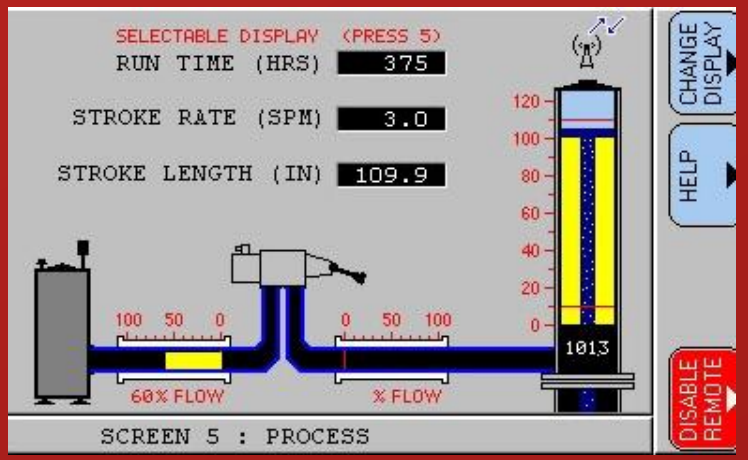
1. Local
2. Remote

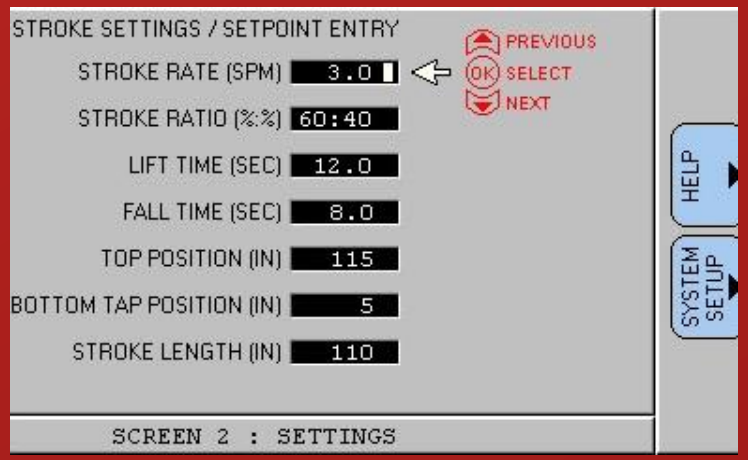
SILVERJACK CONTROLLER

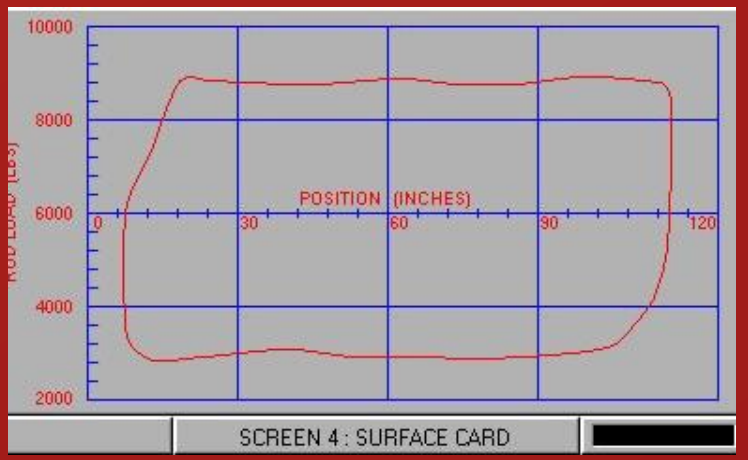
Local Display

SilverJack Optimization Controller
is included with every SilverJack







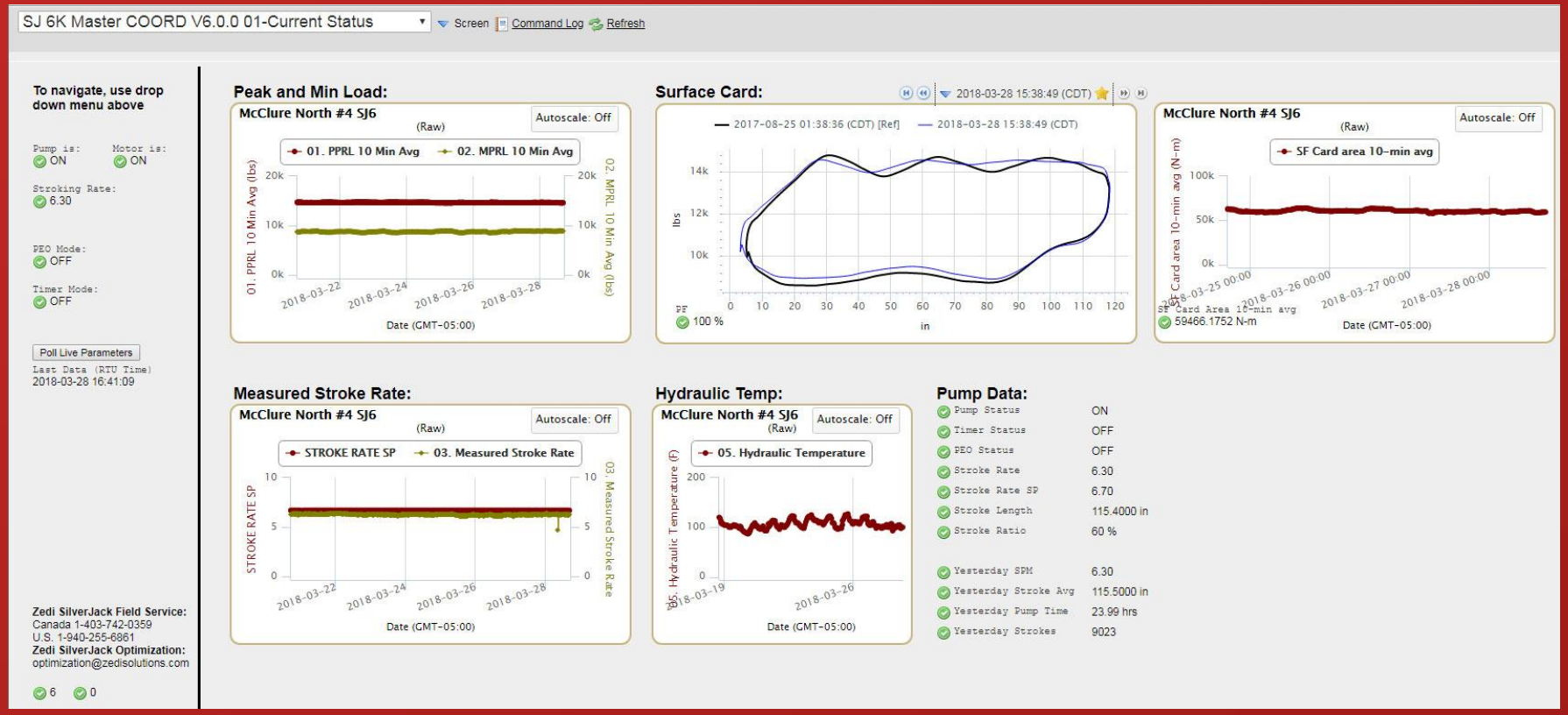


SILVERJACK CONTROLLER

Remote Access

Remote Access With Scada Access

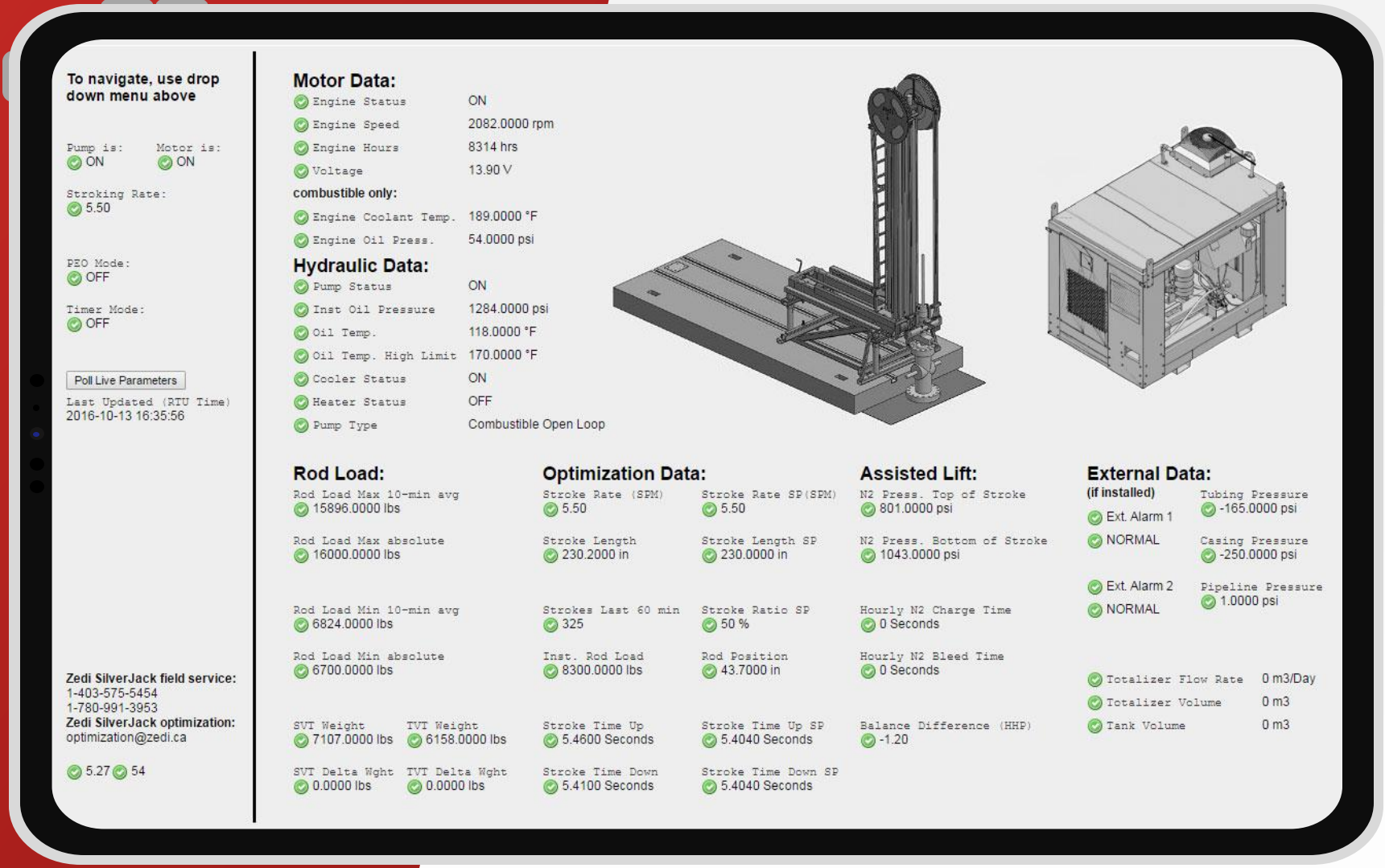
