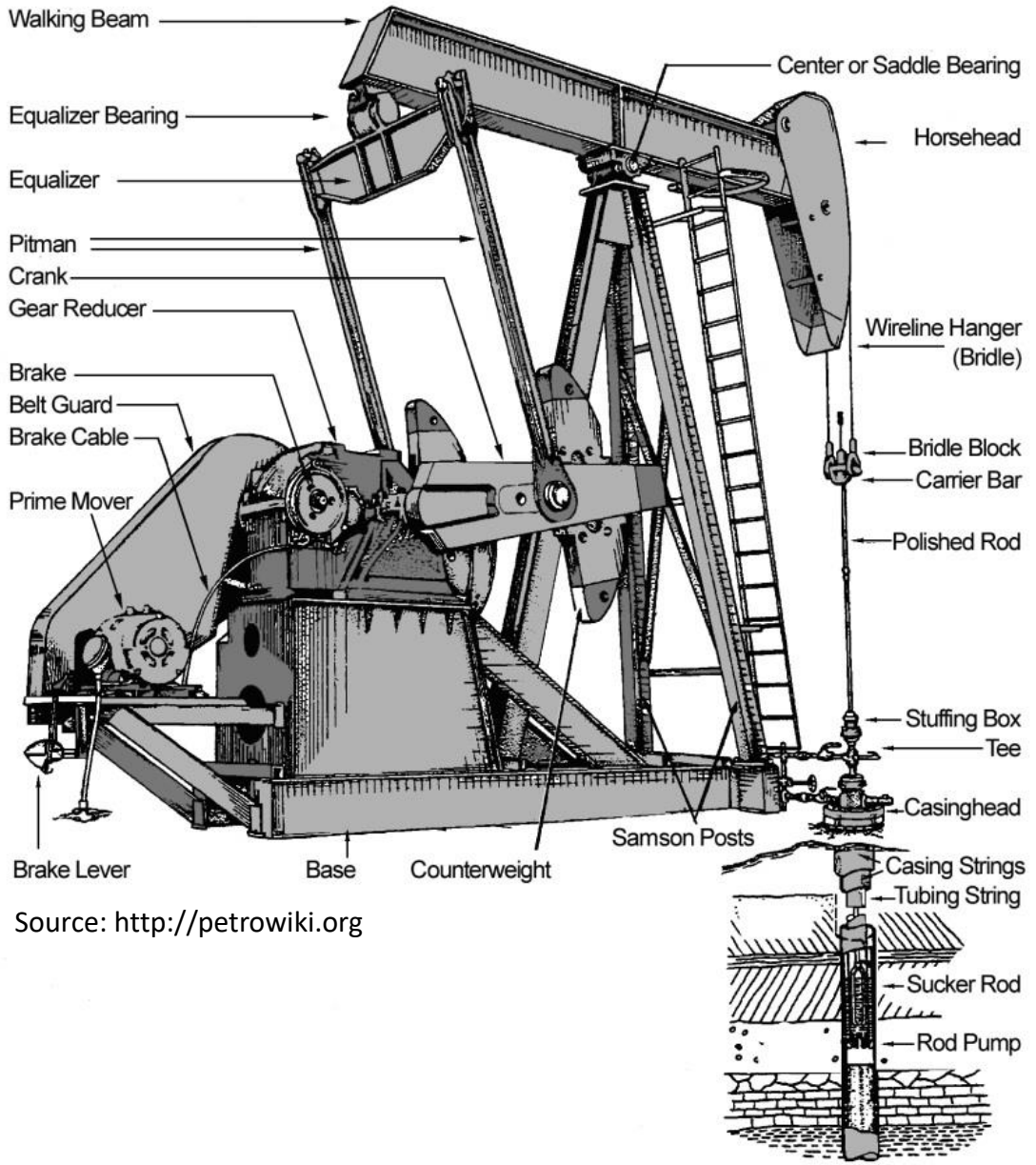
Optimization, Predictive Analytics, & Real-Time Process Models

Rod Pump Analytics

Statistics & Control, Inc.

