



SILVER JACK
LIFT SYSTEMS

DIVISION OF



MANUFACTURING || TAKING CARE OF YOUR BUSINESS

silverjack.ca



About SilverJack

Hydraulic Rod Lift Technology

- **Well Head Equipment**
 - Hydraulic Cylinders
 - Powerpacks
 - Optimization Controller
- **Remote Communications**
 - Remote Access Web Host / App
- **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

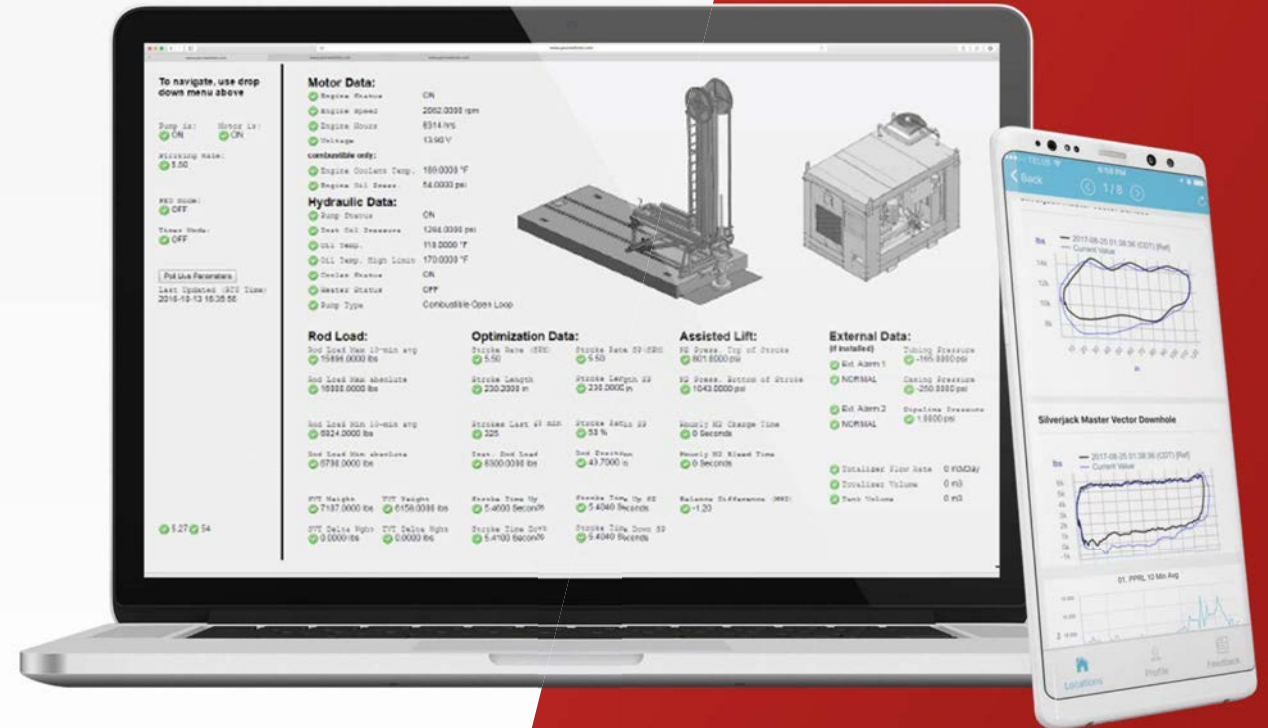


OUR DIFFERENCE

Web Enabled

All SilverJack built to utilize 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 rod lift 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 volume 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

< 250 bbl/day

< 40m³/day



**Up to 29,000lb 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

SJ150 Powerpacks



Installation
Savings



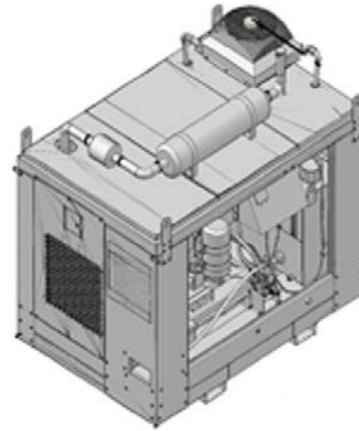
Running Cost
Savings



Carbon Tax
Savings



Property Tax
Savings

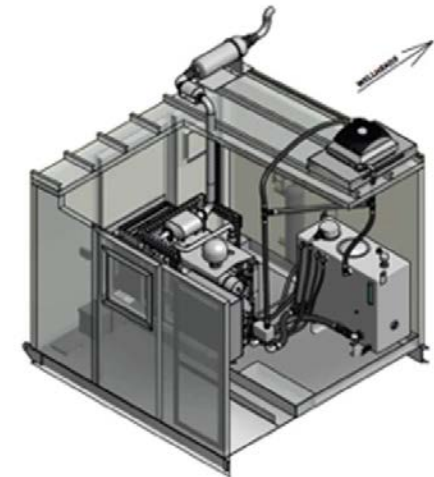


Single Equipment Enclosure

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

Tandem (Walk-in)

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



SJ300 Model

Long Stroke



SJ300

LONG STROKE

< 1,250 + bbl/day
< 200m³/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 N₂ 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

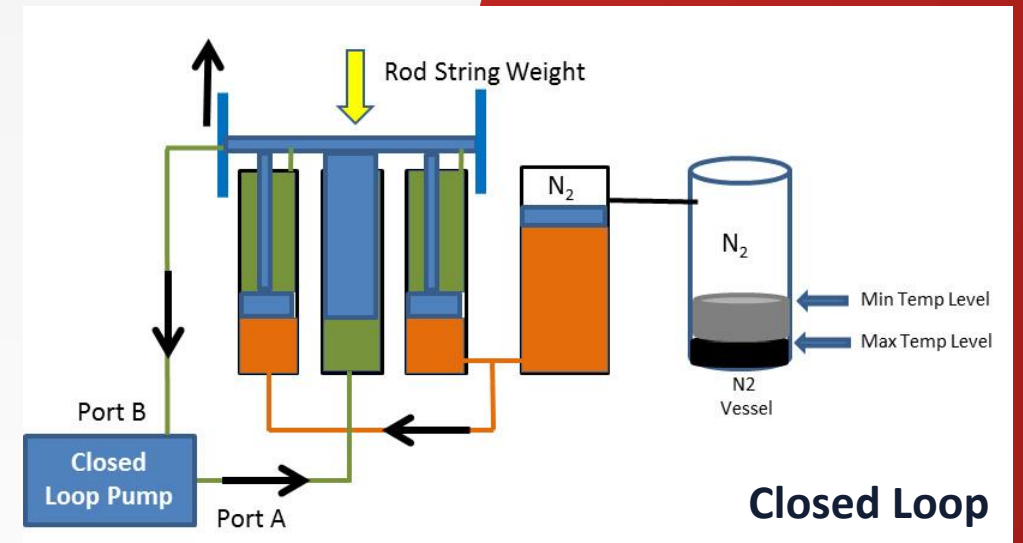
KEY DIFFERENCES

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.



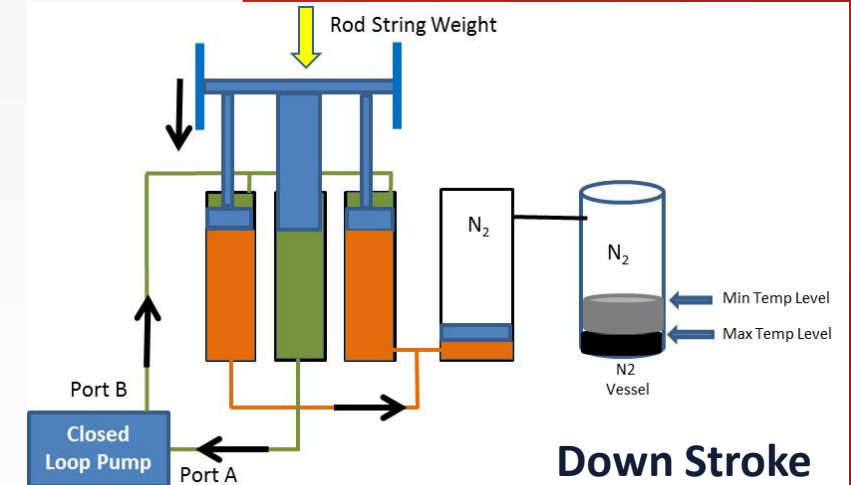
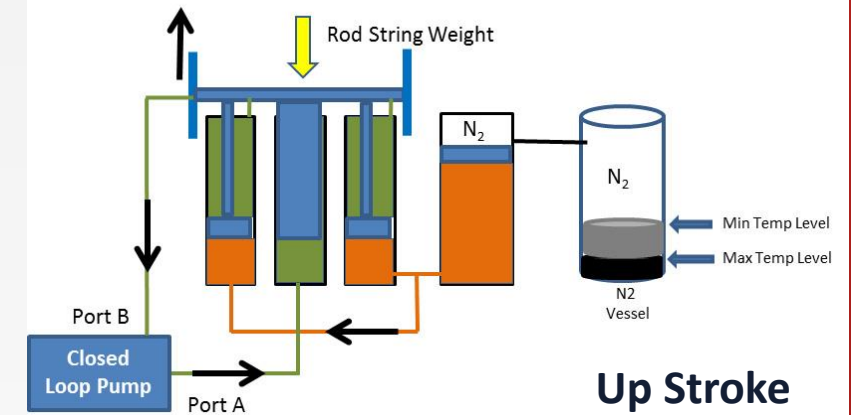
Closed Loop design for SJ300 improved efficiency
and reduced heat generation

