Automating the Rod Pump Wellhead: Chasing Uptime

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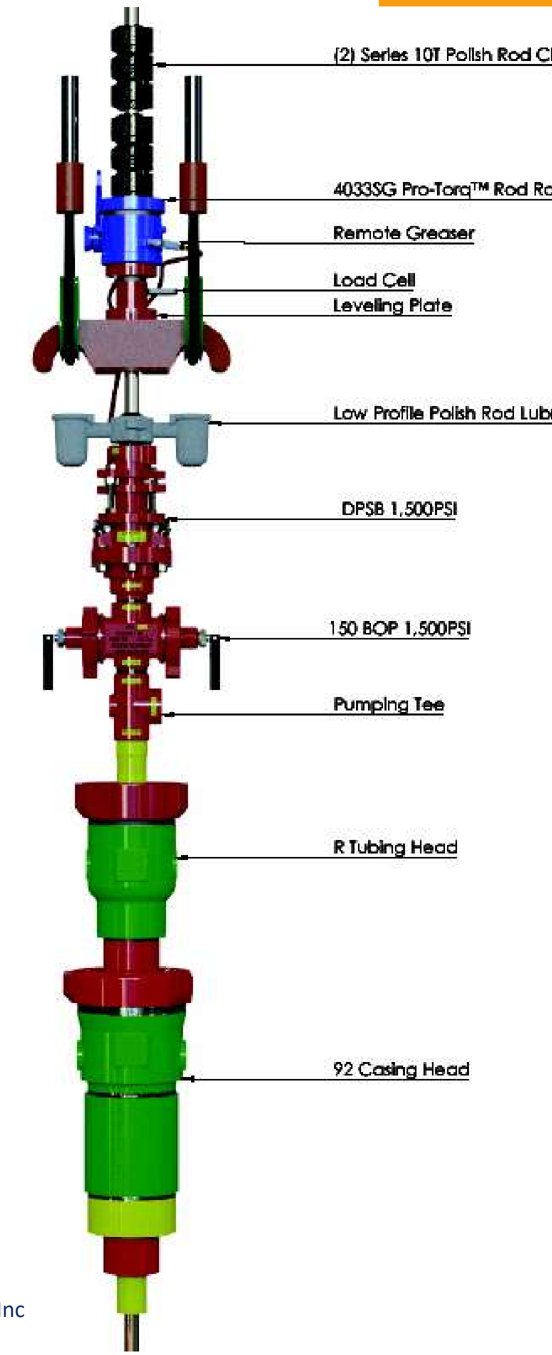
Overview

1. Current state of technology for majority of wells
2. Why automate?
3. Scope
4. Elements
5. Rod Rotator
6. Stuffing Box
7. Stuffing Box Compression
8. Automating Rod BOPs
9. Summary

pical Wellhead for Rod Lift

Original & Current Hookup – 80 Year old echnology

- Manual operation and maintenance
- Manpower intensive
- Multiple connections and leak paths
  - STUFFING BOX ALONE – 3 LEAK PATHS
- Visual only monitoring or pressure gauge, occasional pressure switch



Courtesy of WSI Inc

...y Automate?

...sts
- Noncompliance with HSE
- Trained manpower
- Lost Production

...nefits
- Meets new challenges - staff
- Reduce Manpower
- Reduce Maintenance
- Increase production/Reduce downtime

tomation system

tomation - Scope

Monitoring
- Rod Rotator – Turning/Stopped
- Stuffing Box – Pressure/Leakage
- BOP – Open/Closed/Pressure

reasing
- Rod Rotator
- Stuffing Box

ctuating
- Stuffing Box – Cap adjustment/sealing
- BOP – Open/Close rams

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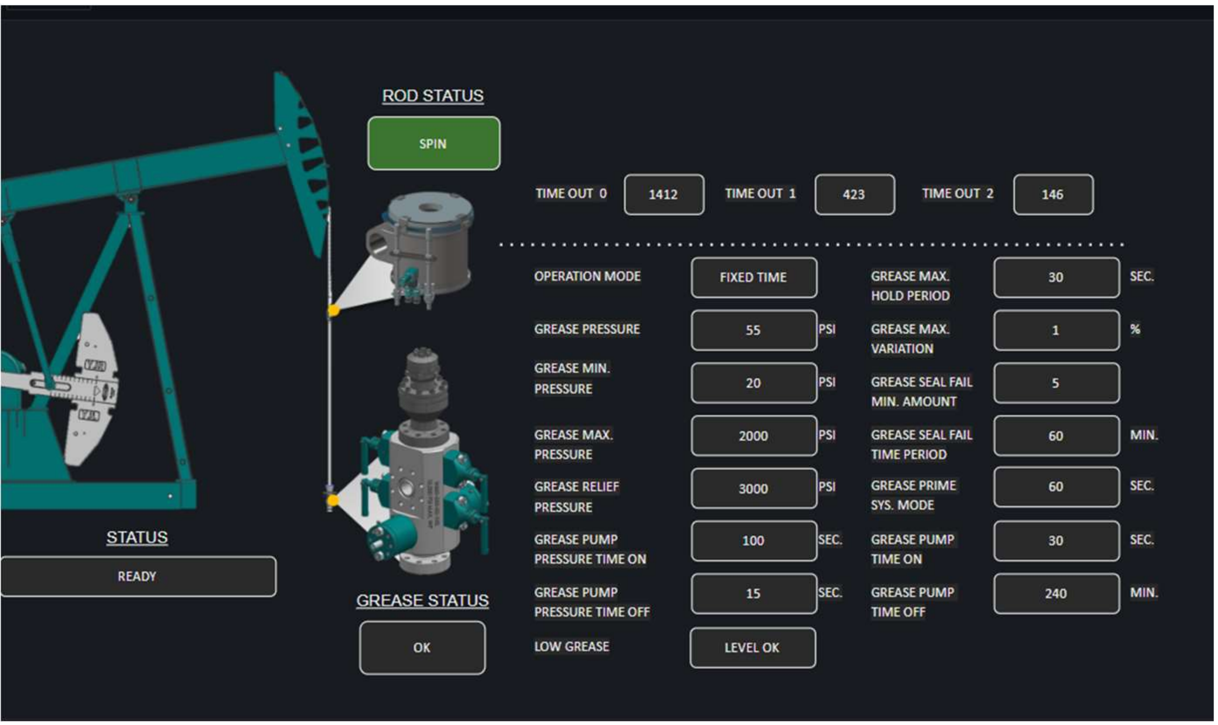
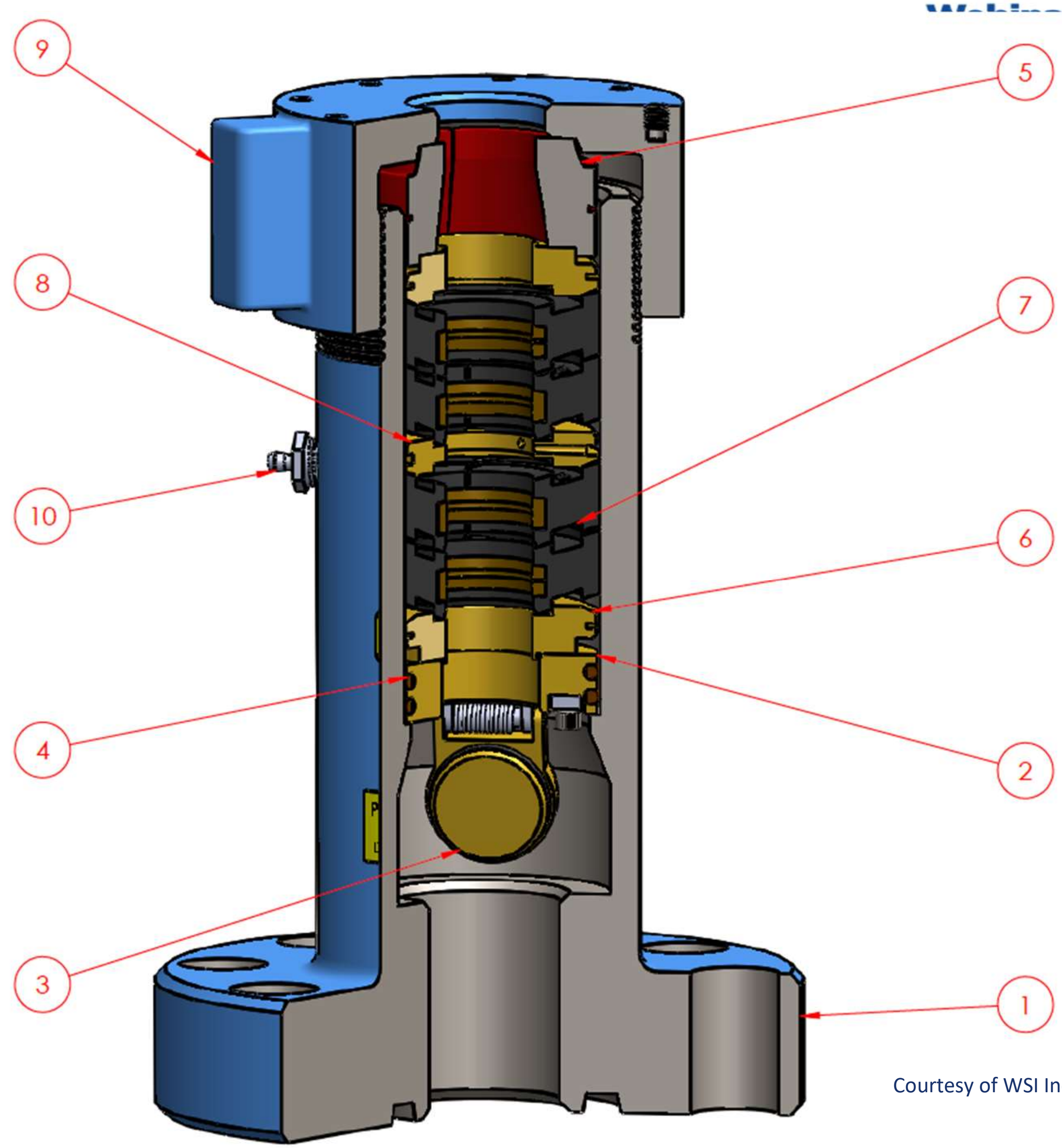
od Rotator