Rod Pump System

- Simple mechanism to extract subsoil fluids
- Major components
  - Prime move
  - Gear reducer or gearbox
  - Pumping unit
  - Sucker rod string
  - Subsurface pump

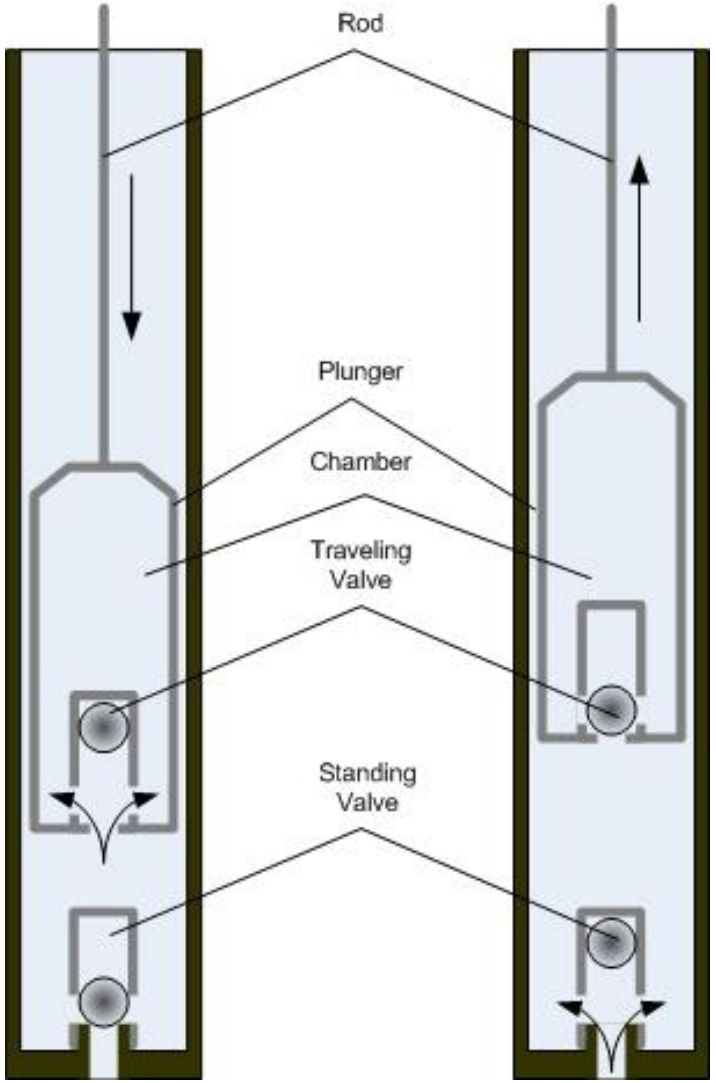


Source: http://petrowiki.org

Statistics & Control, Inc.

Challenges

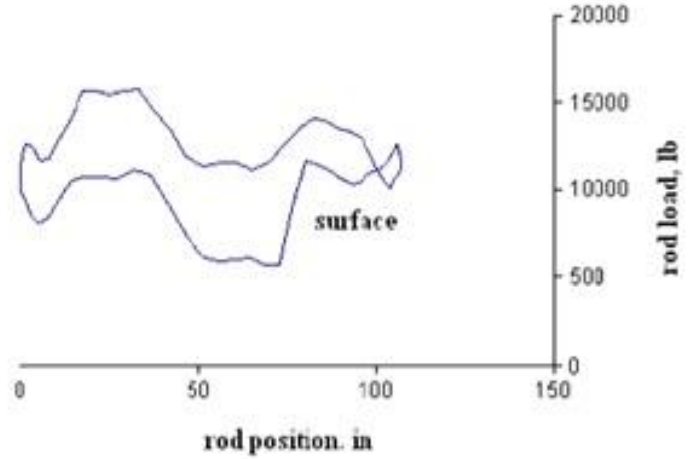
- Many rod pumps difficult to monitor and maintain
- Most wells under or over deliver
  - Difficult to match well inflow with fixed productivity pumping system
  - Downstroke: Plunger volume flooded = small production at surface
  - Upstroke: Fluid arrives at surface, barrel refilled
- Subsurface behavior inferred using dynamometer card