KEY DIFFERENCES

SJ300

N₂ Lift Assist

1. Automation to balance N₂ pressure 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

SJ300 Powerpack



Installation
Savings



Fully Enclosed
Walk-In



Running Cost
Savings



Property Tax
Savings



SilverJack Improvements

New Changes

Quality Improvements

✓ **8 CABLE DESIGN W/ IMPROVED MATERIAL**

Changed from a 4-cable design to an 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

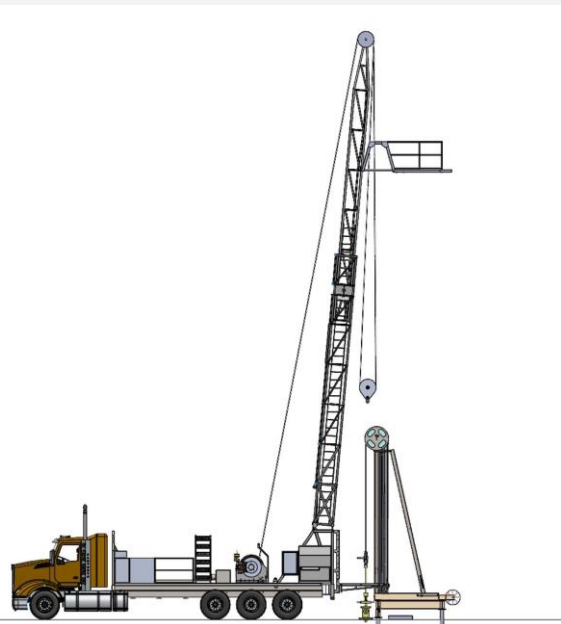
✓ **WELDED PORT REMOVED**

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



LESS CONNECTIONS
PREVENTING SPILLS
AND LOST N₂

Rig Servicing Improvements



**Fastest and
Safest
Equipment to
Rig- In/out**



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.

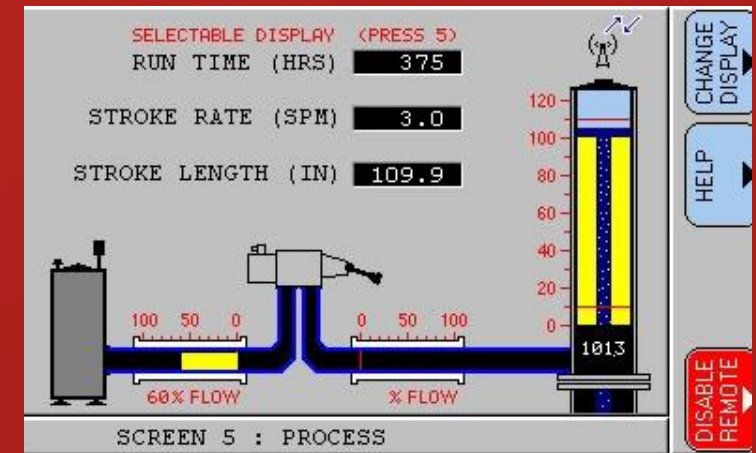
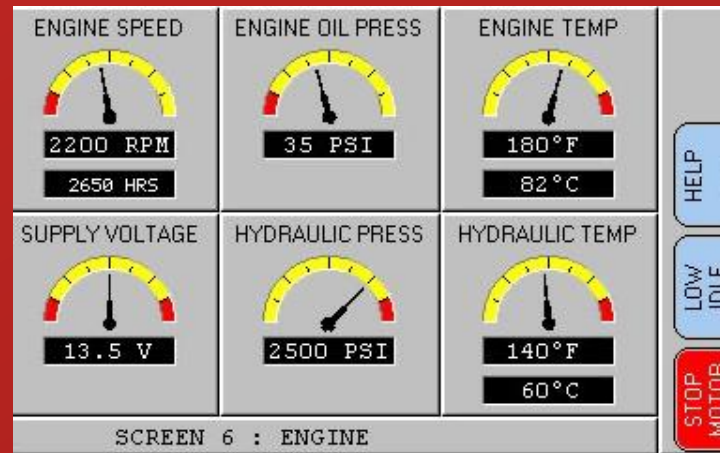
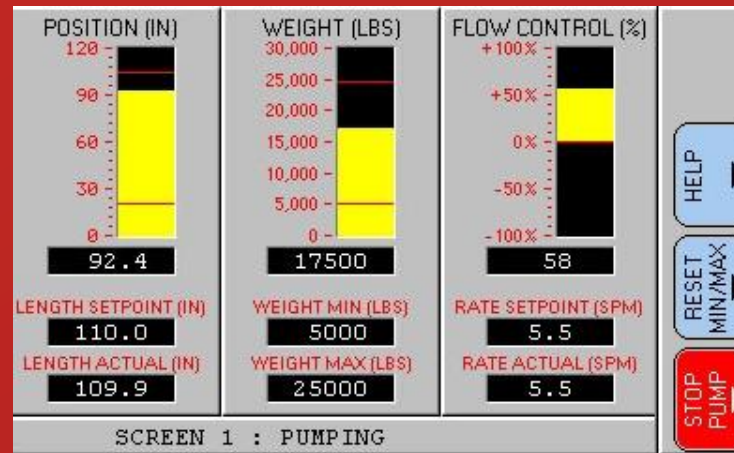
Interface Options

1. Local
2. Remote

SILVERJACK CONTROLLER

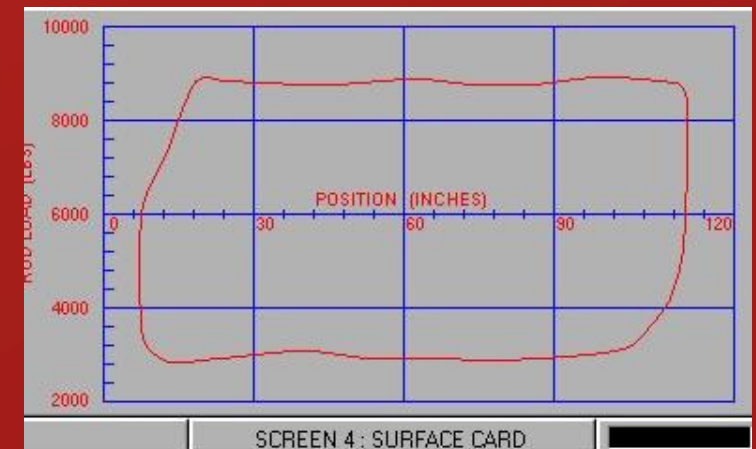
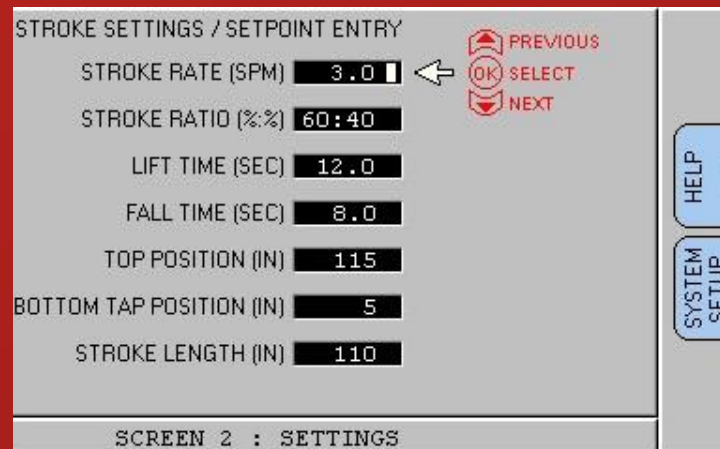
Local Display

SilverJack Optimization Controller
Is Included With Every SilverJack



DIAGNOSTICS/ALARMS	ALARM STATUS	ALARM TIME/DATE
LOW RPM - CHECK FUEL:	ALARM ACTIVE	09:30 11/14/10
LOW BATTERY VOLTAGE:	ALARM ACTIVE	09:30 11/14/10
AUTO POWER OFF:	ALARM ACTIVE	09:40 11/14/10
LOW HYD OIL LEVEL:	CLEARED	22:17 10/08/10
HIGH FLOWLINE PRESS:	CLEARED	13:30 09/23/10
HIGH FLOWLINE PRESS:	CLEARED	13:40 09/23/10
HIGH FLOWLINE PRESS:	CLEARED	13:50 09/23/10
ENG PRESS SENSOR FAULT:	CLEARED	10:15 06/15/10
REPAIR FAULTS THEN PRESS OK TO CLEAR ALARMS		