- Cellular communications used to download operational data
- Provides alarming, remote surveillance, control and optimization capabilities
- Data stored on remote access for long term trending and alarm thresholds

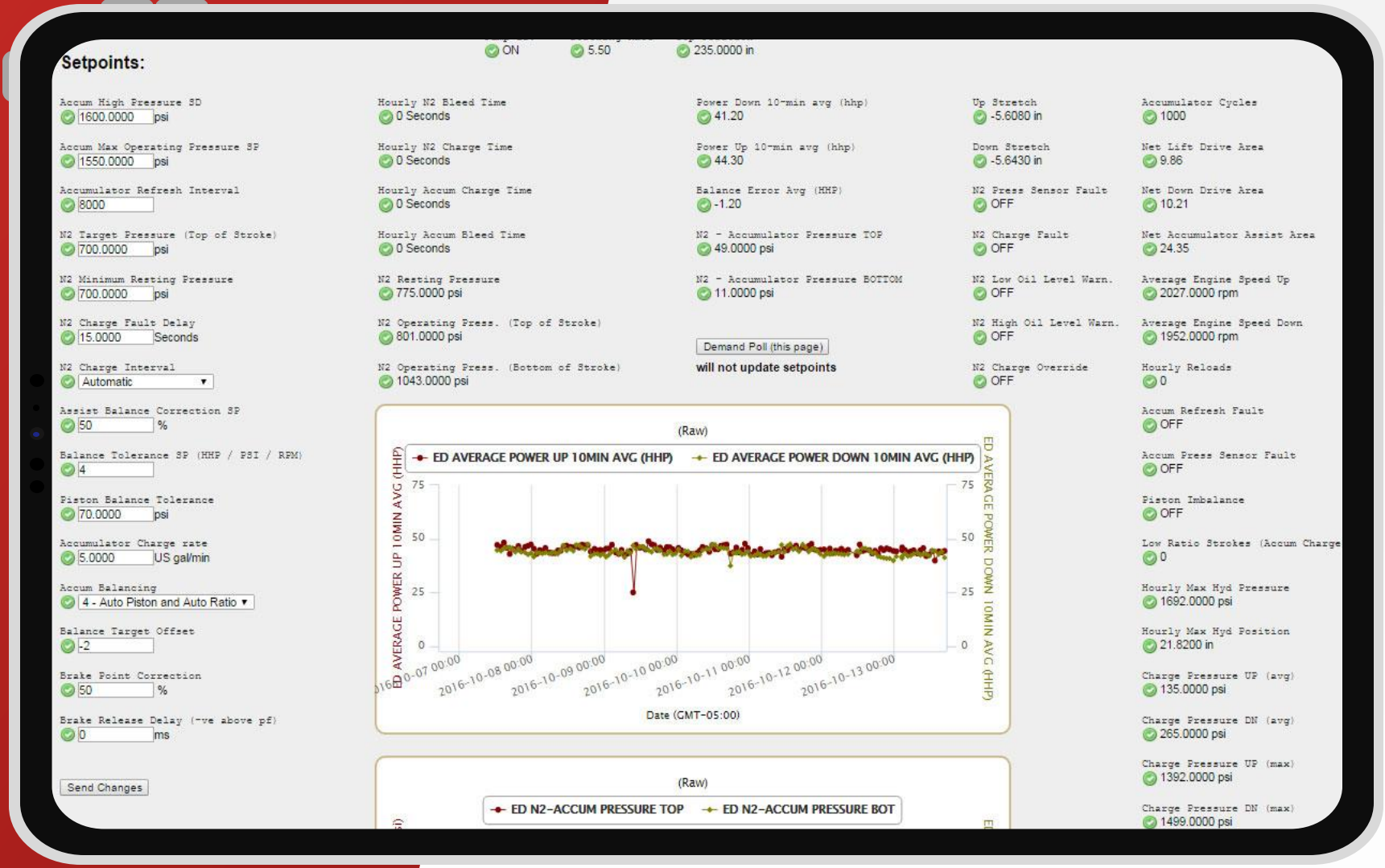


Remote Access

SJ300 Live Data

Screen Example





Remote Access

SJ300 Live Data

Screen Example

Other Live Data Screens:

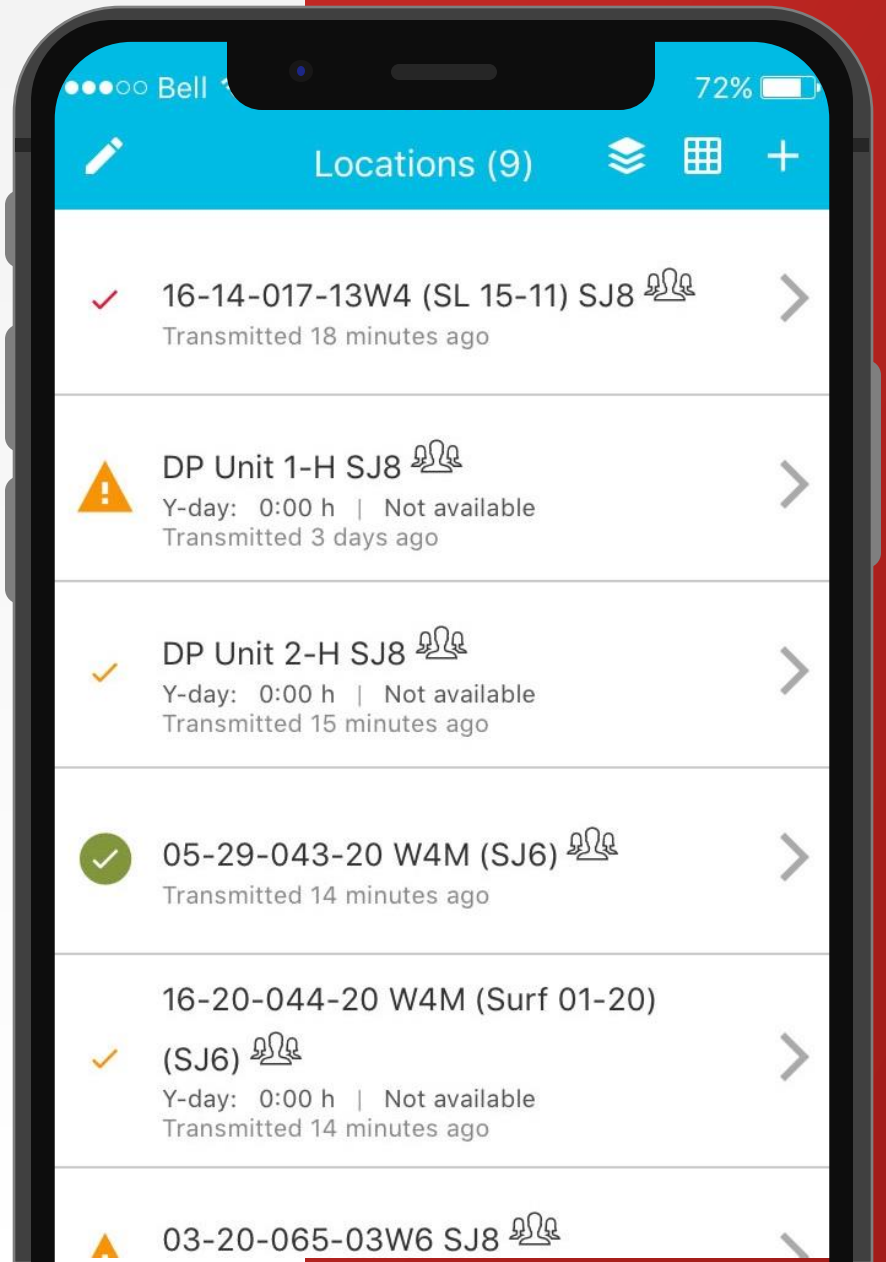
- Cards
- Alarms
- Basic Controls
- PEO
- Historical Data
- System Config
- DH Settings

Remote Acess App

Mobile App

- iOS and Android app for smart phone or tablet
- Targeting on-the-Go employees with smart phones but no laptops

Display any locations from Remote Access. See alarm status, sensor values, near term trends, and map location.

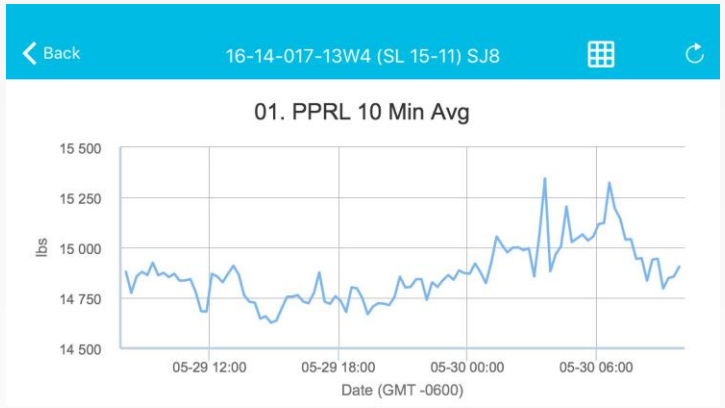


Remote Acess App

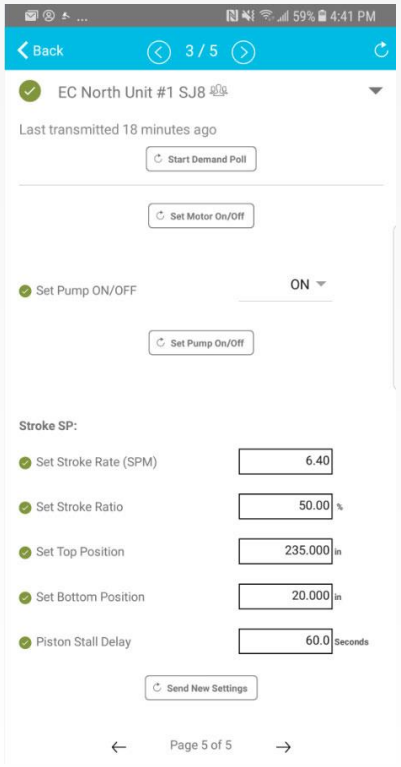
Mobile App

Download App from App Store or Google Play and

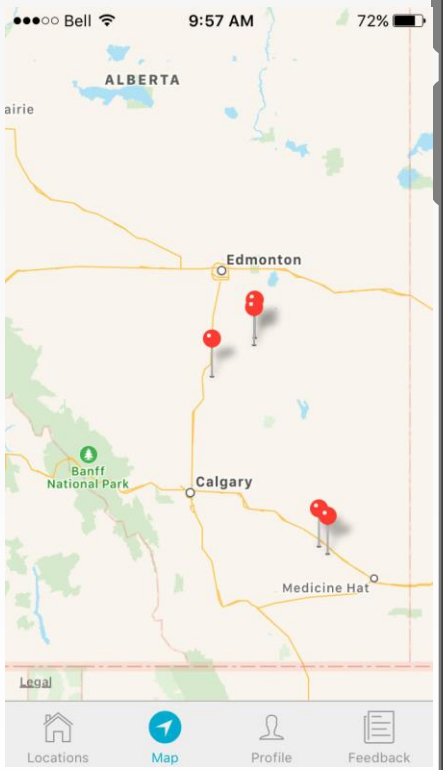
log in with current remote access user account



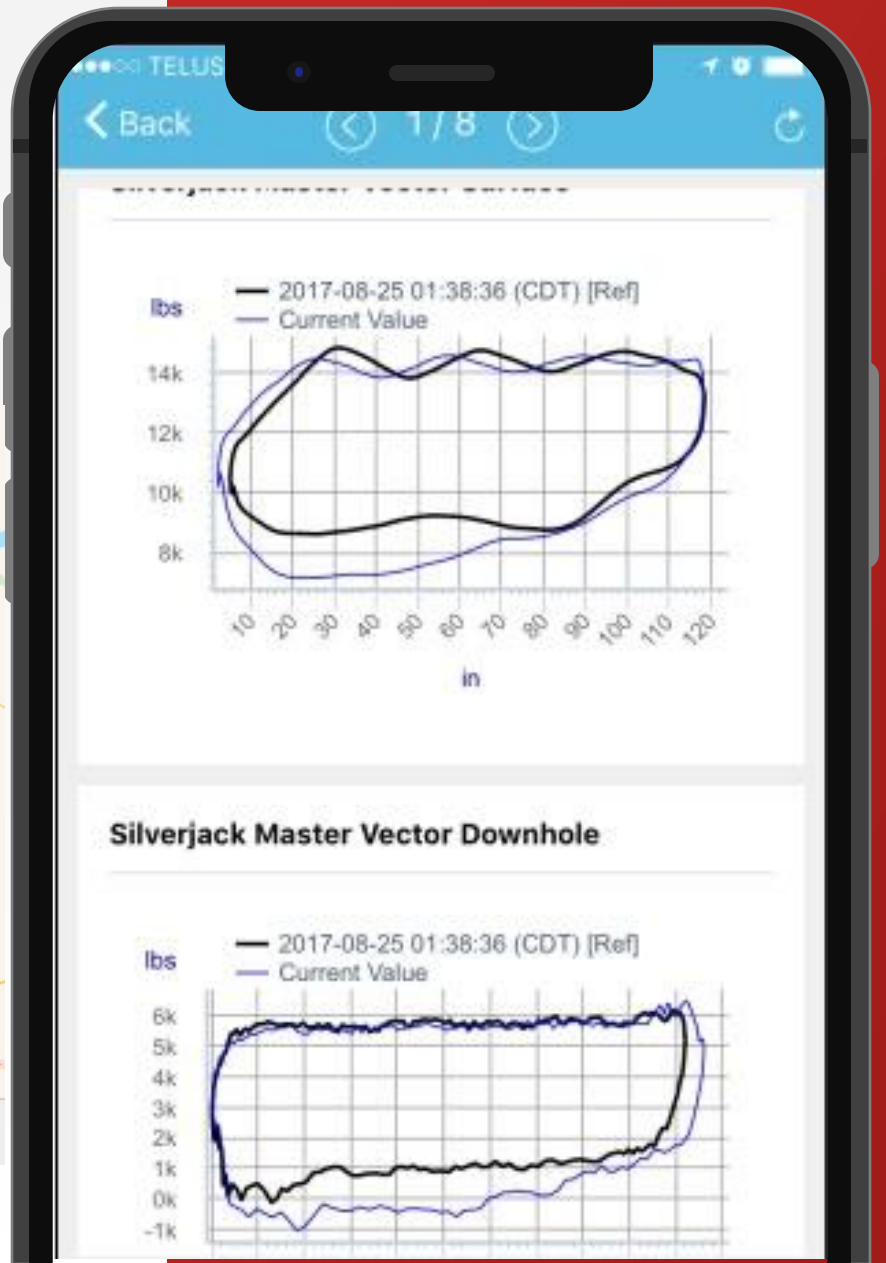
Near Term Trending



Basic Control



Location Map



Power of Optimization

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Enhanced Optimization Capabilities