- Modify to accept Exia Proximity Sensors
- Dual Sensors to monitor for backspin
- Grease port hose run to base of unit



uffing Box with Dome Seals

- Grease via port (10)
- Grease will fill chapter ring (8)
- Excess grease should vent down
- Static tests over 5000psi retained in grease chamber
- What can it hold under dynamic conditions?



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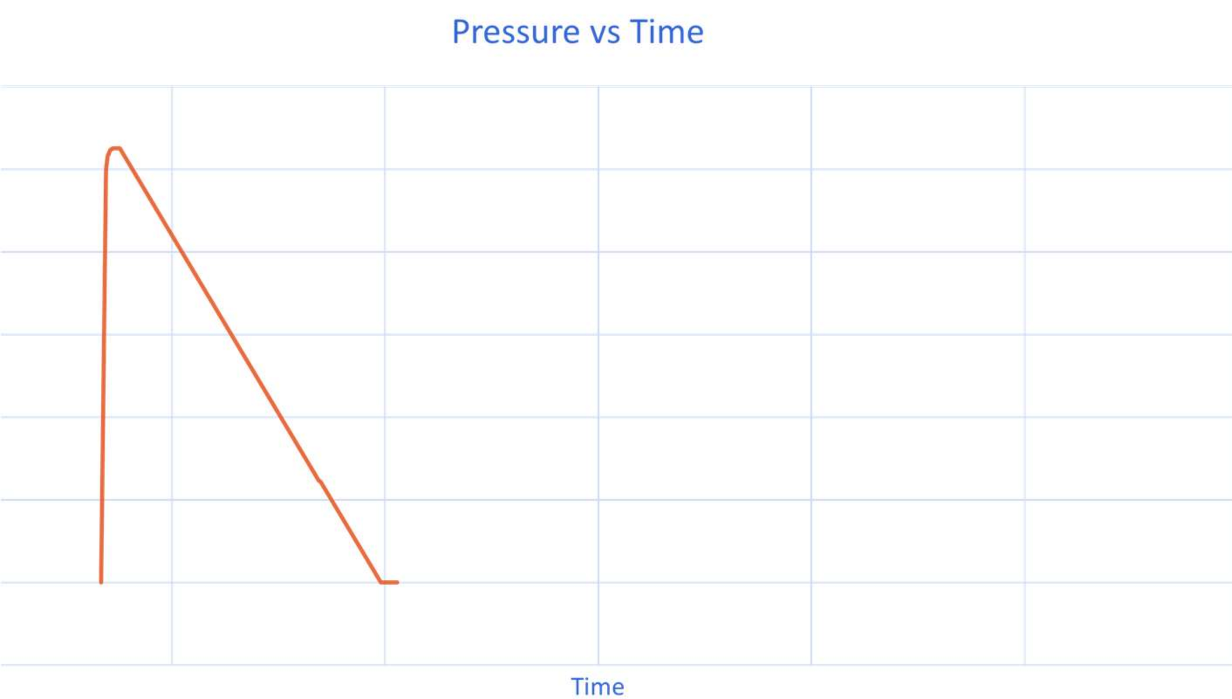
ypothesis - Grease on Demand



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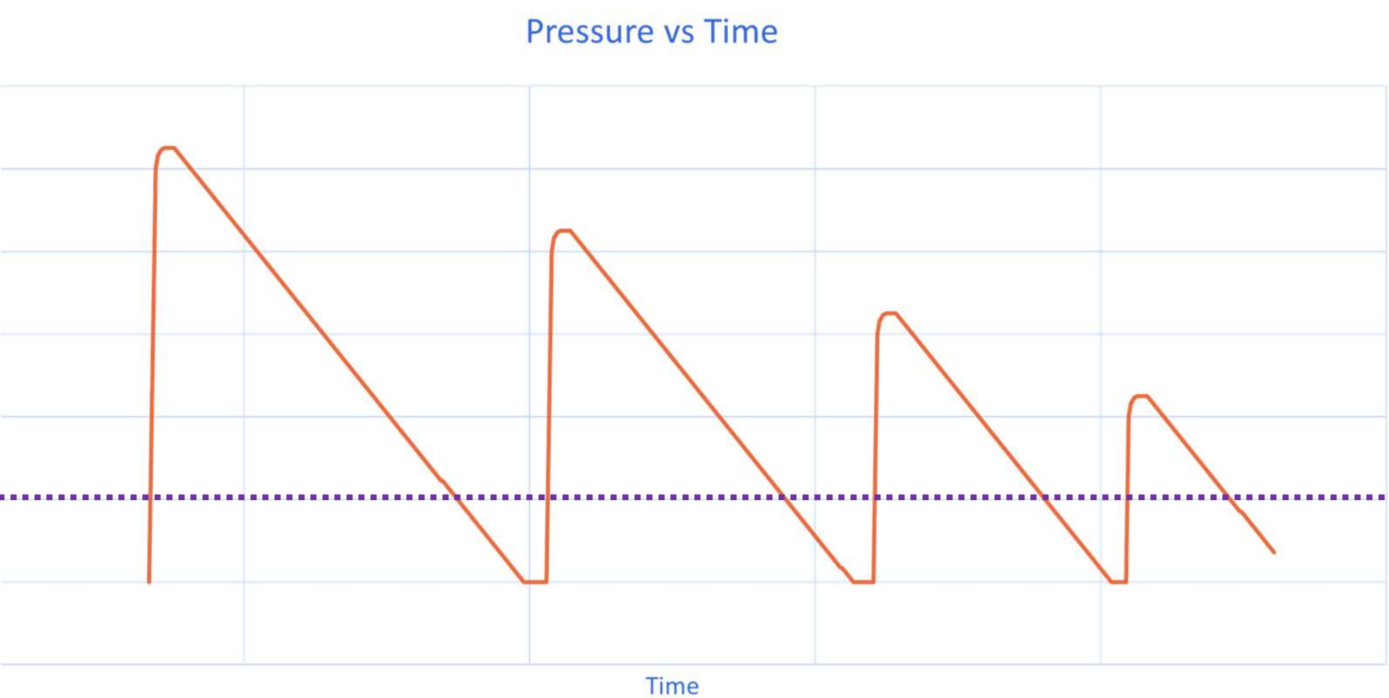