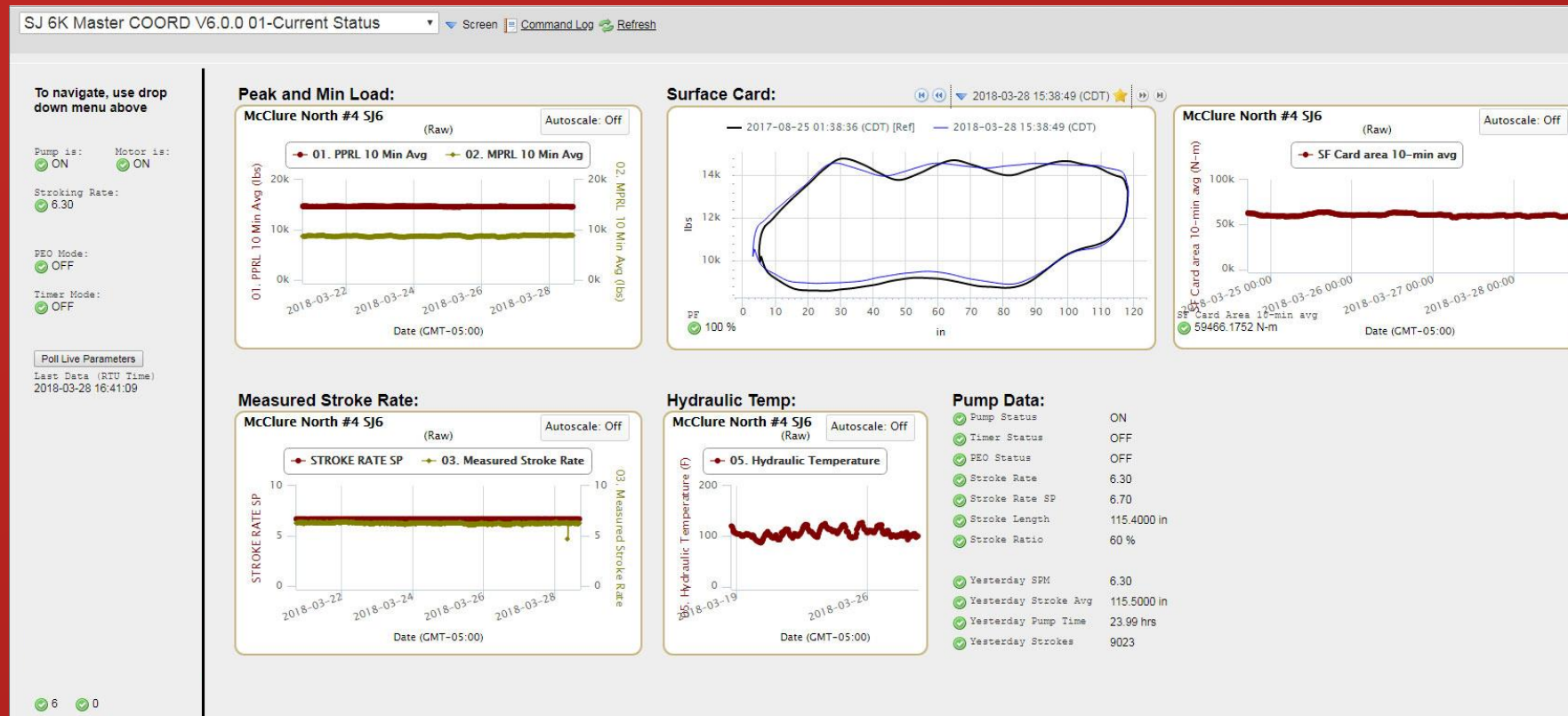
09:33 03/24/10 SCREEN 3 : ALARMS VER 4.26



Remote Access

Remote Access Web Host

- 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



To navigate, use drop
down menu above

Pump is: Motor is:
ON ON

Stroking Rate:
5.50

FEO Mode:
OFF

Timer Mode:
OFF

Poll Live Parameters

Last Updated (RTU Time)
2016-10-13 16:35:56

5.27 54

Motor Data:

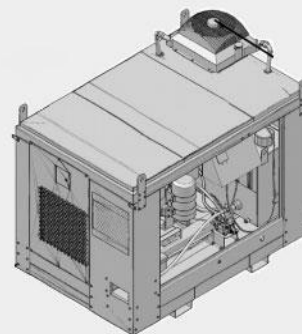
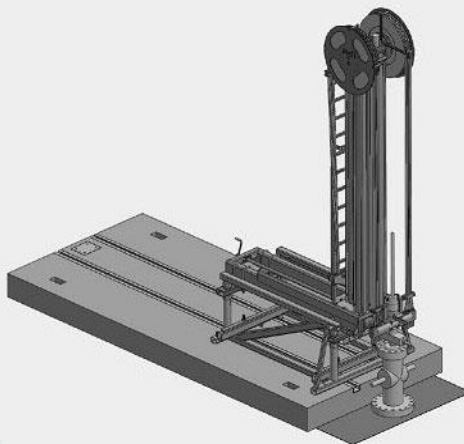
Engine Status ON
Engine Speed 2082.0000 rpm
Engine Hours 8314 hrs
Voltage 13.90 V

combustible only:

Engine Coolant Temp. 189.0000 °F
Engine Oil Press. 54.0000 psi

Hydraulic Data:

Pump Status ON
Inst Oil Pressure 1284.0000 psi
Oil Temp. 118.0000 °F
Oil Temp. High Limit 170.0000 °F
Cooler Status ON
Heater Status OFF
Pump Type Combustible Open Loop



Rod Load:

Rod Load Max 10-min avg
15896.0000 lbs

Rod Load Max absolute
16000.0000 lbs

Rod Load Min 10-min avg
6824.0000 lbs

Rod Load Min absolute
6700.0000 lbs

SVT Weight TVT Weight
7107.0000 lbs 6158.0000 lbs

SVT Delta Wght TVT Delta Wght
0.0000 lbs 0.0000 lbs

Optimization Data:

Stroke Rate (SPM)
5.50

Stroke Length
230.2000 in

Strokes Last 60 min
325

Inst. Rod Load
8300.0000 lbs

Stroke Time Up
5.4600 Seconds

Stroke Time Down
5.4100 Seconds

Stroke Rate SP(SPM)
5.50

Stroke Length SP
230.0000 in

Stroke Ratio SP
50 %

Rod Position
43.7000 in

Stroke Time Up SP
5.4040 Seconds

Stroke Time Down SP
5.4040 Seconds

Assisted Lift:

N2 Press. Top of Stroke
801.0000 psi

N2 Press. Bottom of Stroke
1043.0000 psi

Hourly N2 Charge Time
0 Seconds

Hourly N2 Bleed Time
0 Seconds

Balance Difference (HHP)
-1.20

External Data: (if installed)

Ext. Alarm 1

NORMAL

Ext. Alarm 2

NORMAL

Totalizer Flow Rate 0 m3/Day

Totalizer Volume 0 m3

Tank Volume 0 m3

Tubing Pressure
-165.0000 psi

Casing Pressure
-250.0000 psi

Pipeline Pressure
1.0000 psi

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

Setpoints:

Accum High Pressure SD
✓ 1600.0000 psi

Accum Max Operating Pressure SP
✓ 1550.0000 psi

Accumulator Refresh Interval
✓ 8000

N2 Target Pressure (Top of Stroke)
✓ 700.0000 psi

N2 Minimum Resting Pressure
✓ 700.0000 psi

N2 Charge Fault Delay
✓ 15.0000 Seconds

N2 Charge Interval
✓ Automatic

Assist Balance Correction SP
✓ 50 %

Balance Tolerance SP (HHP / PSI / RPM)
✓ 4

Piston Balance Tolerance
✓ 70.0000 psi

Accumulator Charge rate
✓ 5.0000 US gal/min

Accum Balancing
✓ 4 - Auto Piston and Auto Ratio

Balance Target Offset
✓ -2

Brake Point Correction
✓ 50 %

Brake Release Delay (-ve above pF)
✓ 0 ms

Hourly N2 Bleed Time
✓ 0 Seconds

Hourly N2 Charge Time
✓ 0 Seconds

Hourly Accum Charge Time
✓ 0 Seconds

Hourly Accum Bleed Time
✓ 0 Seconds

N2 Resting Pressure
✓ 775.0000 psi

N2 Operating Press. (Top of Stroke)
✓ 801.0000 psi

N2 Operating Press. (Bottom of Stroke)
✓ 1043.0000 psi

Power Down 10-min avg. (hhp)
✓ 41.20

Power Up 10-min avg. (hhp)
✓ 44.30

Balance Error Avg (HHP)
✓ -1.20

N2 - Accumulator Pressure TOP
✓ 49.0000 psi

N2 - Accumulator Pressure BOTTOM
✓ 11.0000 psi

Demand Poll (this page)
will not update setpoints

Up Stretch
✓ -5.6080 in

Down Stretch
✓ -5.6430 in

N2 Press Sensor Fault
✓ OFF

N2 Charge Fault
✓ OFF

N2 Low Oil Level Warn.
✓ OFF

N2 High Oil Level Warn.
✓ OFF

N2 Charge Override
✓ OFF

Accumulator Cycles
✓ 1000

Net Lift Drive Area
✓ 9.86

Net Down Drive Area
✓ 10.21

Net Accumulator Assist Area
✓ 24.35

Average Engine Speed Up
✓ 2027.0000 rpm

Average Engine Speed Down
✓ 1952.0000 rpm

Hourly Reloads
✓ 0

Accum Refresh Fault
✓ OFF

Accum Press Sensor Fault
✓ OFF

Piston Imbalance
✓ OFF

Low Ratio Strokes (Accum Charge)
✓ 0

Hourly Max Hyd Pressure
✓ 1692.0000 psi

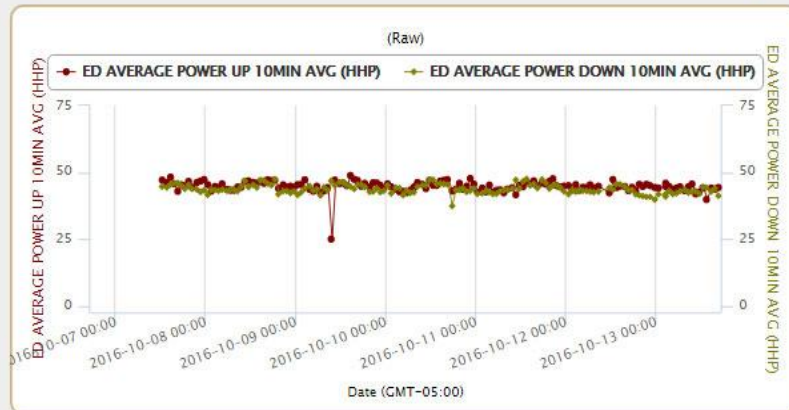
Hourly Max Hyd Position
✓ 21.8200 in

Charge Pressure UP (avg)
✓ 135.0000 psi

Charge Pressure DN (avg)
✓ 265.0000 psi

Charge Pressure UP (max)
✓ 1392.0000 psi

Charge Pressure DN (max)
✓ 1499.0000 psi

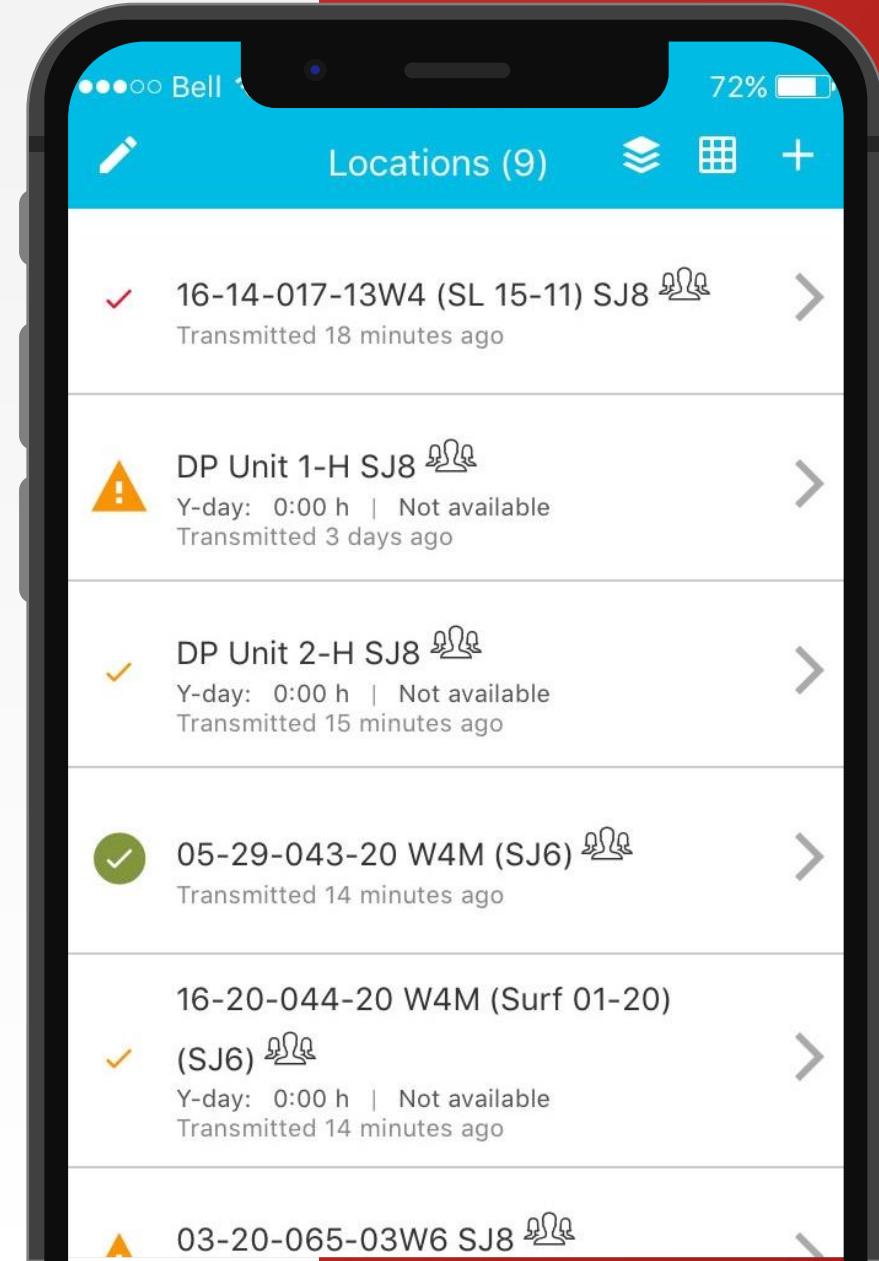


Remote Access App

Mobile App

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

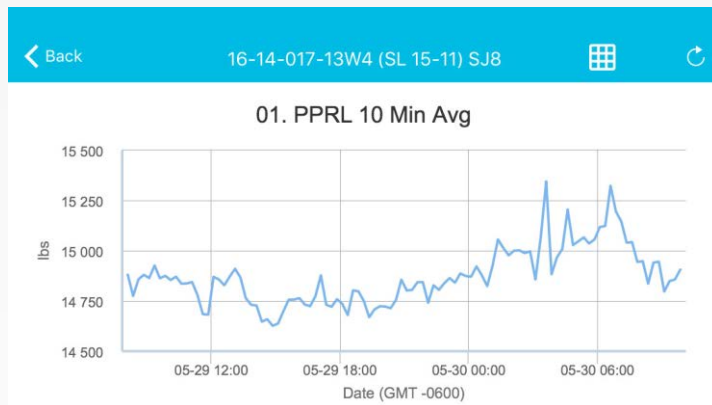
Display any locations from Remote Access. See alarm status, sensor values, near term trends, and map location.



Remote Access App

Mobile App

Download App from App Store or Google Play and
log in with current remote access user account



Near Term Trending

EC North Unit #1 SJ8

Last transmitted 18 minutes ago

Start Demand Poll

Set Motor On/Off

Set Pump ON/OFF: ON

Set Pump On/Off

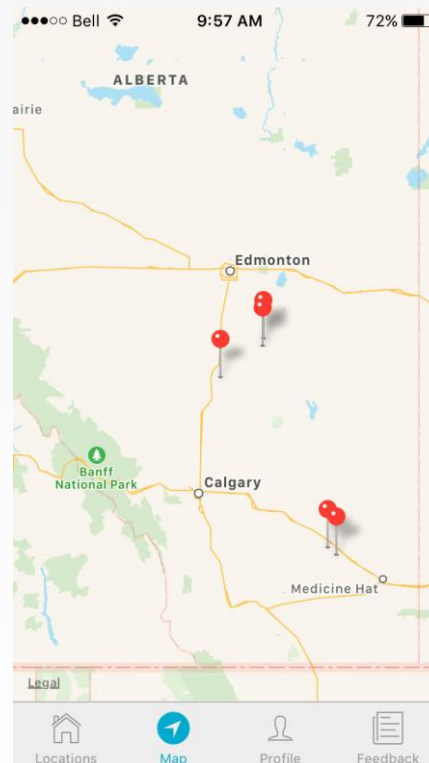
Stroke SP:

- Set Stroke Rate (SPM): 6.40
- Set Stroke Ratio: 50.00 %
- Set Top Position: 235.000 in
- Set Bottom Position: 20.000 in
- Piston Stall Delay: 60.0 Seconds

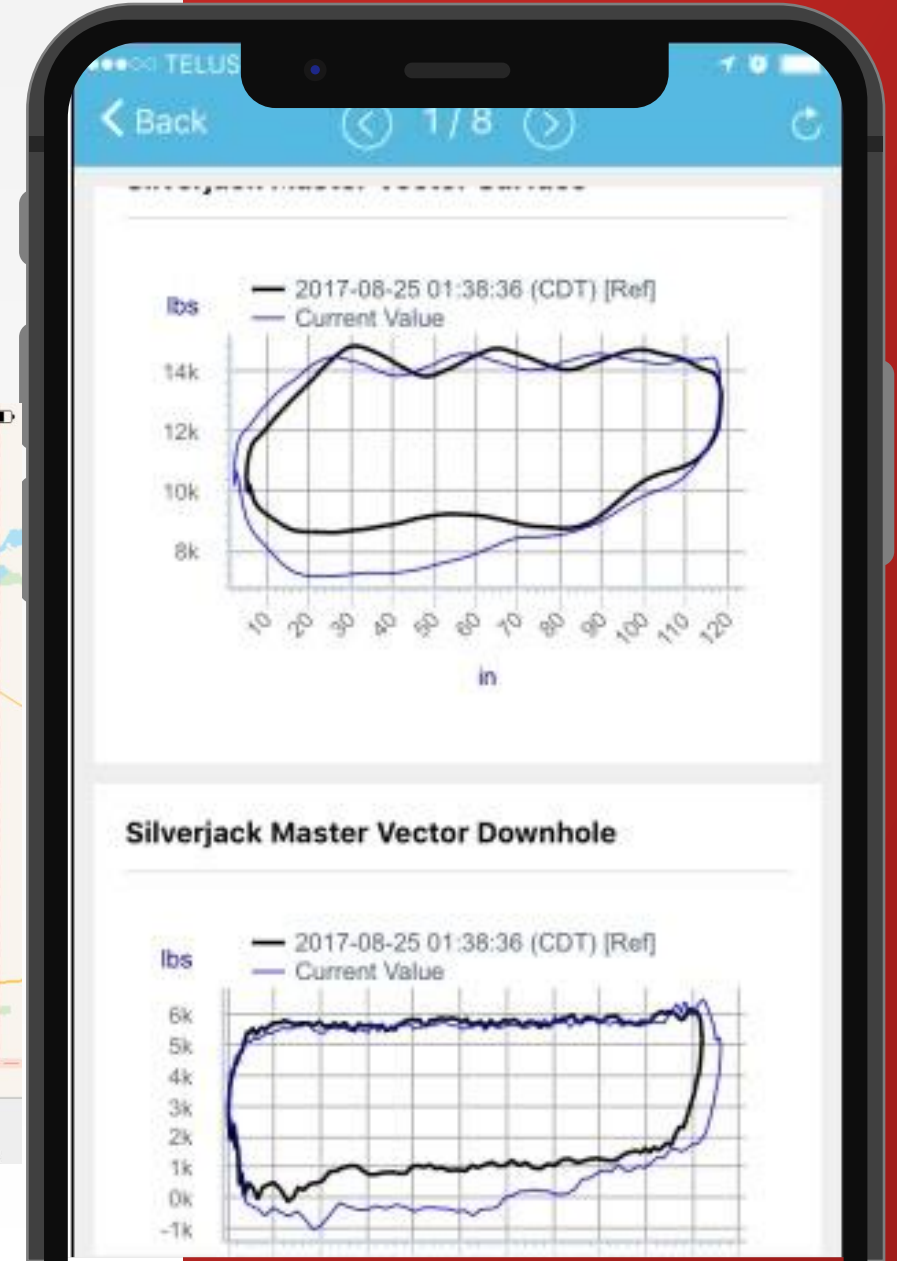
Send New Settings

Page 5 of 5

Basic Control



Location Map



Power of Optimization



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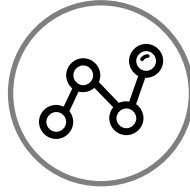
User Initiated Optimization