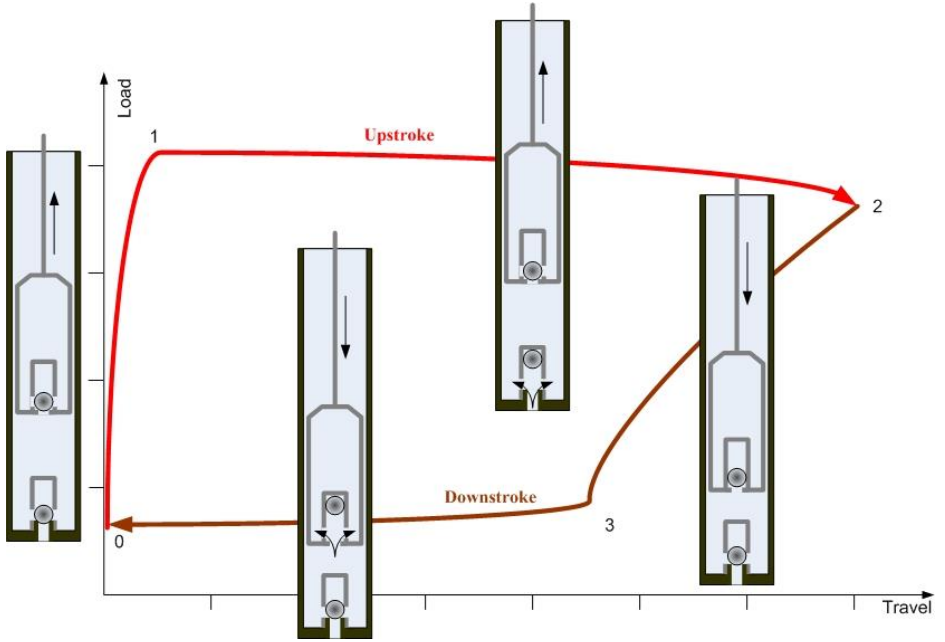
Statistics & Control, Inc.

Dynamometer Card

- Dynamometer card: graphical representation of relationship between rod load and stroke position
- Two types:
  - Surface
  - Pump (downhole)
    - Plot of calculated loads at various positions of pump stroke