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- Add in a lower threshold to
  the pump

ontrol Panel w/
ease pump

rimental Panel for field tests
- Controller
- Grease Pump
- Power supply
- Barriers
- Telemetry Package

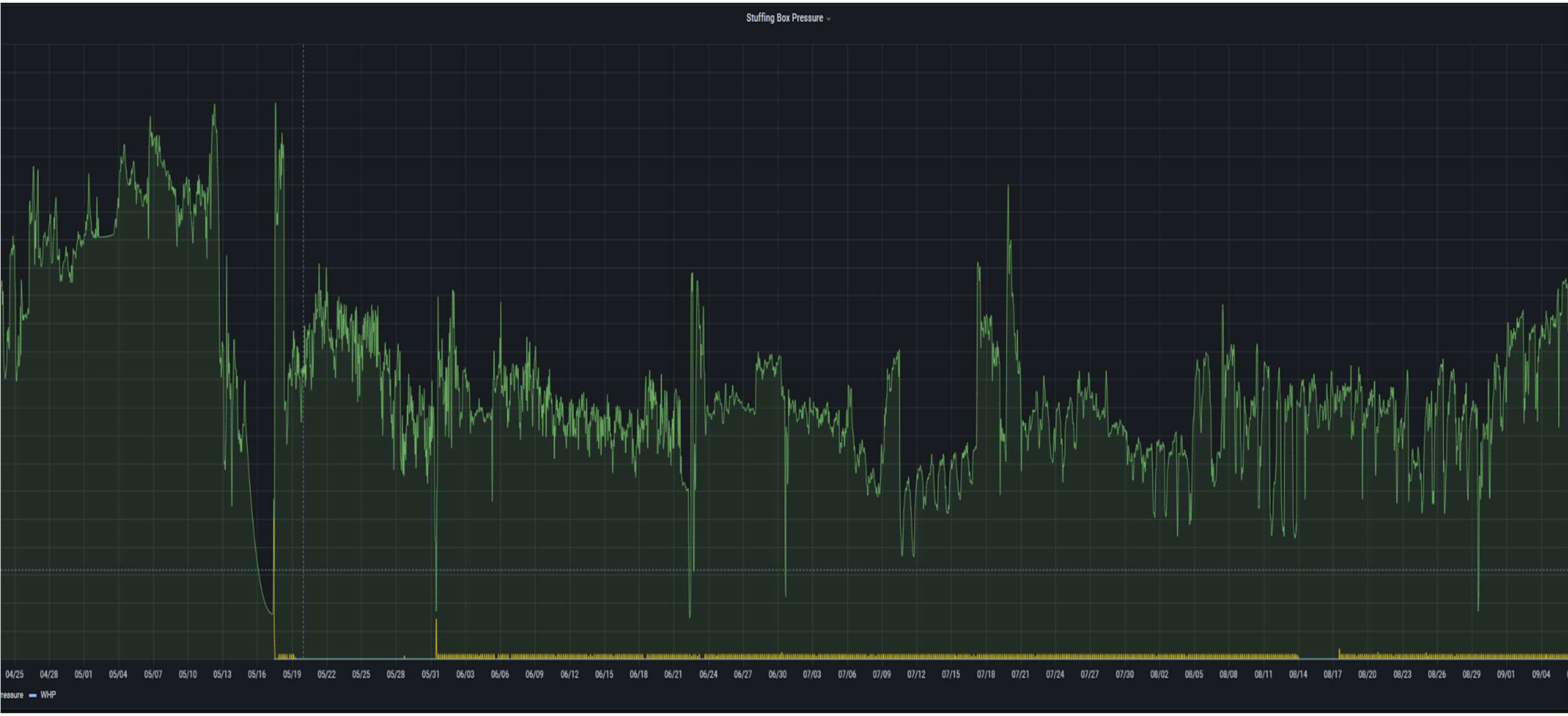
- Grease on time
- Grease on pressure measurement
- Monitors Rod Rotator sensor
- Grease Rod Rotator

elemetry System

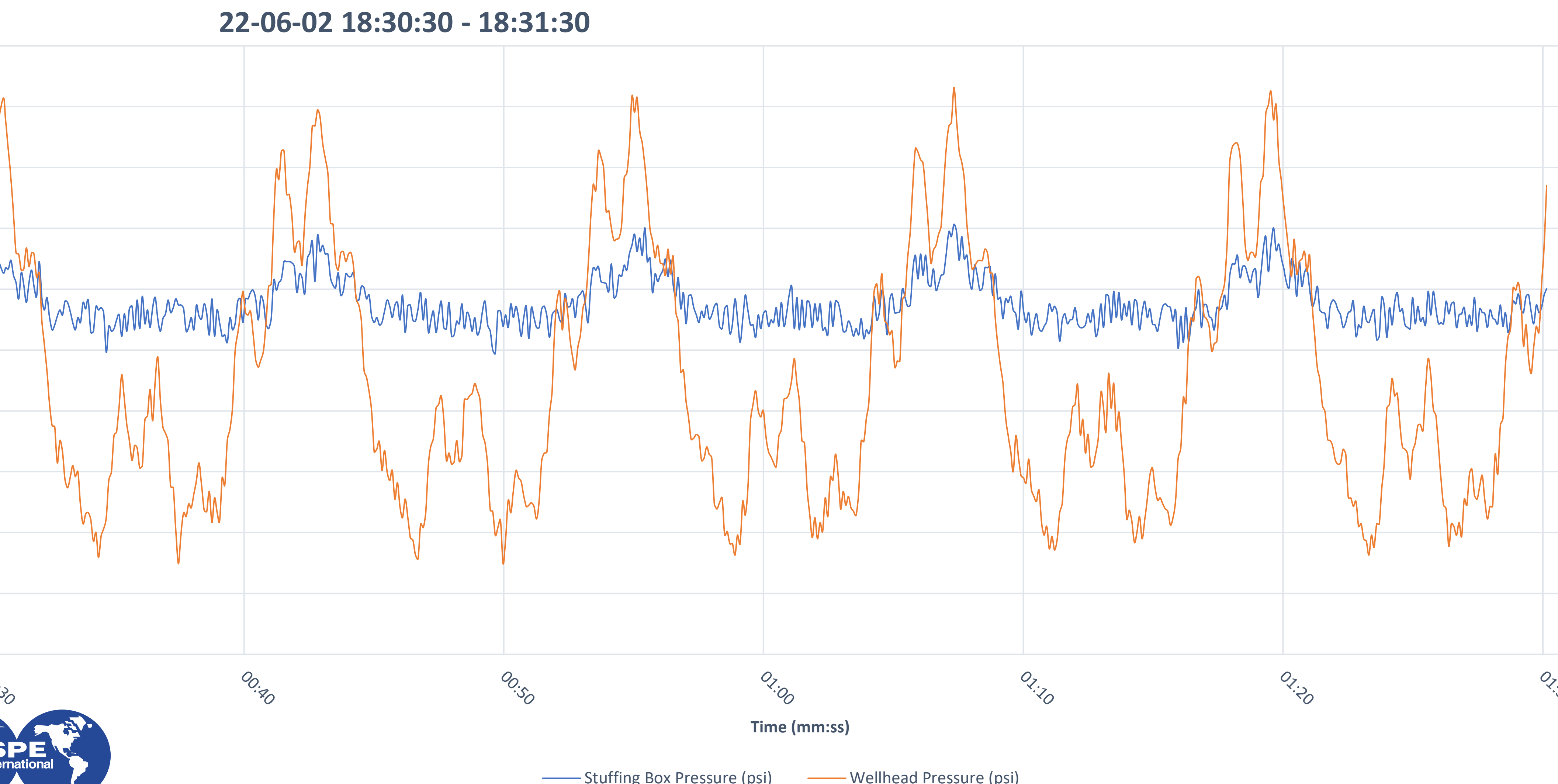
- sic package transmits rod rotator tus, stuffing box pressure and gnostics every 10 seconds
- ded RR sensor status to system
- ded grease pump status to system