User Initiated Optimization

Goal: Reduce Time to Complete Optimization Cycle

Measure

Remote data collection every 15 to 60 minutes (or less with high resolution option)

Optimize

Use remote control capabilities to remotely change pumping parameters. No site visit, no mechanical changes, no downtime.

Analyze

Use Remote Access tools to remotely analyze performance (long term trending, pump cards, alarm history, etc.) and decide on changes

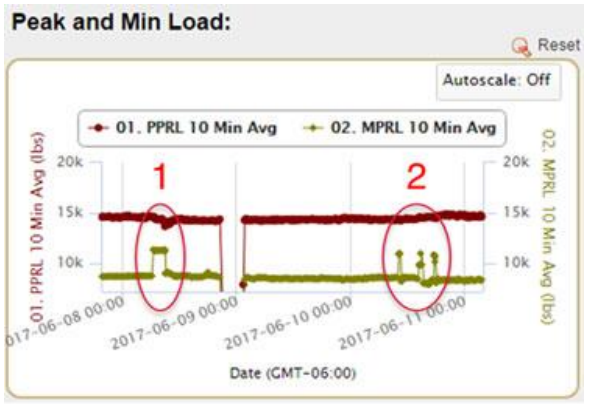
Test

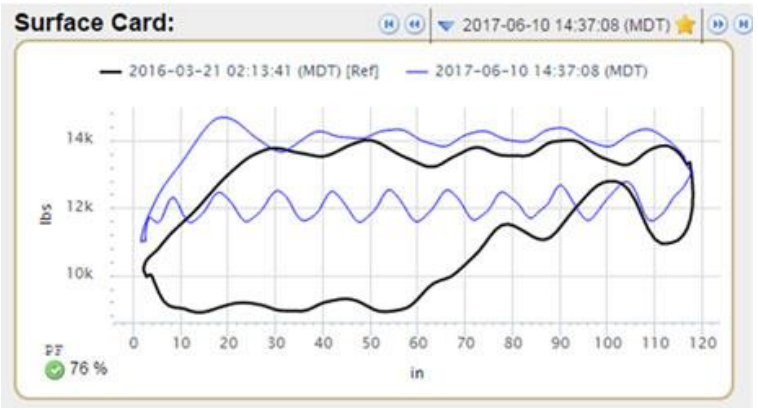
Autonomous Optimization Example

Standing Valve Stuck Open

- **Measure**

  Downloading polish rod loads every 15 minutes





Problem Resolution / Confirmation

~ 30 to 45 min (depending on user response time)

01 Analyze

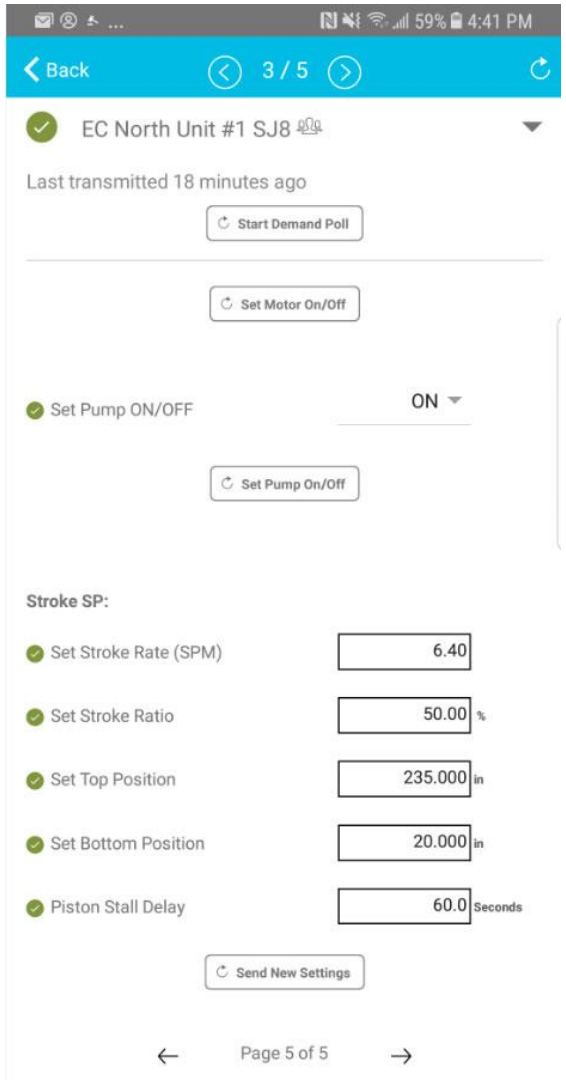
- Alarm set on MPRL trend > High MPRL alarm sent
- Alarm triggers user to investigate (manage by exception)
- User connects to Remote Access to investigate and determine problem

02 Optimize

- User remotely increases down stoke speed via Remote Access (or app)
- Increases fluid velocity passing open valve to flush debris

03 Test

- Monitor data trends on Remote Access to determine if problem is resolved or further action required.



Autonomous Optimization Capabilities

Limitations of User Initiated Optimization:

- Polling interval (~ 15 minutes)
- User response time (? minutes)
- User knowledge / troubleshooting time

Autonomous Optimization

- Controller identifies issue and makes real time changes to pumping parameters
- No user intervention required

Currently available for:

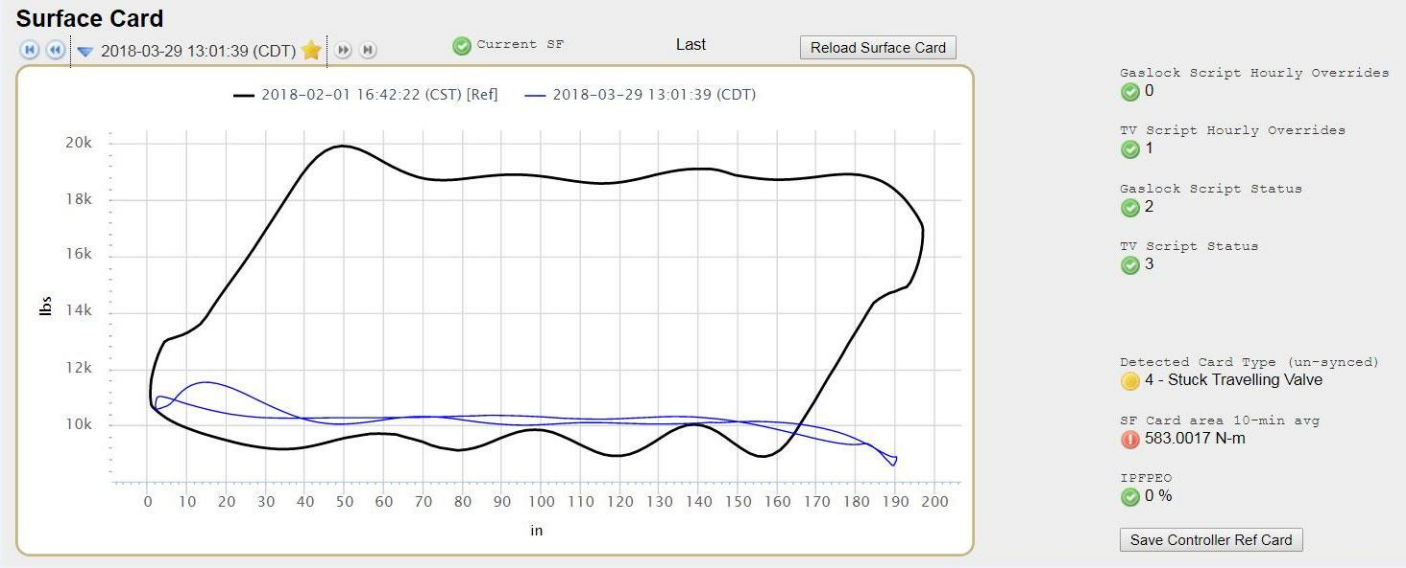
- Pumped off condition
- Standing Valve Stuck Open
- Traveling Valve Stuck Open
- Gas Lock