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

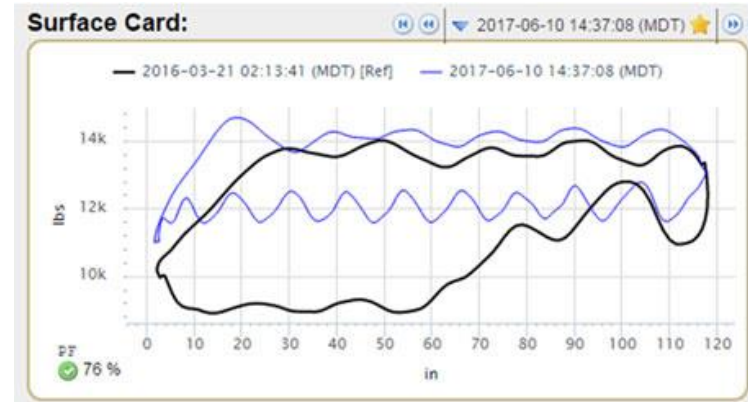
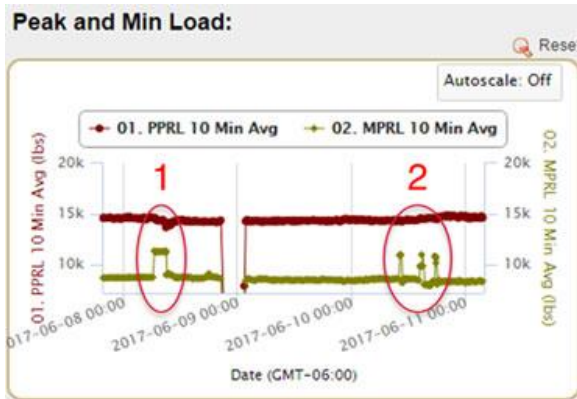


Test

Standing Valve Stuck Open

■ Measure

Downloading polish rod loads every 15 minutes



Problem Resolution / Confirmation

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

Analyze

01

- 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

Optimize

02

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

Test

03

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

EC North Unit #1 SJ8

Last transmitted 18 minutes ago

Start Demand Poll

Set Motor On/Off

Set Pump ON/OFF ON

Set Pump On/Off

Stroke SP:

- Set Stroke Rate (SPM) 6.40
- Set Stroke Ratio 50.00 %
- Set Top Position 235.000 in
- Set Bottom Position 20.000 in
- Piston Stall Delay 60.0 Seconds

Send New Settings

Page 5 of 5

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

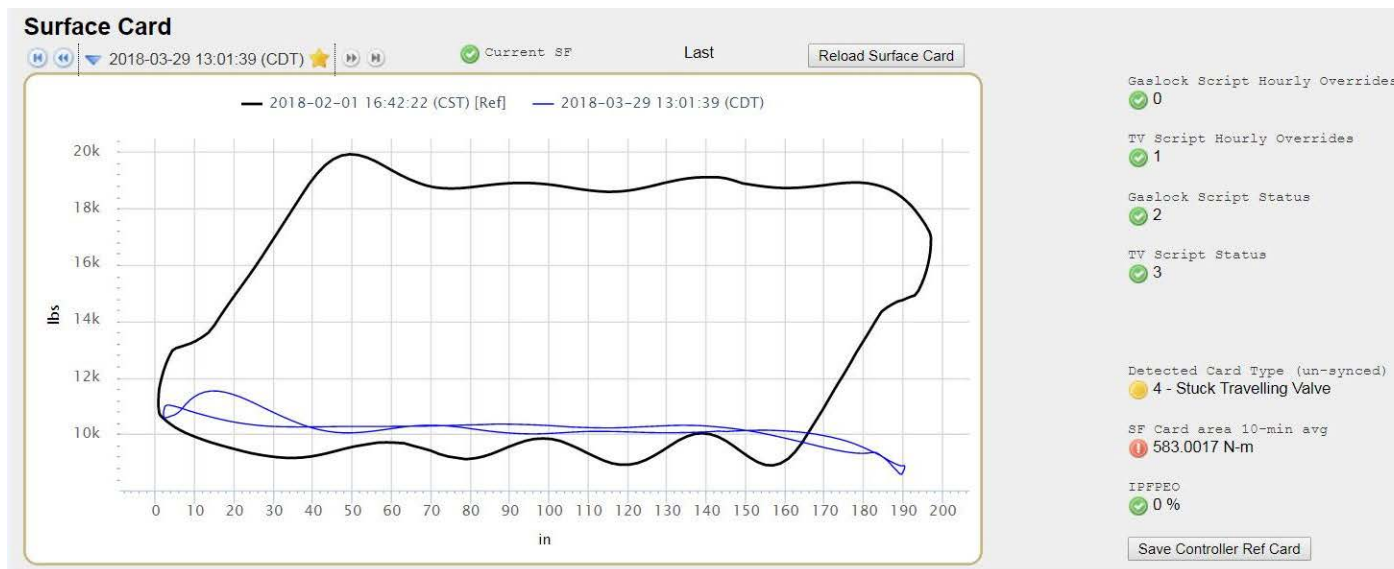
Currently available for:

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

Stuck Traveling Valve

■ Measure

System identifies problem not just symptom



Problem Resolution / Confirmation

as little as 3 to 4 minutes

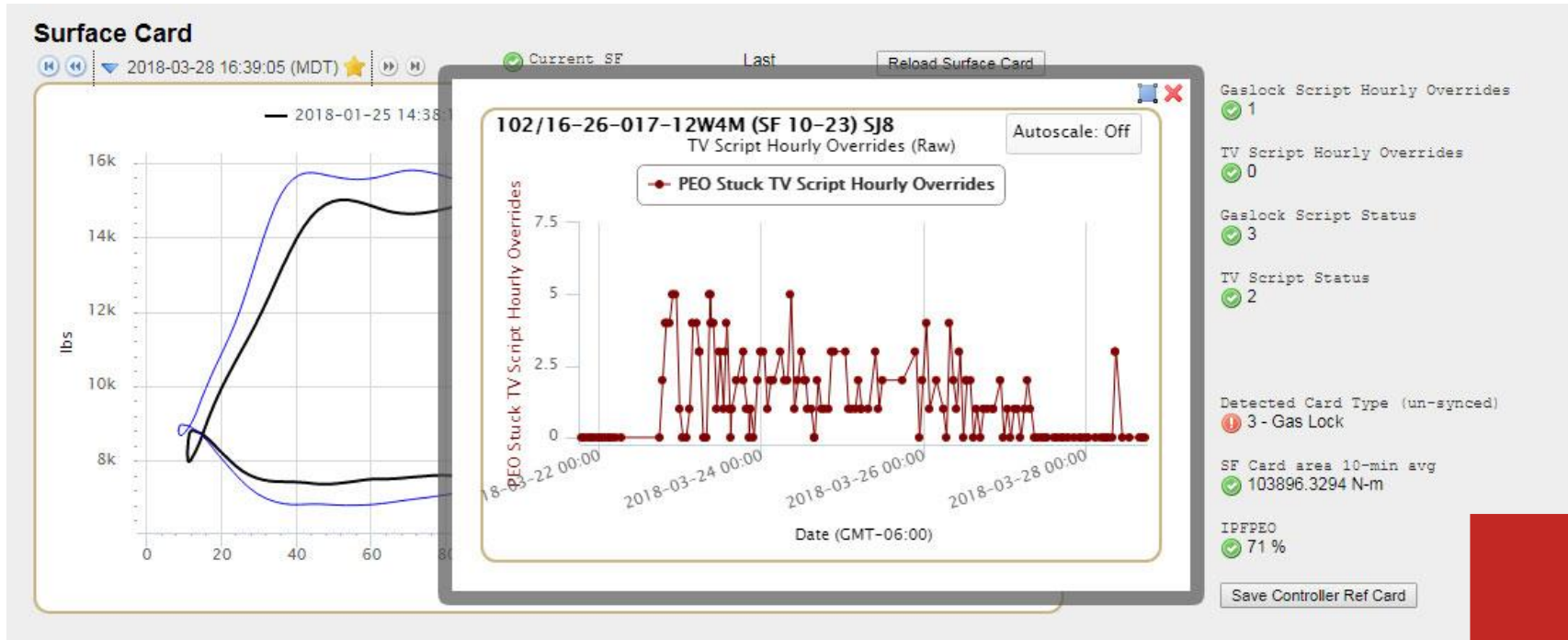
Pump Efficiency Optimizer Controls:

PEO Spm Adjust Interval 5	PEO Mode OFF
PEO Spm Adjust Value 0.10	PEO Script Card Select Downhole Card
Target Pump Fill 20 %	Stuck SV Start 0 - Disabled
PEO Spm Minimum Value 2	Stuck SV End 0 - Disabled
Pump Bore Diameter 2.2500 in	Stuck TV Start 0 - Disabled
Estimated Rod Stretch 5.0000 in	Stuck TV End 0 - Disabled
PEO Fluid Weight 10000.0000 lbs	Scr 1 - Ratio 35%
Min Pumpfill (GL Detection) 10 %	Scr 2 - Ratio 35%
Update PEO Parameters	Scr 3 - Ratio 35%
Inst Pump Fill - PEO Method 51 %	Scr 4 - Light Tap
MPRL 10-min Average 12660.0000 lbs	Scr 5 - Max Tap
	Scr 6 - Max Tap
	Scr 7 - Ratio 35%
	Scr 8 - Ratio 70%
	Scr 9 - Ratio 35%
	Scr 10 - Light Tap
	Scr 11 - Max Tap
	Scr 12 - Max Tap + Med high SPM
	Scr 13 - Max Tap + Med High SPM + ...
	Scr 14 - Max Tap + Med High SPM + ...
	Scr 15 - Max Tap + Med High SPM + ...