ta is point data – 1 sample every 10s

ontext - 4/22 – 09/09



lormal" Stuffing Box Pressure



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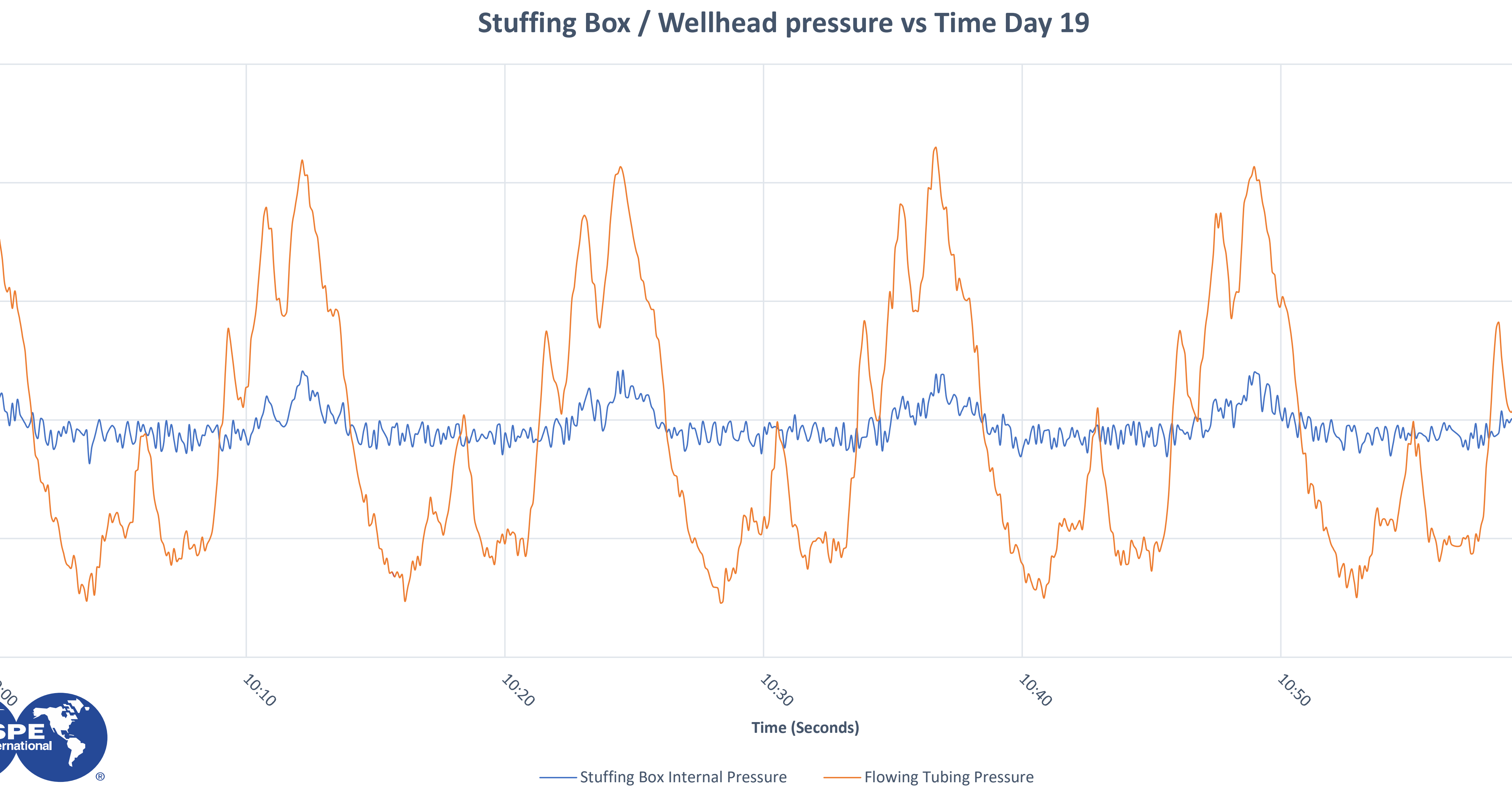
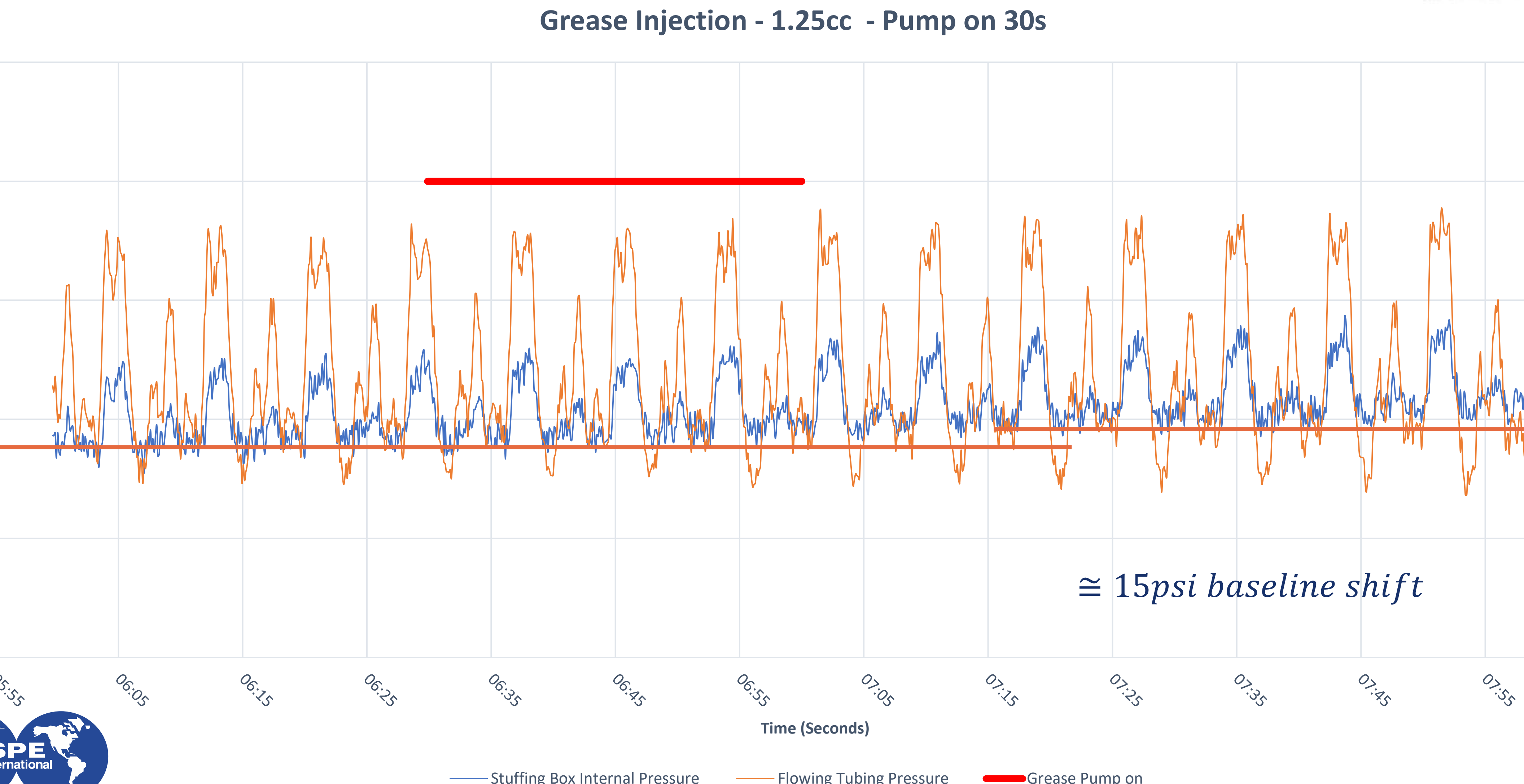
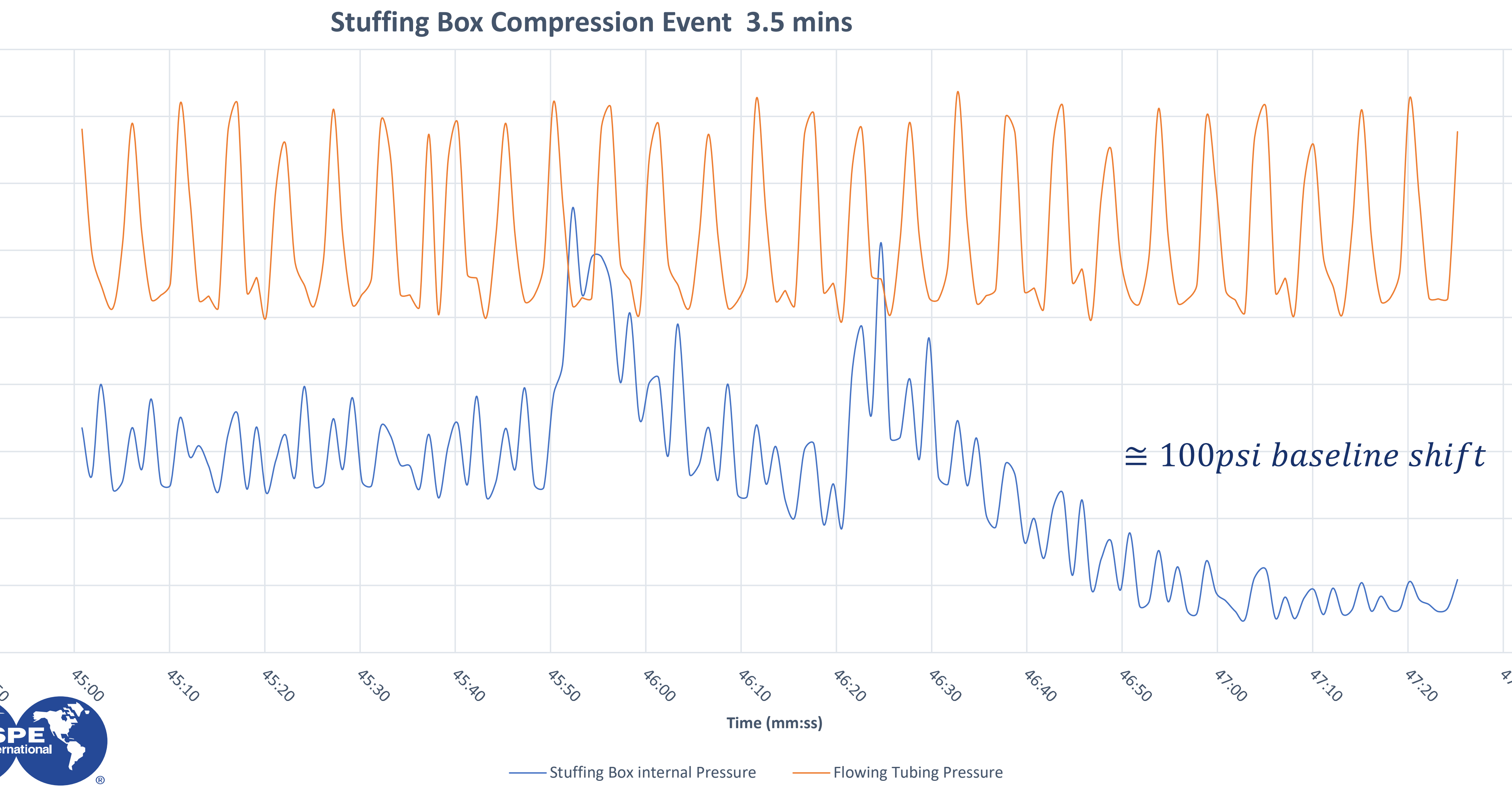