Autonomous Optimization Example

Stuck Traveling Valve

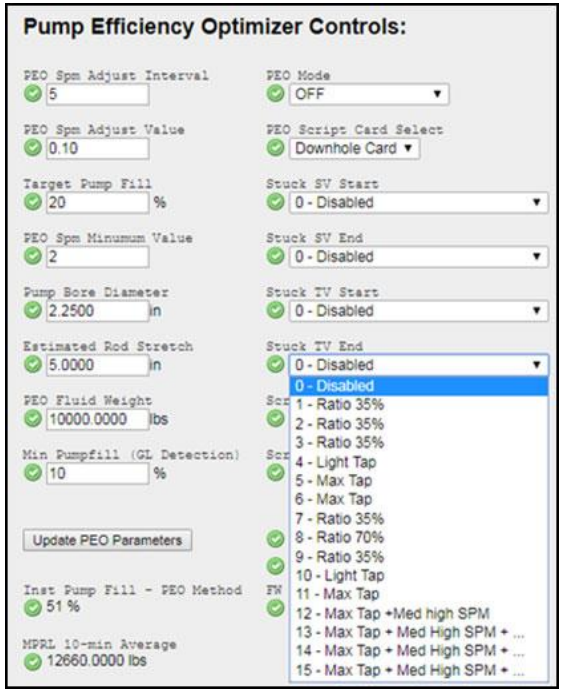
- **Measure**

  System identifies problem not just symptom



Problem Resolution / Confirmation

as little as 3 to 4 minutes



01 **Analyze**

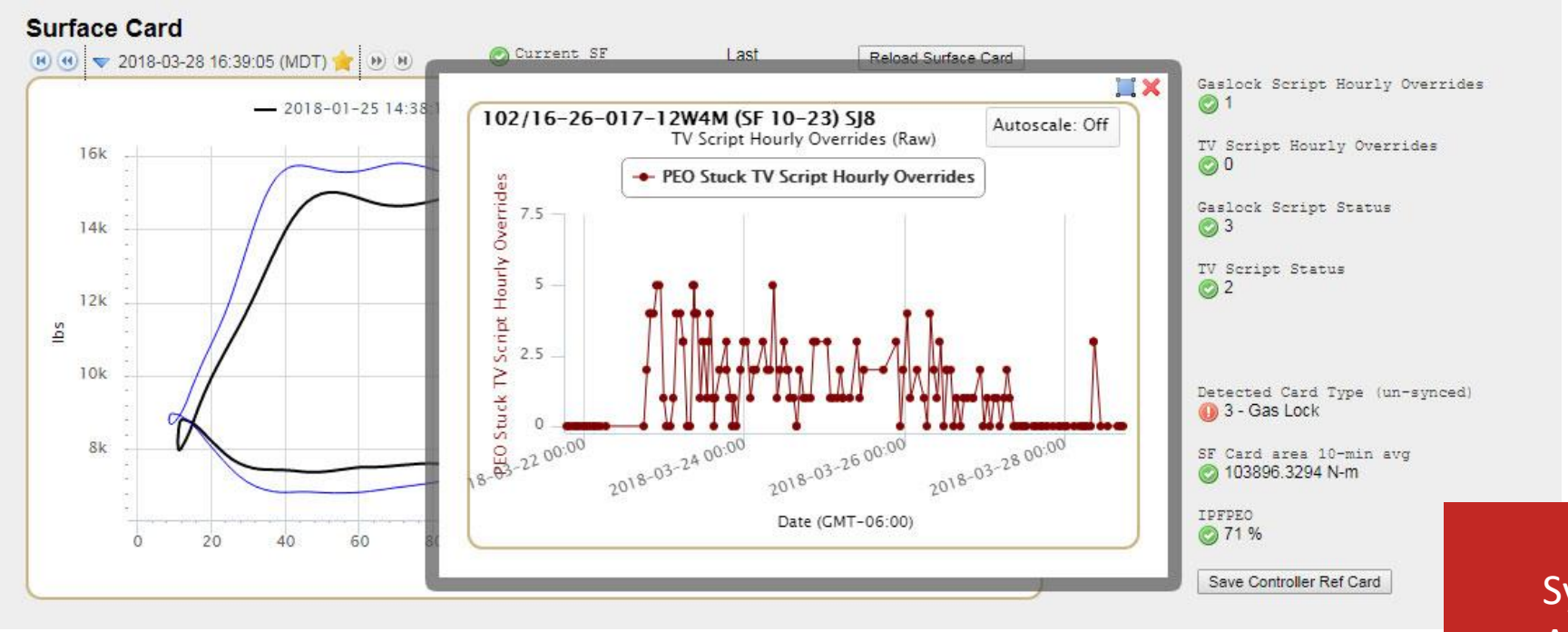
02 **Optimize**

03 **Test**

- System engages pre-defined script depending on issue identified
- End user defines extend of Autonomous changes (starts with least aggressive action)

User Initiated Optimization Example

Stuck Traveling Valve

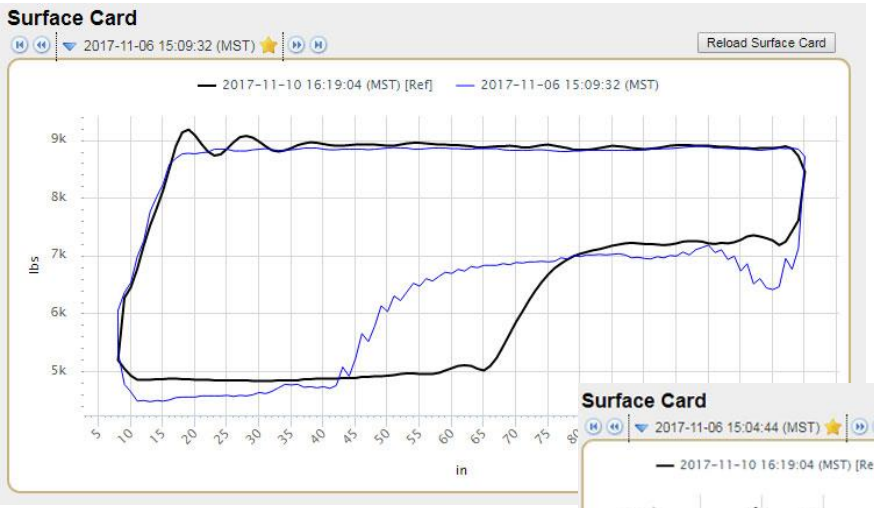


System tracks how often Autonomous Optimization algorithm is engaging to resolve issues

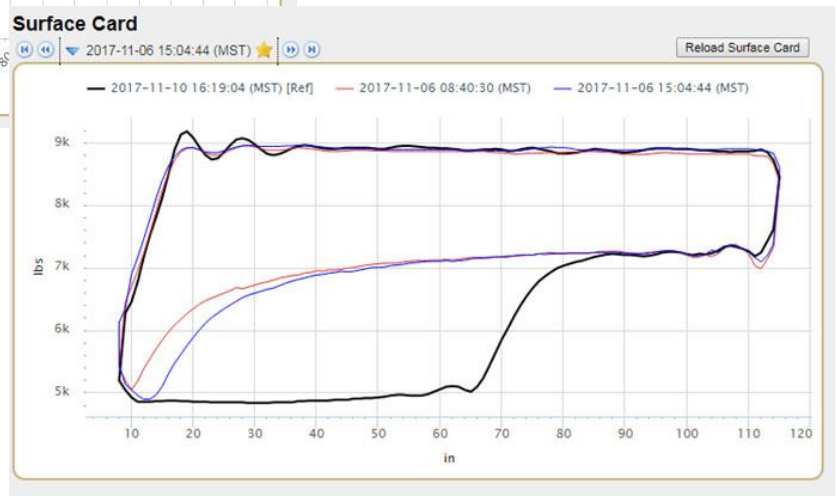
User Initiated Optimization Example

Gas Lock

- **Measure** Downloading polish rod loads every 15 minutes



Gas Interference



Gas Lock

Gas Lock intervention also supported by Autonomous Optimization feature.