- 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)

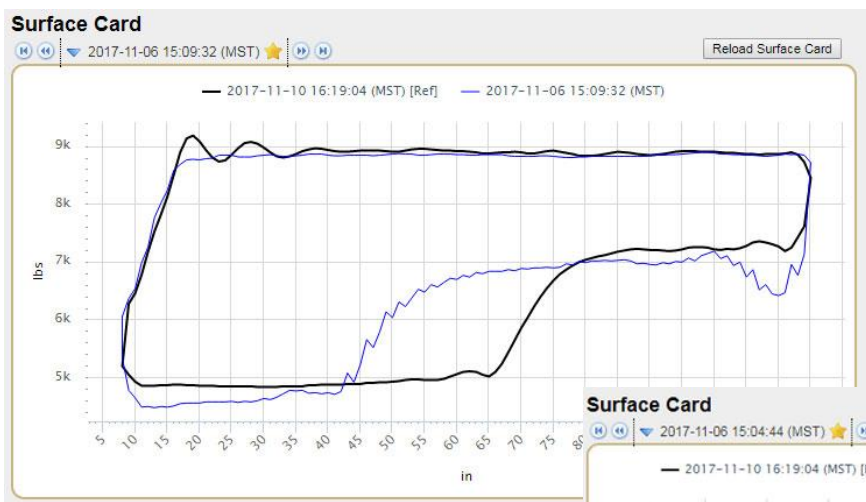
Stuck Traveling Valve



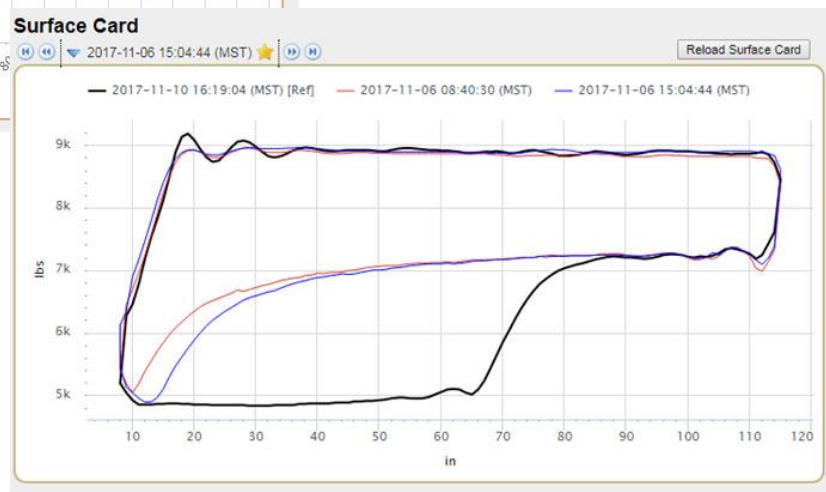
System tracks how often Autonomous Optimization algorithm is engaging to resolve issues

Gas Lock

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



Gas Interference



Gas Lock

Gas Lock intervention also supported by Autonomous Optimization feature.

Analyze

01

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

Optimize

02

- 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.

Test

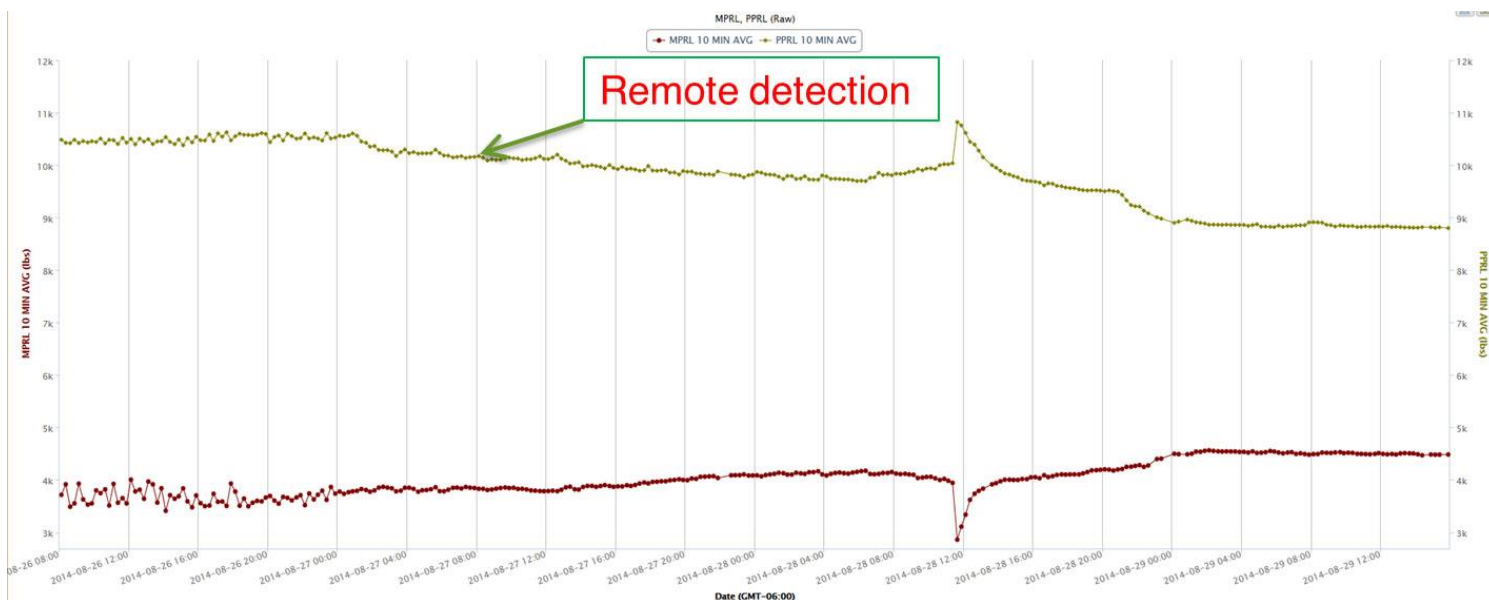
03

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

Hole In Tubing

■ Measure

Downloading polish rod loads every 15 minutes



Analyze

01

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

Optimize

02

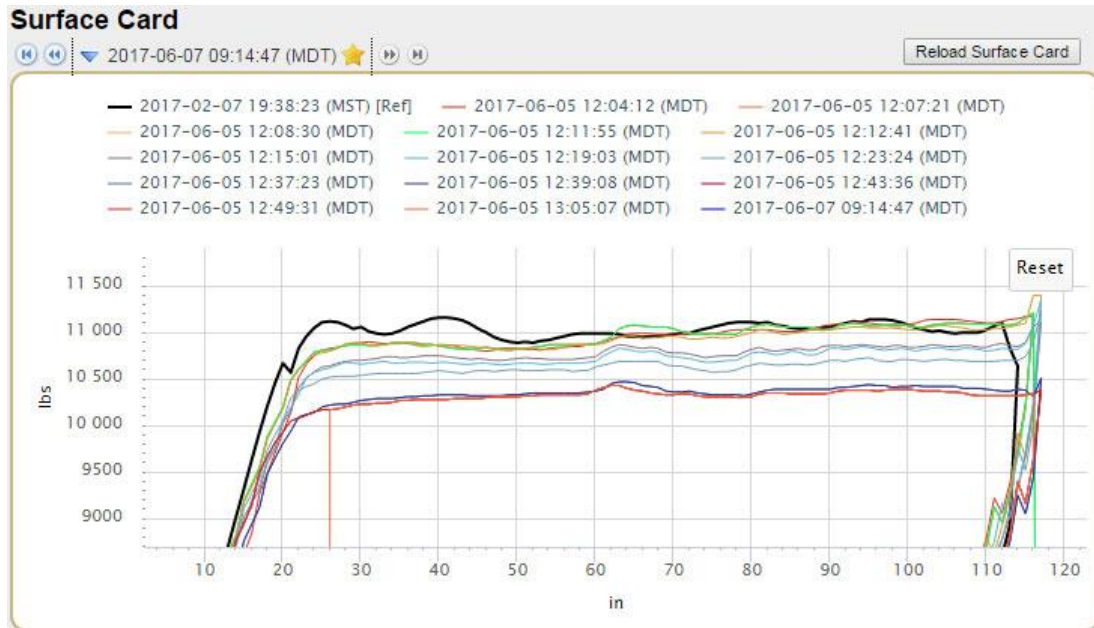
- Mechanical issue that cannot be resolved with Optimization
- Value is in early notification and problem identification

Test

03

- See next slide

Hole In Tubing (con't)



Example of Testing Procedure

Benefit

Minimized troubleshooting time & cost.

Identified problem remotely in 1hr with no field testing.