nal" Stuffing Box Pressure – Grease event



uffing Box Compression Event



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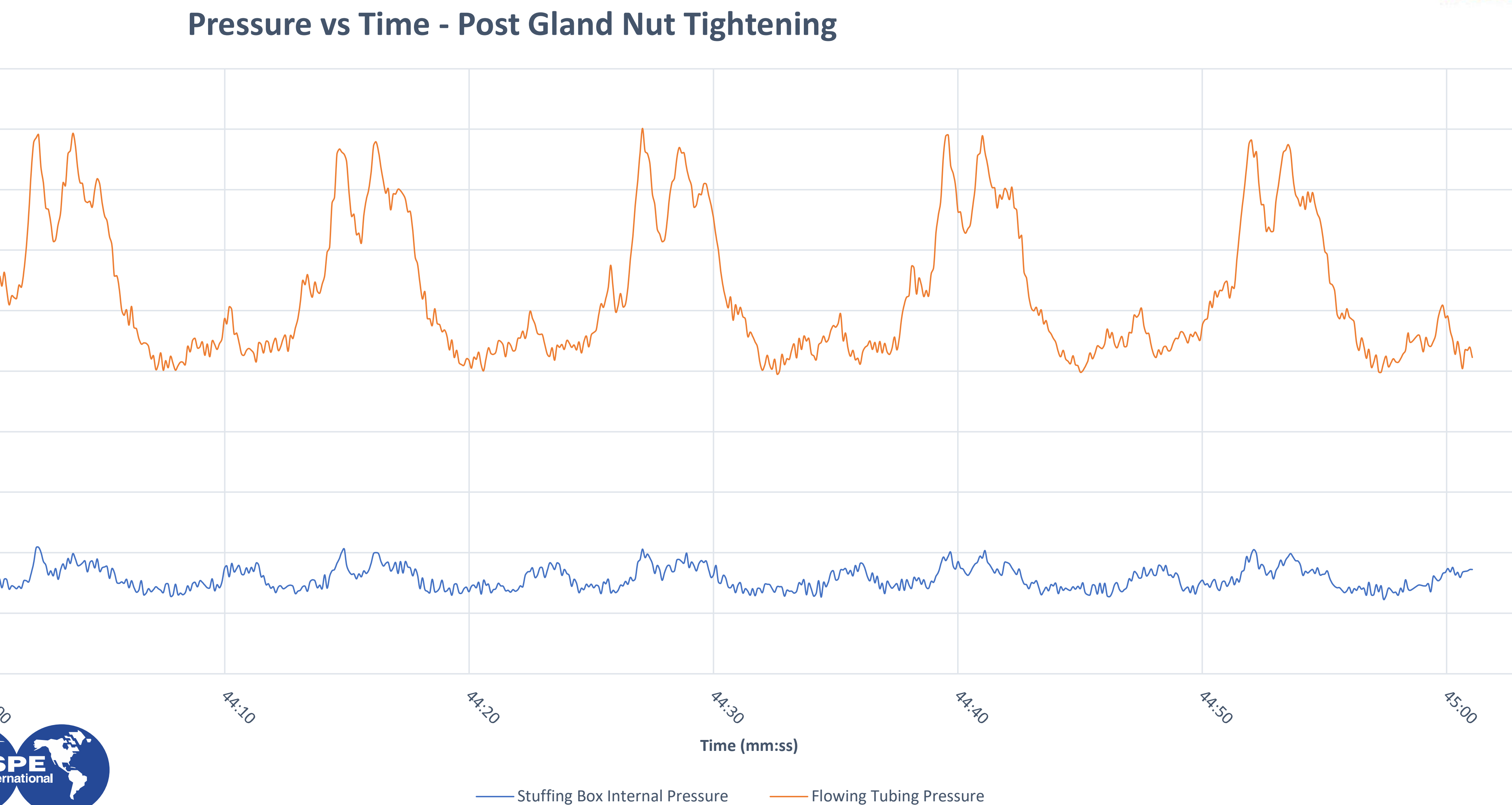