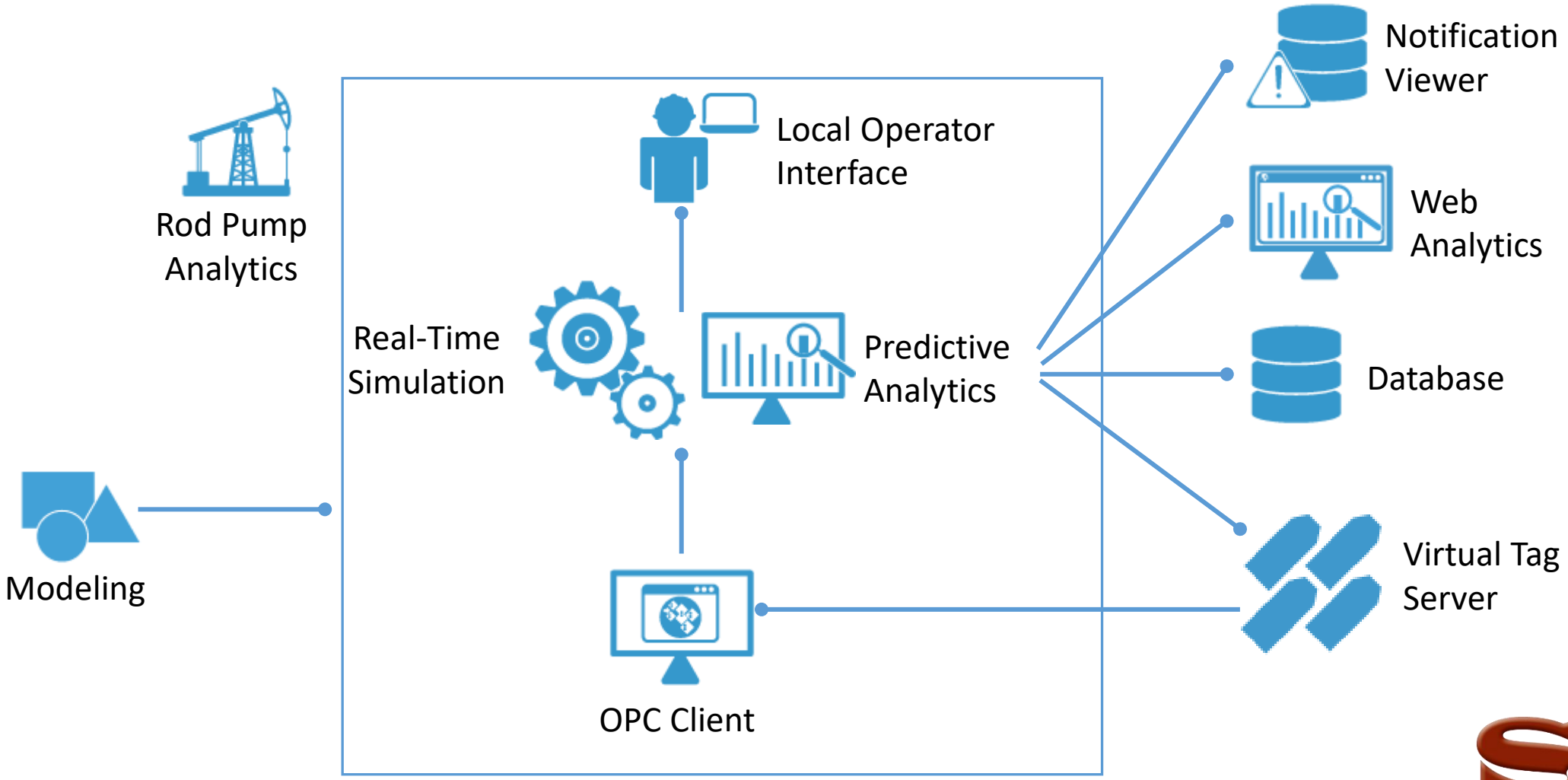
Surface dynamometer card example (source: S. G. Gibbs)



Downhole dynamometer card example

Statistics & Control, Inc.

Solution Overview



Statistics & Control, Inc.

Benefits

- Determine actual operating conditions
- Anticipate rod pump problems and provide maintenance scheduling decisions
- Provide smart alerts
- Match capacities using regulatory control and pump-off control

Statistics & Control, Inc.

Real-Time Simulation

- Implements pump-off control, Rod Pump Analytics Module
- Features
  - Accurately estimate total fluid production from wells (shallow or deep) without complex well site configuration
  - Analyze system load by detecting load cell drift from changing downhole conditions
  - Access dynamometer cards for events (e.g., Full, Current, Shutdown, etc.) and cards leading up to event
  - Provide alarms for torque, stress, pump efficiency, prime mover size, unbalance, etc.

Statistics & Control, Inc.