01 Analyze

- Alarm set on pumpfill drop
- Alarm triggers user to investigate (manage by exception)
- User connects to Remote Access to investigate and determine problem

02 Optimize

- User remotely increases down stoke speed via Remote Access (or App)
- If faster down stroke not successful, lower bottom position to put well on tap. History shows 50-70% success rate.

03 Test

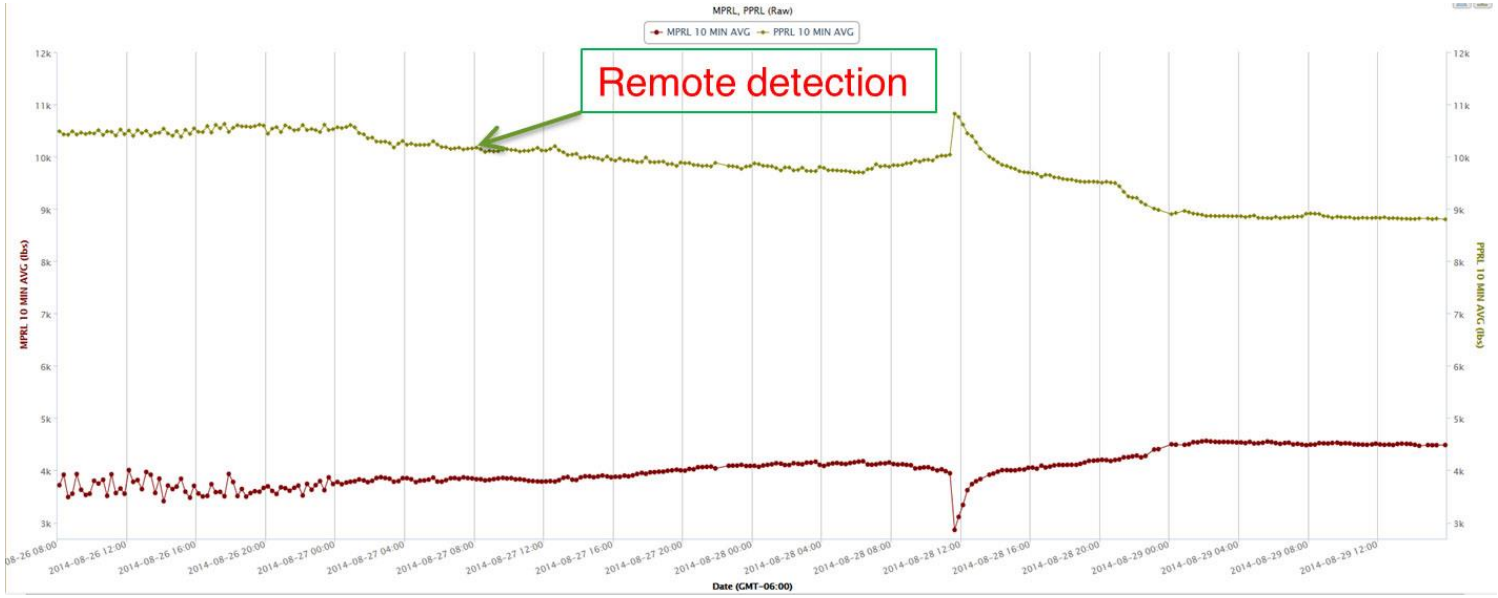
- Monitor data trends on Remote Access to determine if problem is resolved or further action required.

User Initiated Optimization Example

Hole In Tubing

- **Measure**

  Downloading polish rod loads every 15 minutes



01 Analyze

- Alarm set on PPRL trend à Low PPRL alarm created
- Alarm triggers user to investigate (manage by exception)
- User connects to Remote Access to investigate and determine problem

02 Optimize

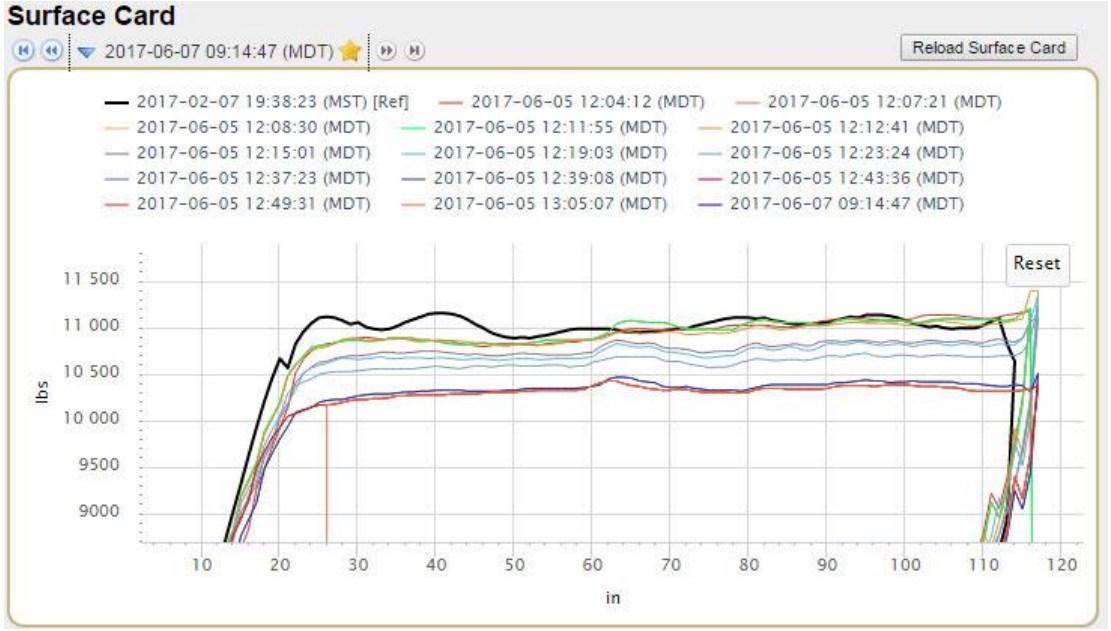
- Mechanical issue that cannot be resolved with Optimization
- Value is in early notification and problem identification

03 Test

- See next slide

User Initiated Optimization Example

Hole In Tubing (con't)



Example of Testing Procedure

Benefit

Minimized troubleshooting time & cost.

Identified problem remotely in 1hr with no field testing.

01

Reported Problem

- Reported Problem: Initial report was dropping production. No obvious problem.
- No visible change in PPRL.

02

Troubleshooting Steps:

1. Remotely reduced stroke rate, 5 SPM to 1 SPM
2. Demand polled pump cards
3. Overlaid pump cards to compare

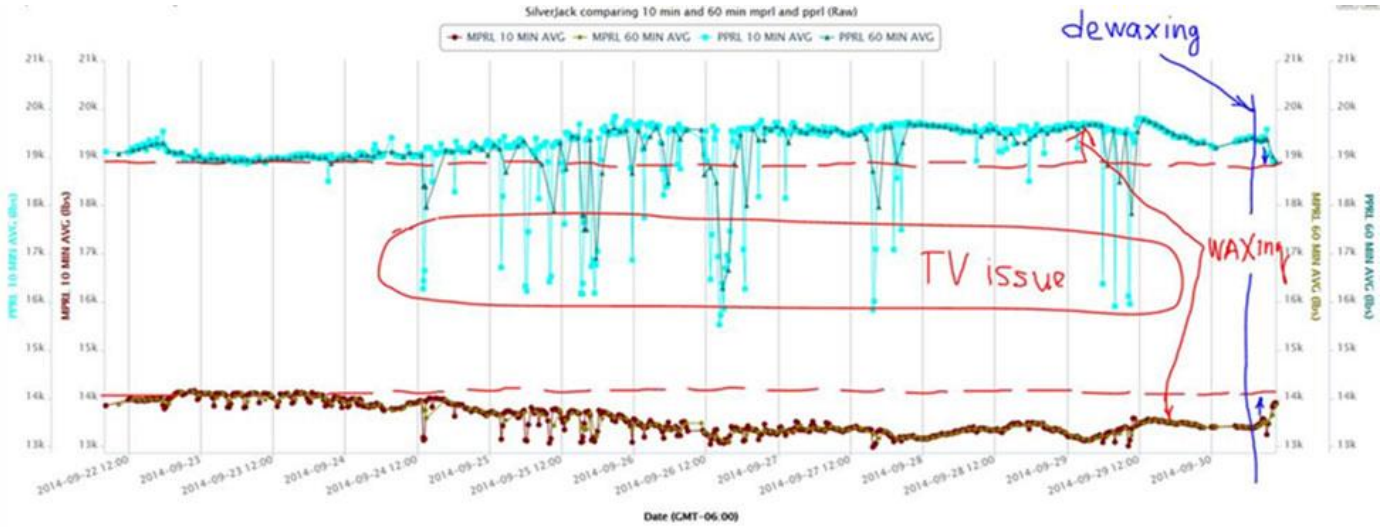
03

Conclusion

- At 1 SPM, PPRL slowly dropping (fluid escaping through hole exceeded amount being lifted). Column of fluid dropping.
- No surface production.