Reported Problem

01

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

Troubleshooting Steps:

02

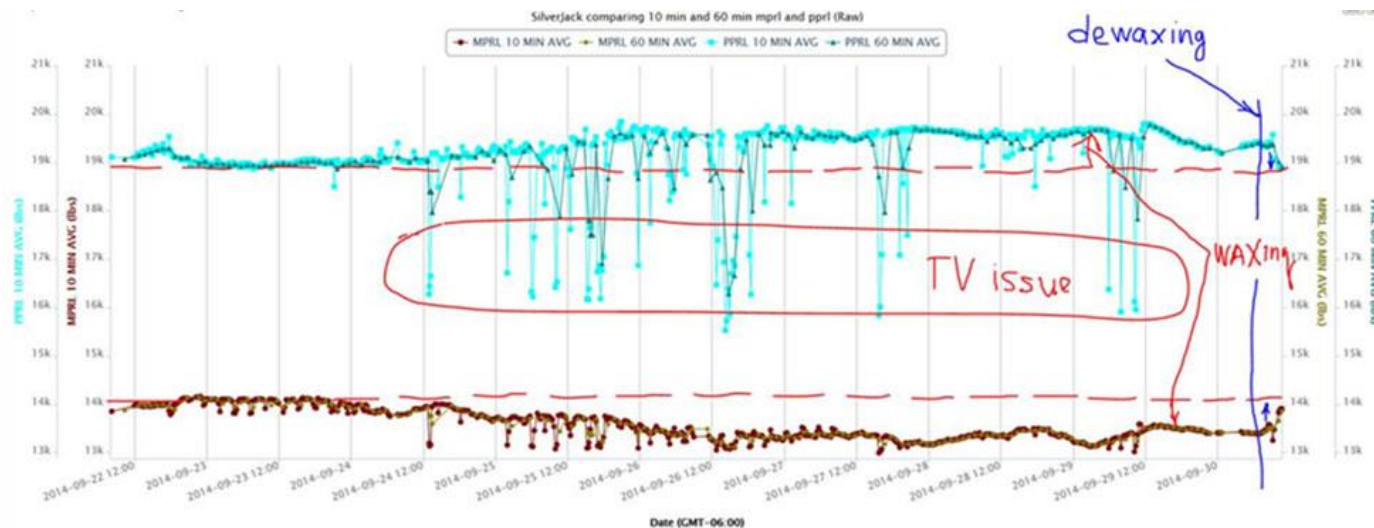
1. Remotely reduced stroke rate, 5 SPM to 1 SPM
2. Demand polled pump cards
3. Overlaid pump cards to compare

Conclusion

03

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

Waxing



Analyze Symptoms

01

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

Conclusion

02

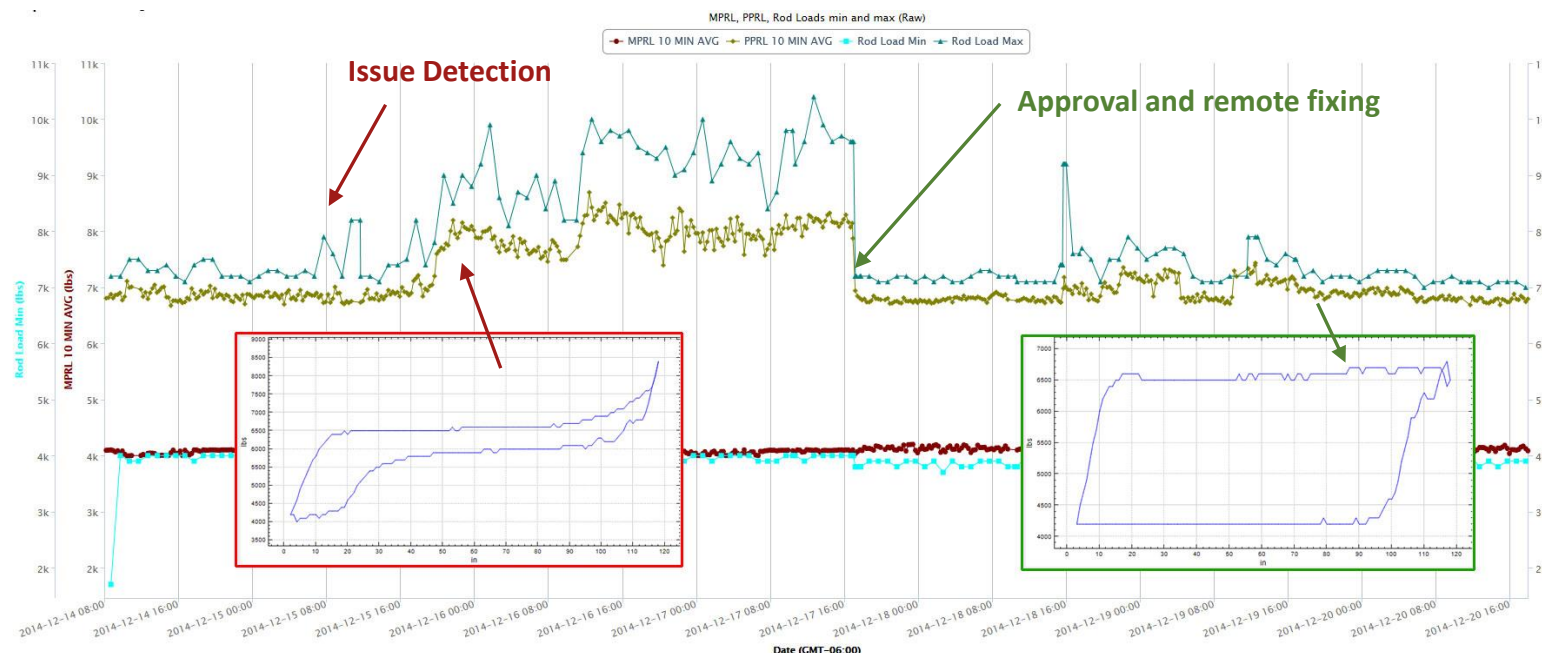
- Waxing issues

Solution

03

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

Debris in Pump



Benefit

Fast detection avoided equipment damage/workover.