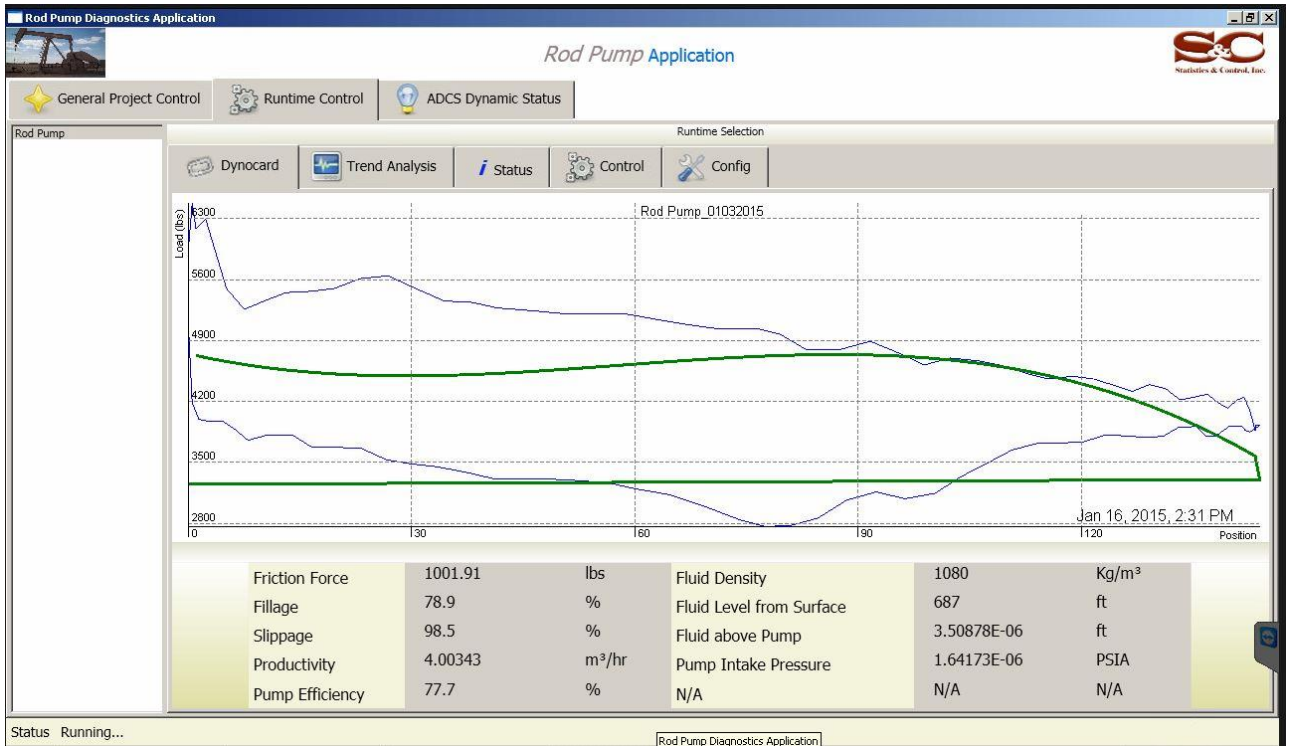
Pump-Off Control

- Goal: Optimal speed allows rod pump to have sufficient time to free fall through fluid on downstroke
- Functions
  - Controls running times of pumping units
  - Optimizes pumping unit run time, reducing damage to pumping system
  - Match capacities
    - Automatically detect when pumping system beginning to run out of available fluid to pump and shuts
    - Shuts well down for adjustable “idle time” so well can replenish fluid in wellbore

Statistics & Control, Inc.