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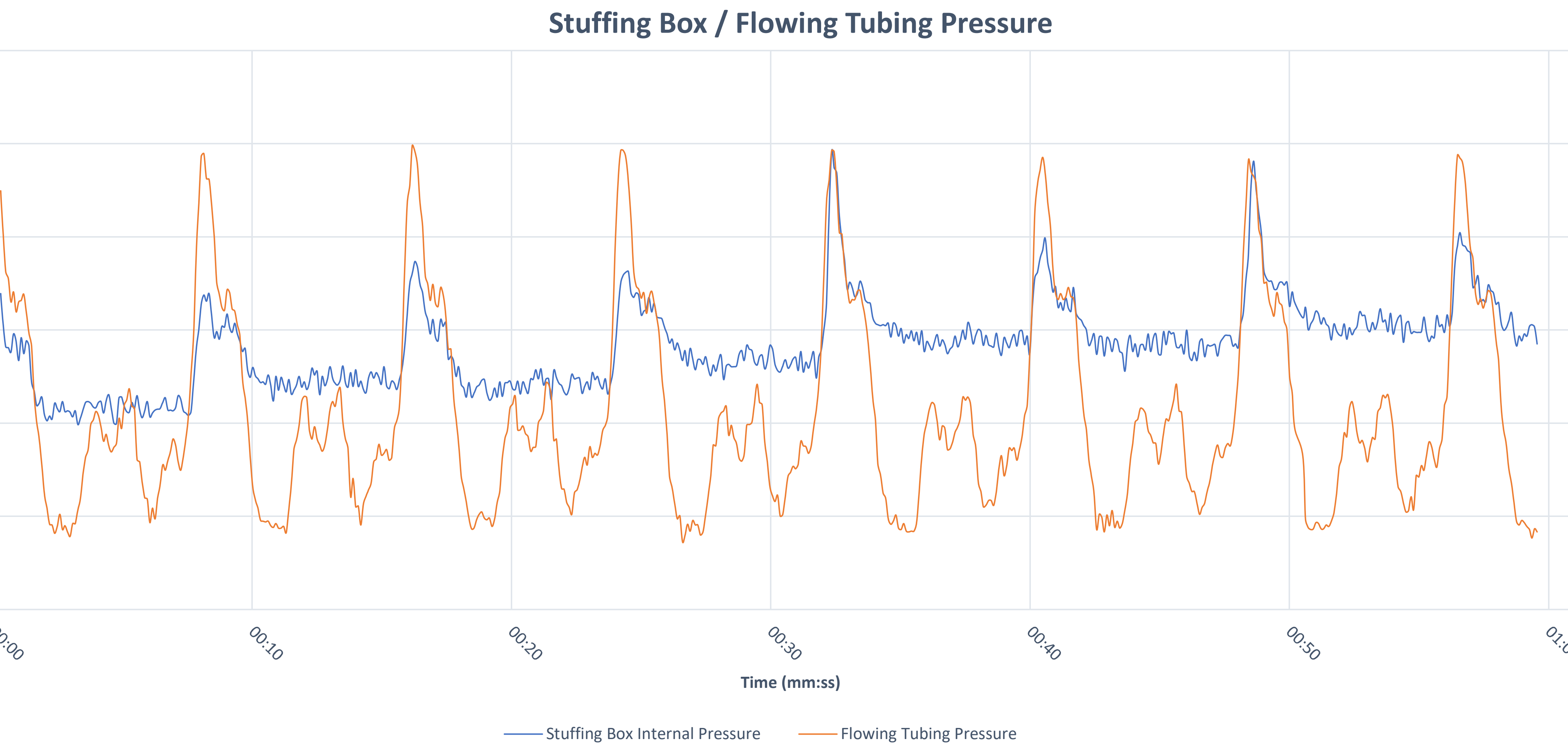
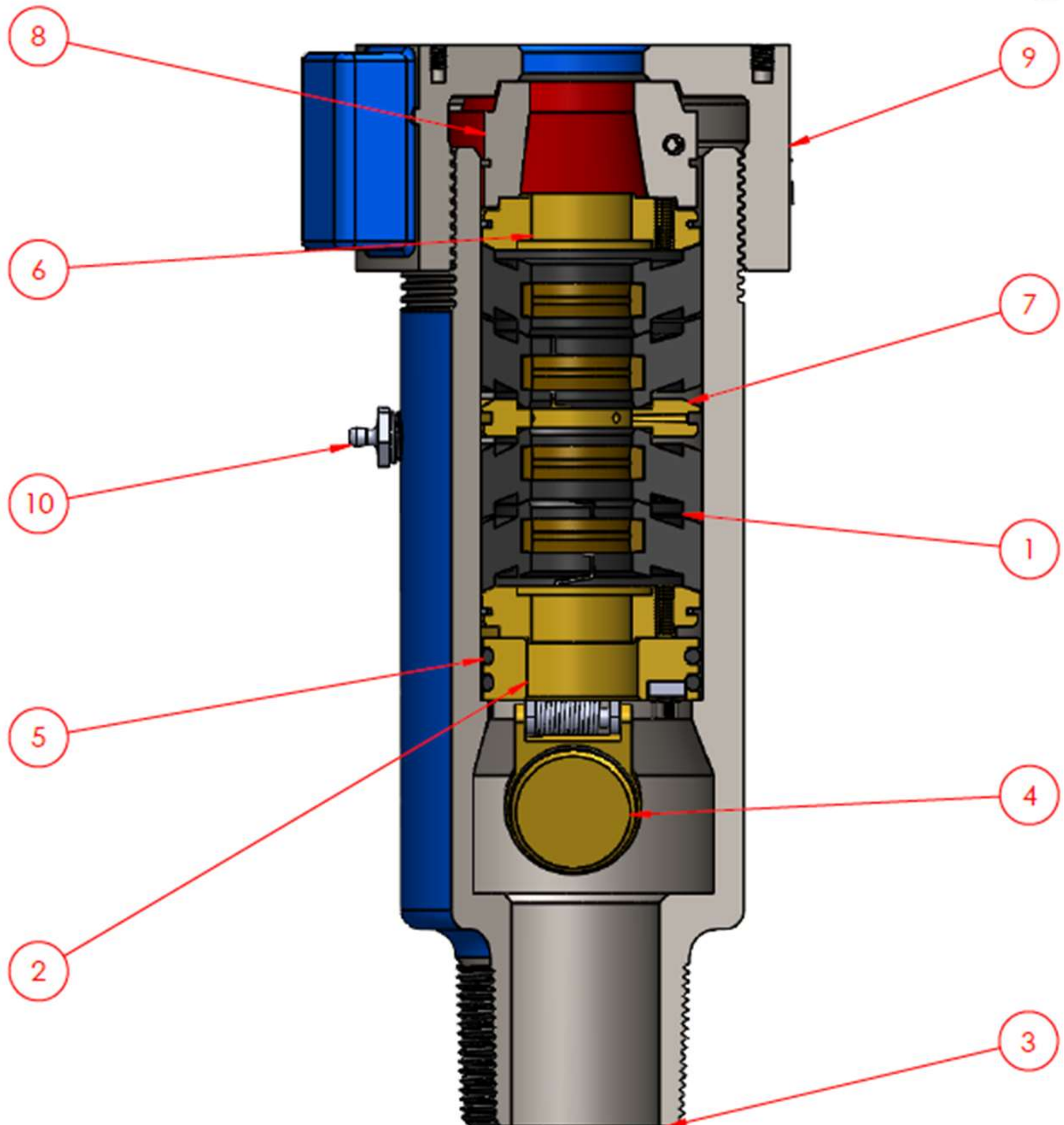