Remote fix avoided trip to site

01 Analyze Symptoms

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

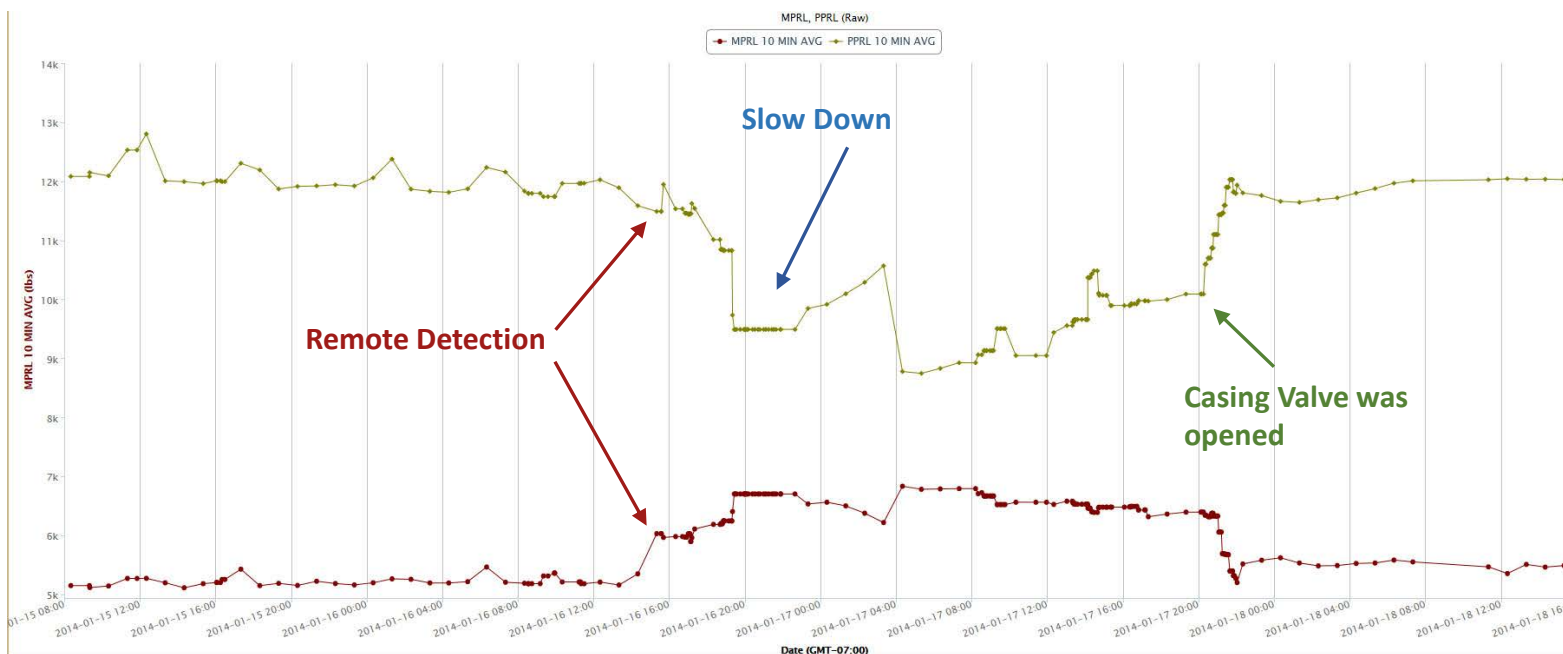
02 Conclusion

- 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

Casing Valve Closed



Benefit

Quick detection avoided lost production

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

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

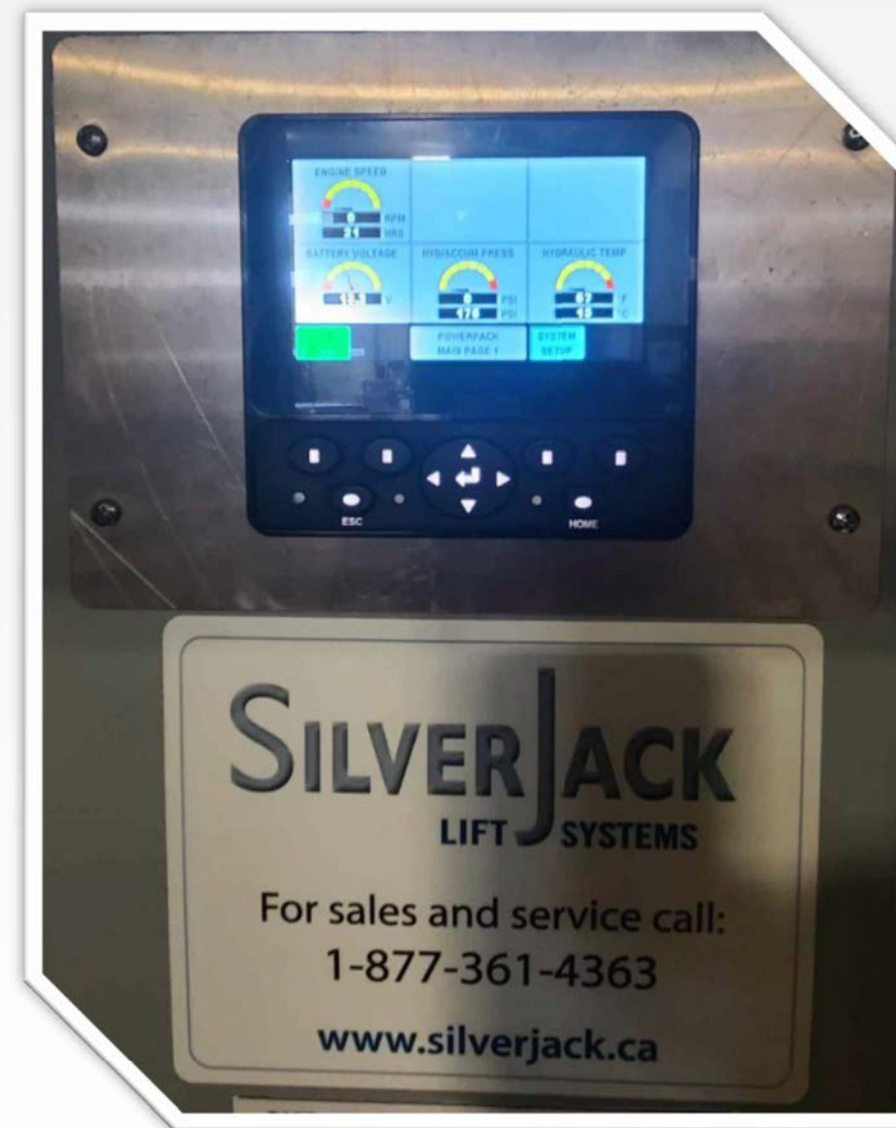


Focus on **PROBLEM RESOLUTION**, not just problem identification

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 N₂ balancing

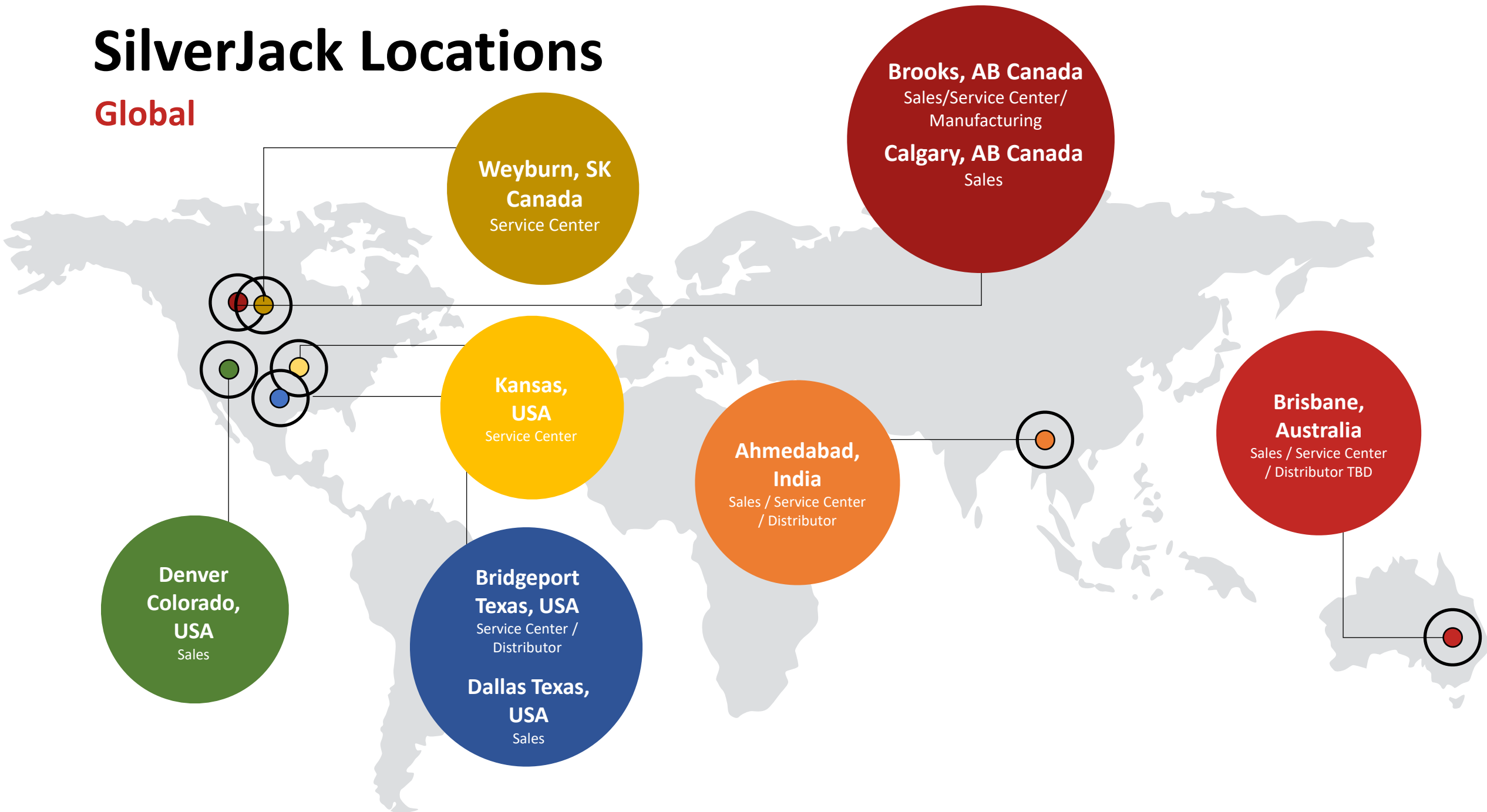
to adjust for ambient temperature changes



Remote Optimization Service and Field Support

SilverJack Locations

Global



Thanks!



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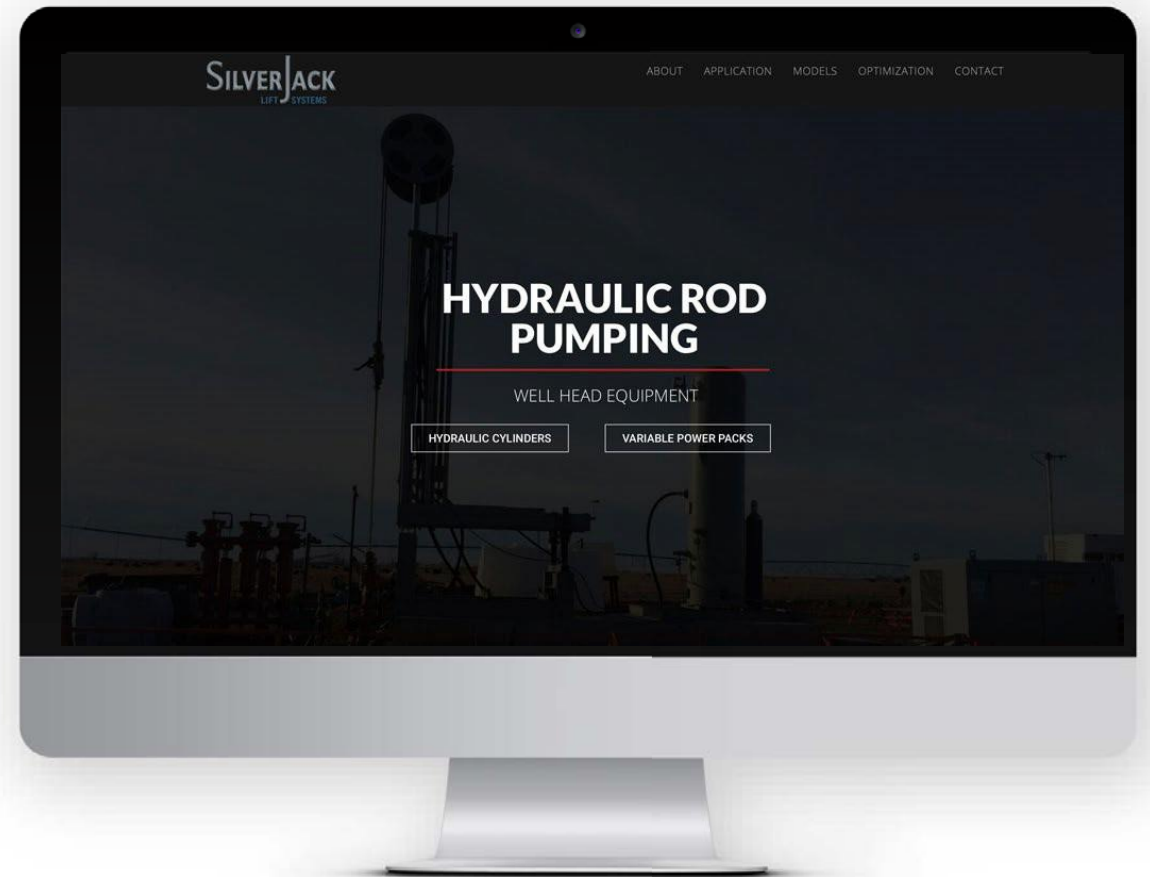
1-877-361-4363



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