Dynocard Visualization

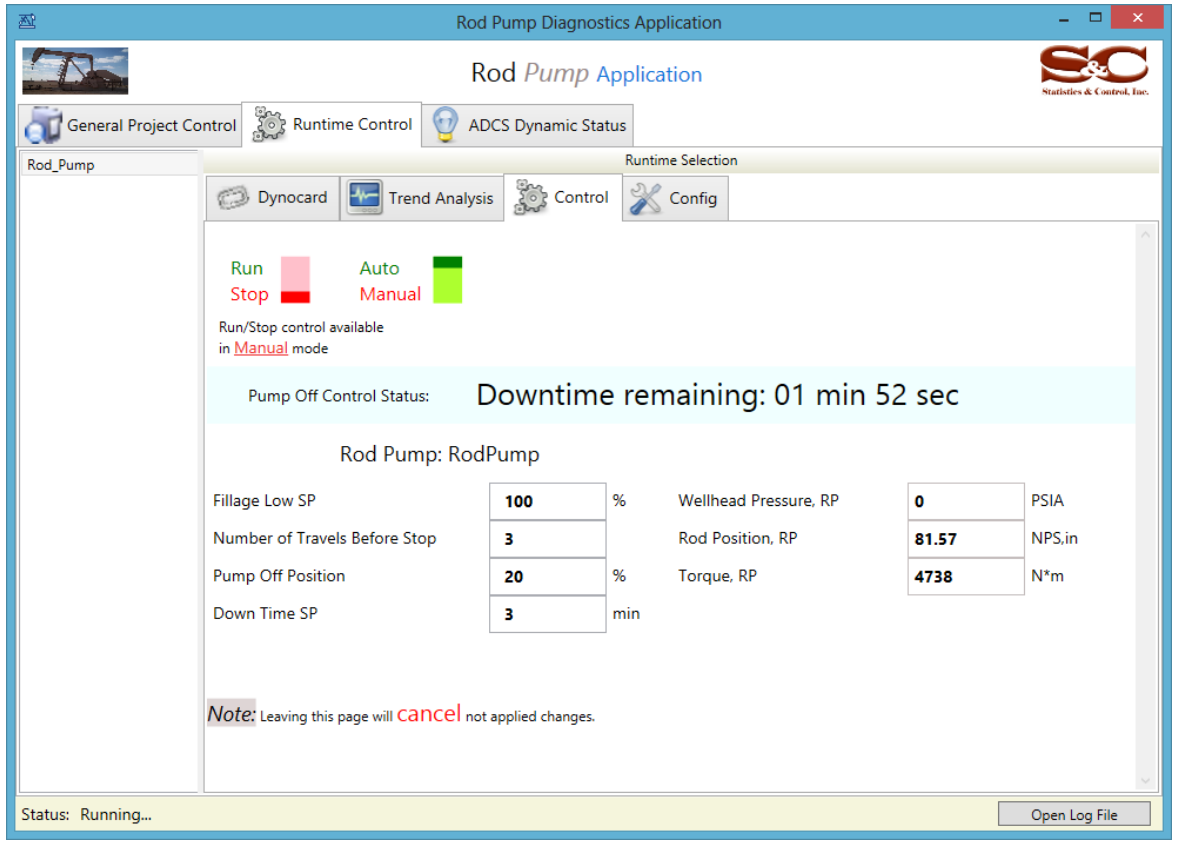
- Displays graph based on rod load and stroke position
- Represents downhole dynamometer card
- Data sources
  - Field Rod Pump: OPC
  - Enterprise Rod Pump: OPC (rare) or ODBC (most common)
- Lines
  - Green: Optimized
  - Blue: Real-time data



Statistics & Control, Inc.