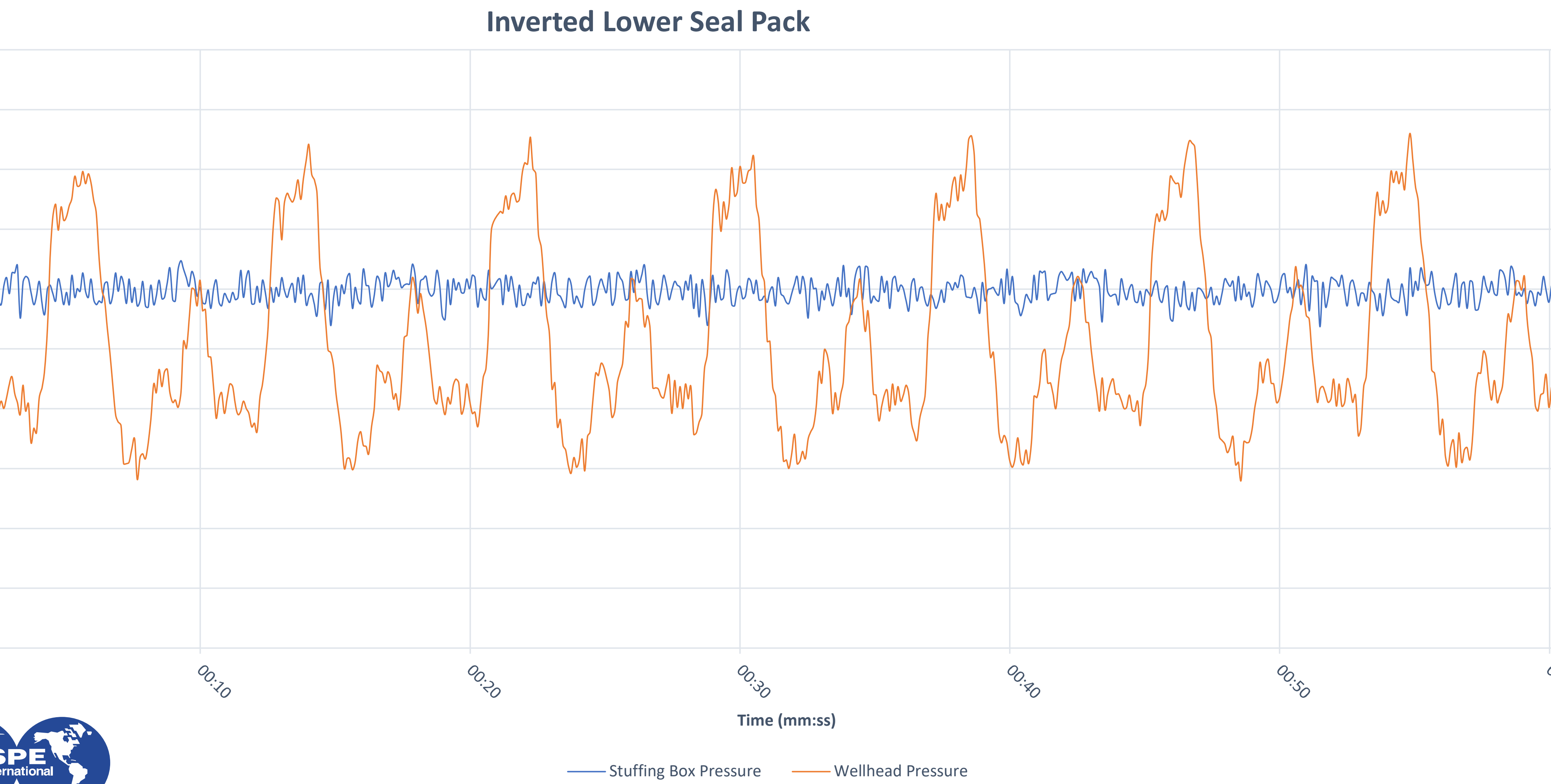
uffing Box w. Inverted Lower Seals

- xperiment!
- ower Seal Pack inverted (#1)
- equires grease pressure to seal



Courtesy of WSI Inc

Stuffing Box with Inverted Seals Pressure Response

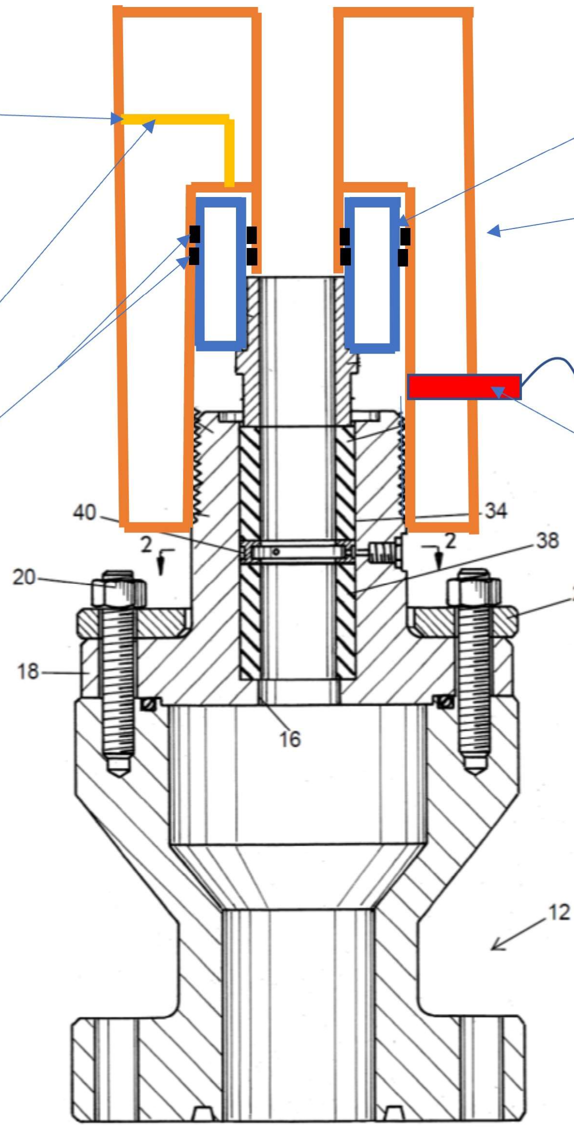


ngoing Research & evelopment

- More Data
- More Wells
- Dial in grease injection
- Build parameters for condition-based monitoring
- Training dataset for ML

utomatic Stuffing Box Compression system

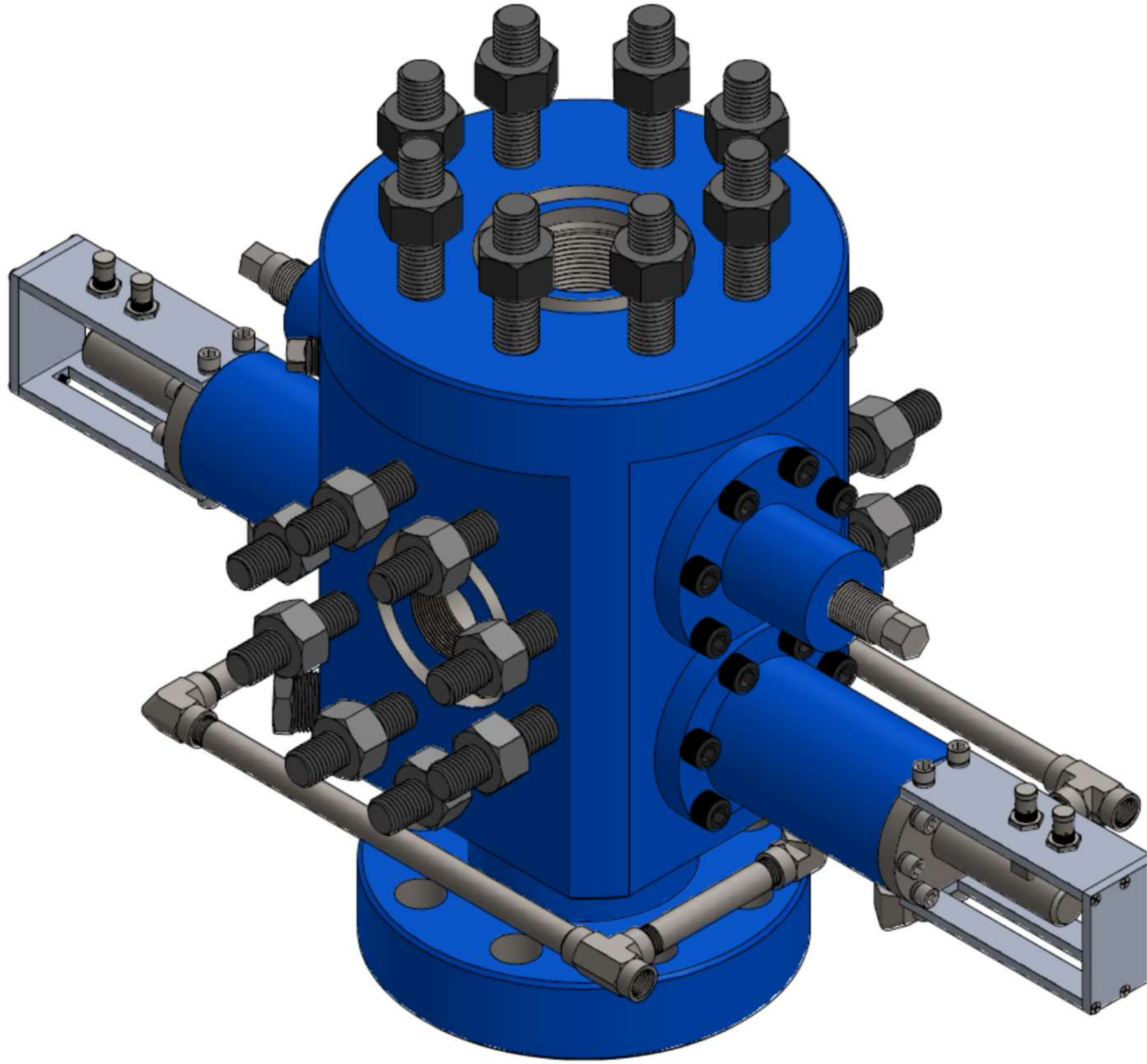
- Powered by the stuffing box grease system
- Distribution valve allows grease to be pumped into the cylinder, pushing piston down
- Used precise quantity of grease to control pressure on seals
- Use Stuffing box pressure response to determine when to energize
- Iterate sequence until SB / FT pressure profile indicates adequate seal engagement



utomated BOP for Rod Pump Applications

ope

- tial requirement for Urban and Watercourse otection
- event of unexpected pump shut off, tomatically close the BOP
- ust close in event of power loss to pump
- ust not close on moving polished rod
- ust not open with pressure in the well
- the event on high well pressure, must signal C to shut in, then close BOP (Frac hit otection?)
- sy integration with existing POC and uipment
- mmunicate status to onsite SCADA (if plicable)
- lar Powered?