User Initiated Optimization Example

Waxing



01 Analyze Symptoms

- Upstroke rod load increased at the same time as downstroke rod load decreased
- Several more severe drops in upstroke load indicating travelling valve issues

02 Conclusion

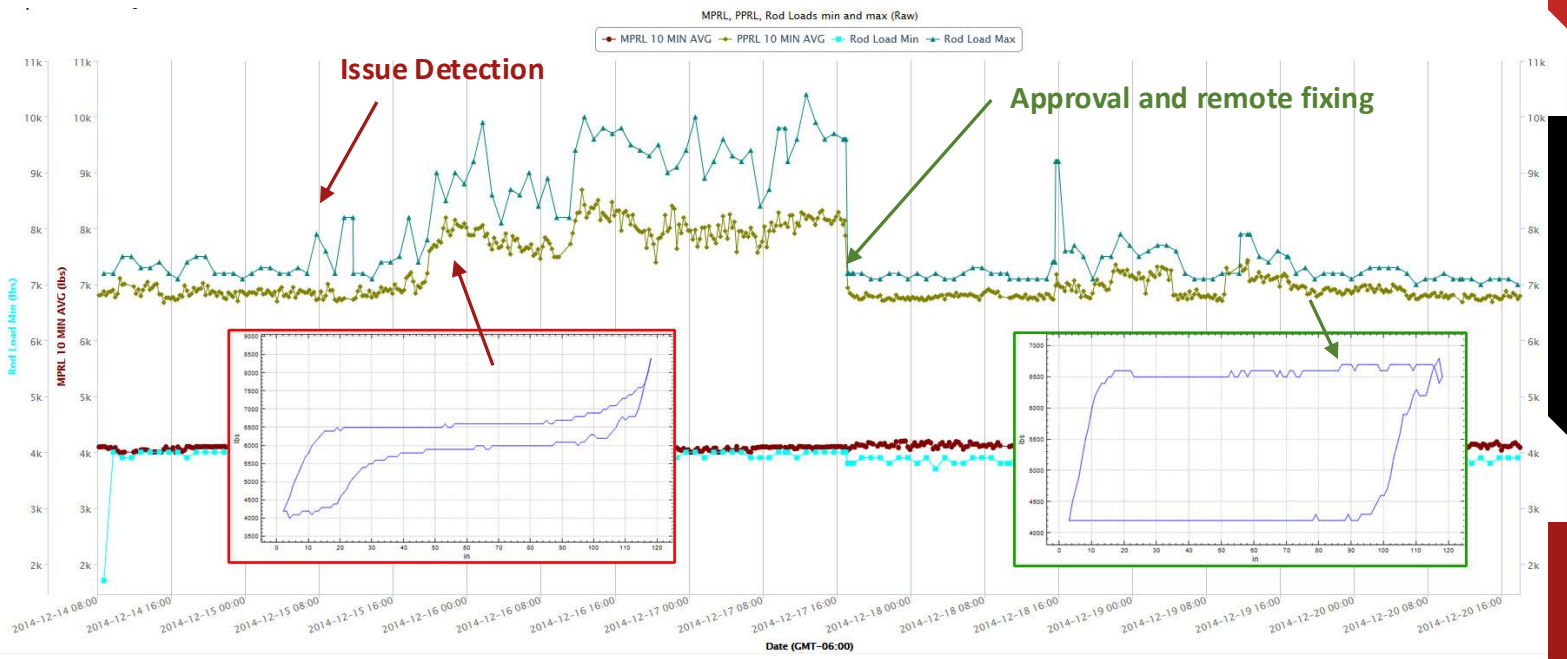
- Waxing issues

03 Solution

- Initiated dewaxing treatment on well and well returned to normal after a few hours

User Initiated Optimization Example

Debris in Pump



01 Analyze Symptoms

- On upstroke, PPRL increased at 90 inch mark. Detected via rod load alarm.

02 Conclusion

- Top tapping due to debris at the top of the pump

03 Solution

- Top position set point was decreased for 2 days for natural clean up
- Benefit: Fast detection avoided equipment damage/workover. Remote fix avoided trip to site

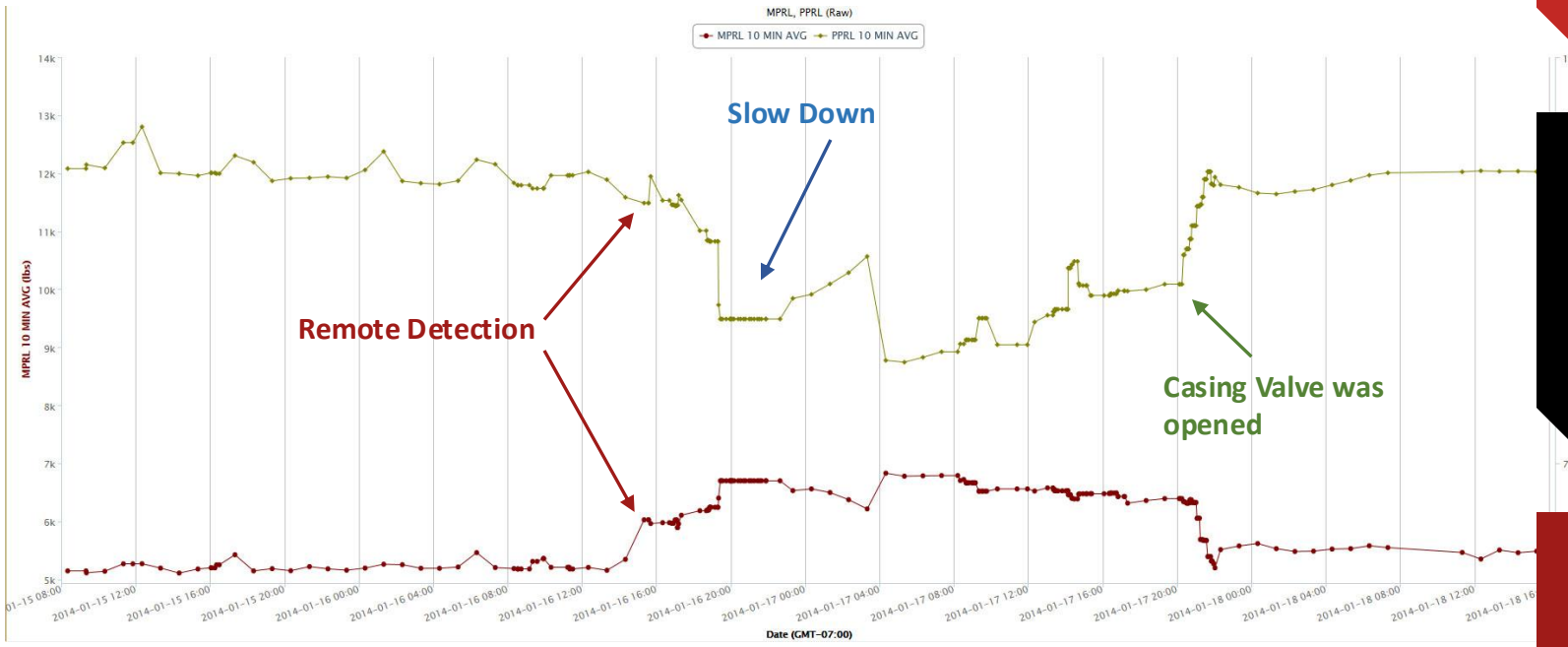
Benefit

Fast detection avoided equipment damage/workover.