Control Visualization

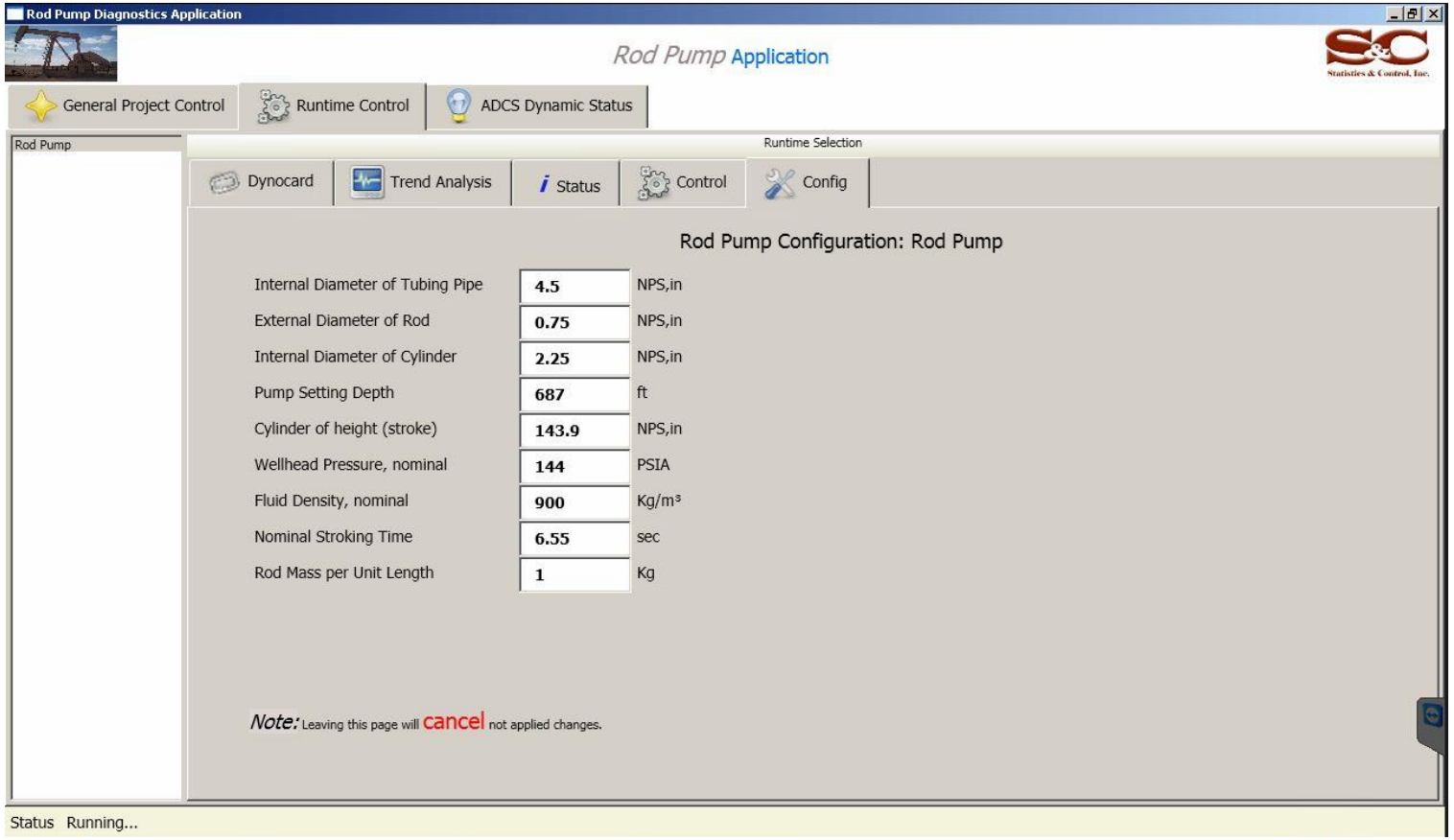
- Shows set points for pump operation and rules for pump-off control



Statistics & Control, Inc.

Configuration Visualization

- Configure and modify well and pump parameters



Statistics & Control, Inc.

Conclusion

- Determine actual operating conditions
- Anticipate rod pump problems and provide maintenance scheduling decisions
- Provide smart alerts
- Match capacities using regulatory control and pump-off control
- Monitor from anywhere using HTML 5 technologies

Statistics & Control, Inc.