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ototype

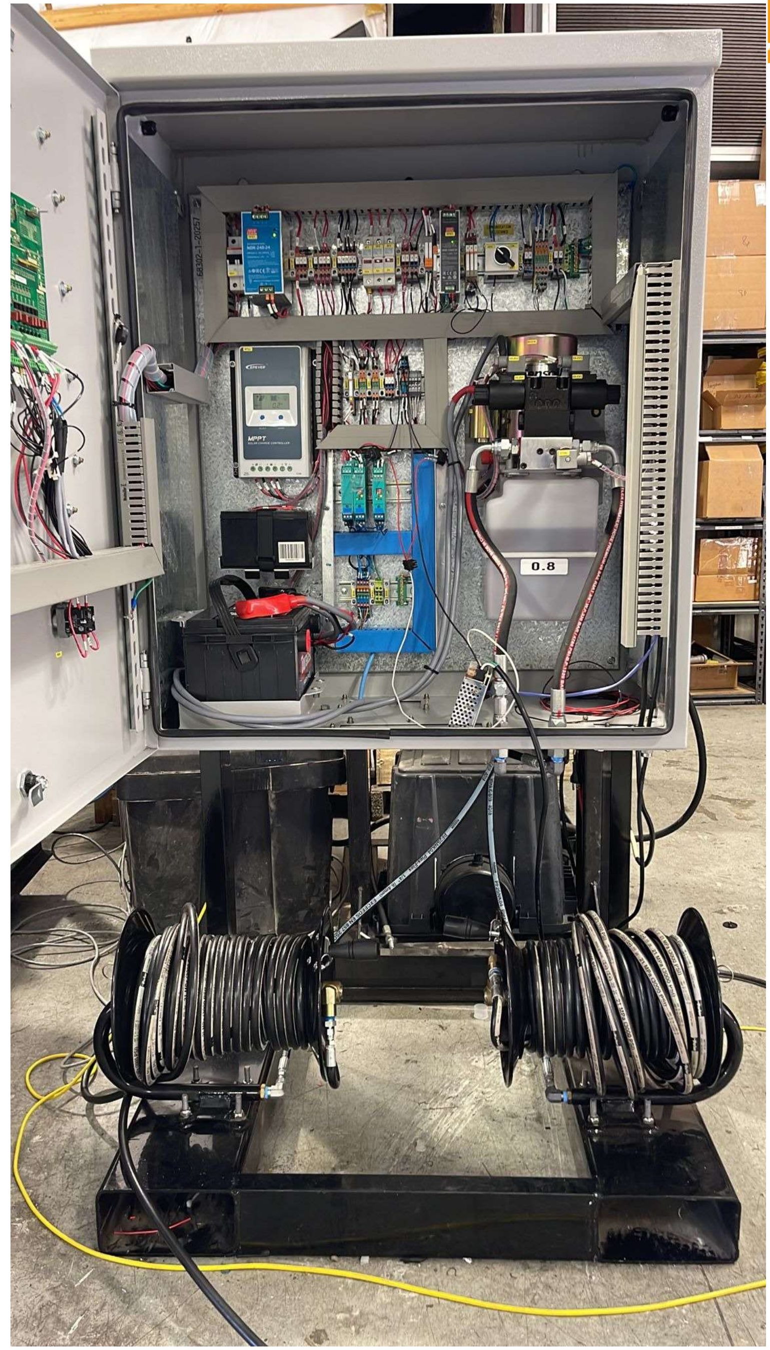
- Reconfigured Electrohydraulic panel
- Integrated Solar Charge System and Battery
- Microprocessor controller
- Hydraulic Hoses (for prototype only)
- Sensor and communication cables

ototype

Modbus RS485 read only communications
Primary integration via permissive relays

24v Permissive to panel for ESD from facility
24v Permissive to panel from POC

N/O relay to POC on BOP close
N/O relay to POC on high pressure*



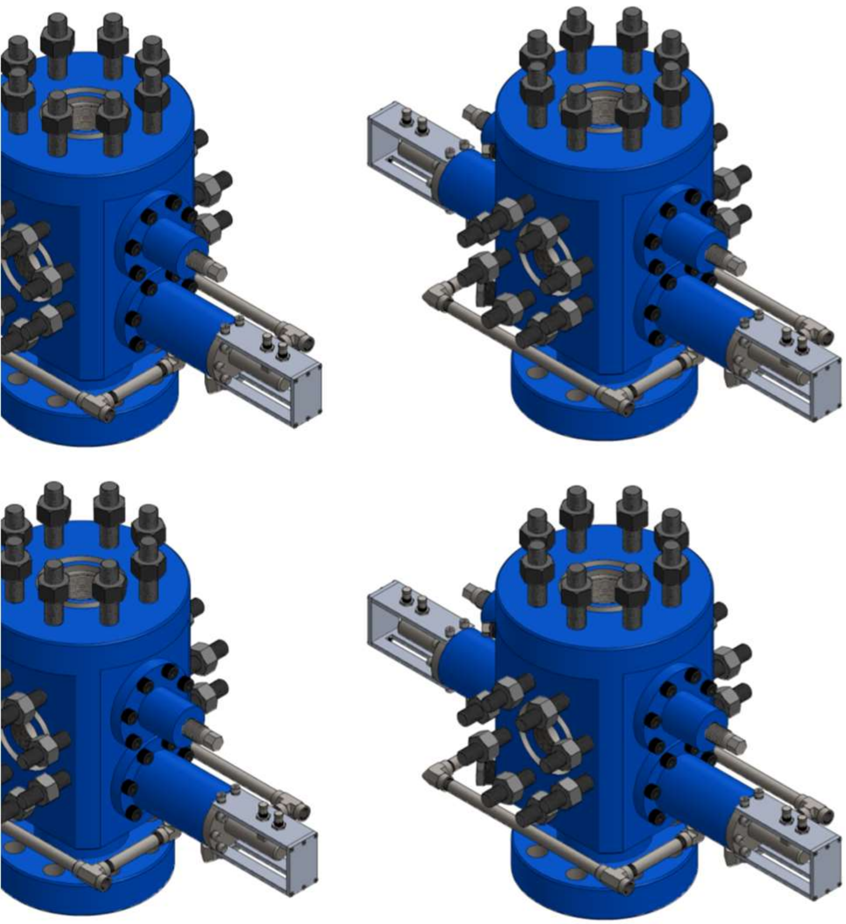
sure threshold set via internal controller

ench Test

- Ex ia Proximity sensors for ram open / close confirmation
- Ex ia Pressure transducer installed below lower rams to monitor well pressure and trigger safety interlock
- Multiple safety interlocks in event of equipment damage

Field test planned for Q4

P Automation R&D



Integrate with Auto Stuffing Box

Frac Protect protocol

– Close BOP, pressure up on Stuffing Box Compression cap to provide additional sealin

Scale – multiple wells from single panel

Summary

- Wellhead systems are overdue for automation
- Simple, cost-effective solutions will become the norm
- Effective Automation can improve uptime and reduce downtime
- Preventative maintenance rather than exception repair wins

Thank you – Questions?

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