Remote fix avoided trip to site

User Initiated Optimization Example

Casing Valve Closed



01 Analyze Symptoms

- Quick, significant drop in pump fill and upstroke rod load, increase in downstroke rod load. Detected via rod load alarm.

02 Conclusion

- Casing valve closed

03 Solution

- Travel to site and open casing valve

Benefit

Quick detection avoided lost production

Advanced Optimization Capabilities

Optimization Benefit

Other examples of common problems that can be detected with SilverJack and Remote Access:

- Parted rods
- Seized downhole pump
- Worn or split pump barrel
- Worn pump plunger or travelling valve
- Clogged pump intake

Focus on PROBLEM RESOLUTION, not just problem identification

Combination of Remote Access, advanced controller, and flexibility of hydraulically driven system combine to provide industry leading optimization capabilities

Optimization capabilities help reduce workover requirements and downtime

Why Choose SilverJack

Key Differentiators

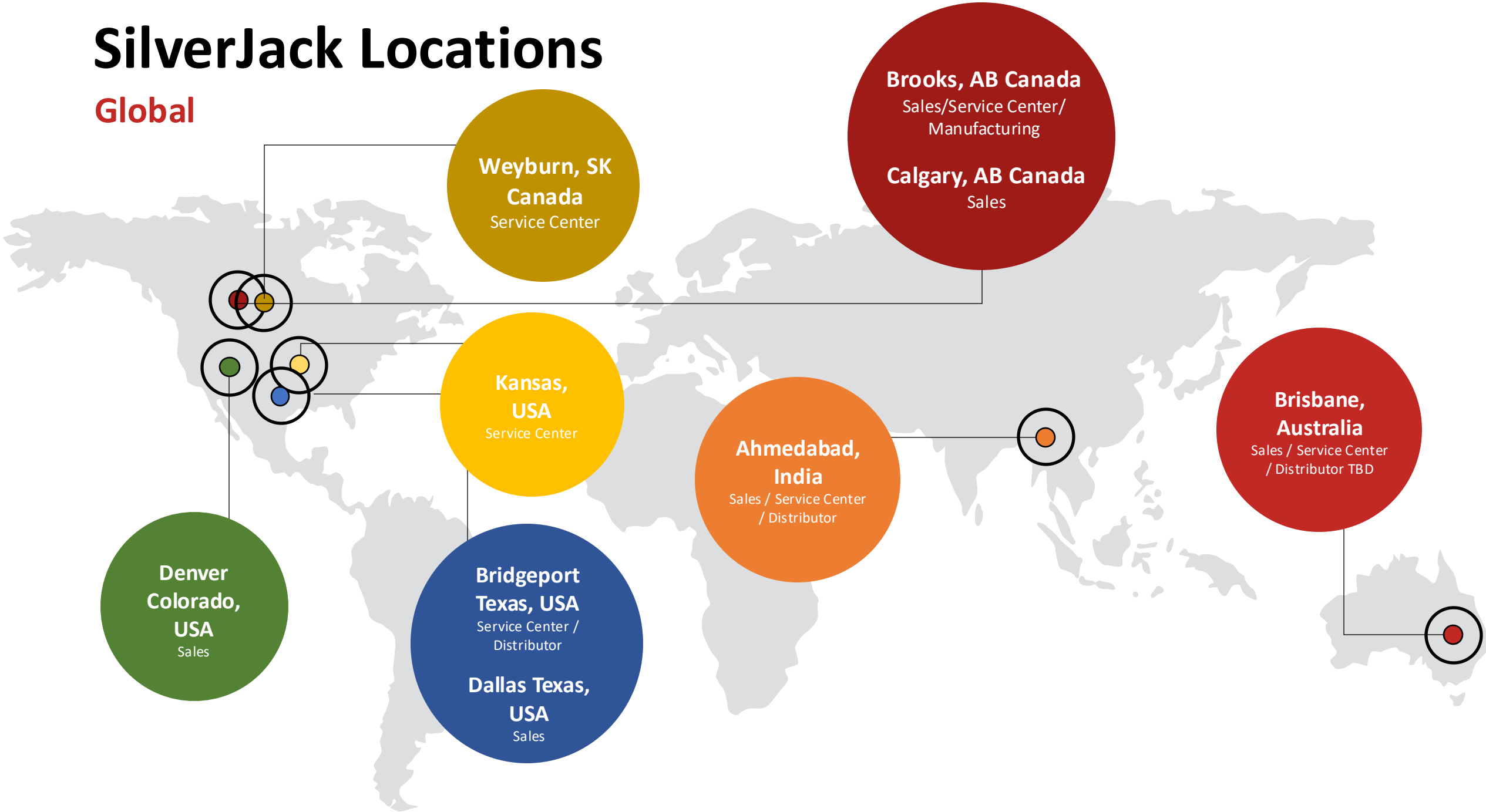
- **High Volume Rod Pumping Capabilities**
- **Stroke Length 300”**

  Longer stroke means more precise control and more production with less SPM
- **Gas and AC Driven SilverJack Solutions**
- **Automated SJ300 N_2 balancing**

  to adjust for ambient temperature changes
- **Remote Optimization Service and Field Support**

SilverJack Locations

Global



Thanks!

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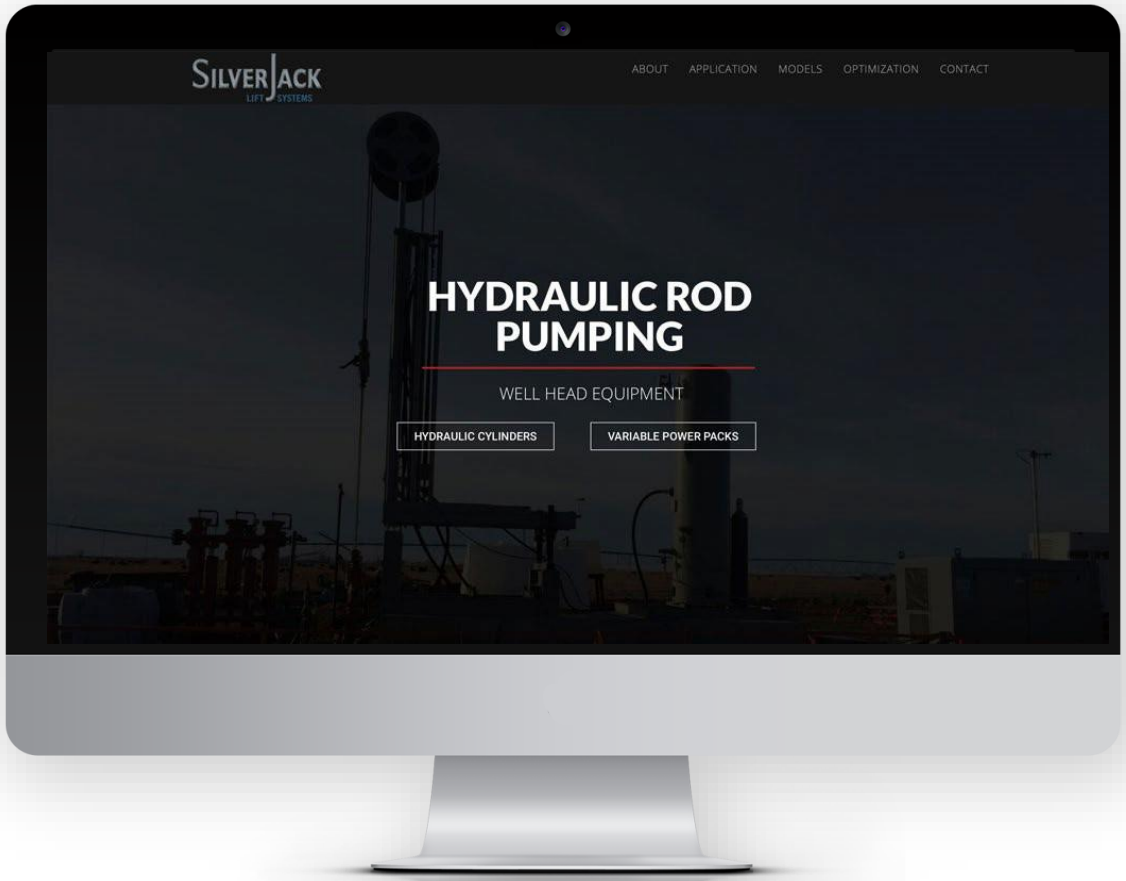

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