

EuALF – European Artificial Lift Forum

Aberdeen Exhibition and Conference Center

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Plunger Lift: SCSSSV Applications

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Plunger lifting: background

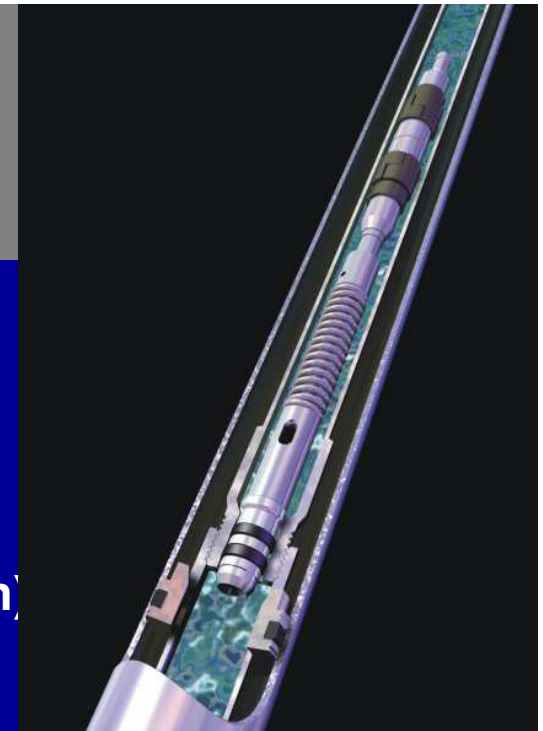
- Need for effective de-liquification of mature wells with SCSSSV within NAM
- Current plunger technology is used worldwide to efficiently unload LL wells
- More gains than normal Pressure Build Up due to automatic cycle and efficient unloading
- Cheaper than other de-liquification methods
- New plunger technology designed to mitigate for tubing ID restriction

Safety valve (obstruction)

Plunger cycle

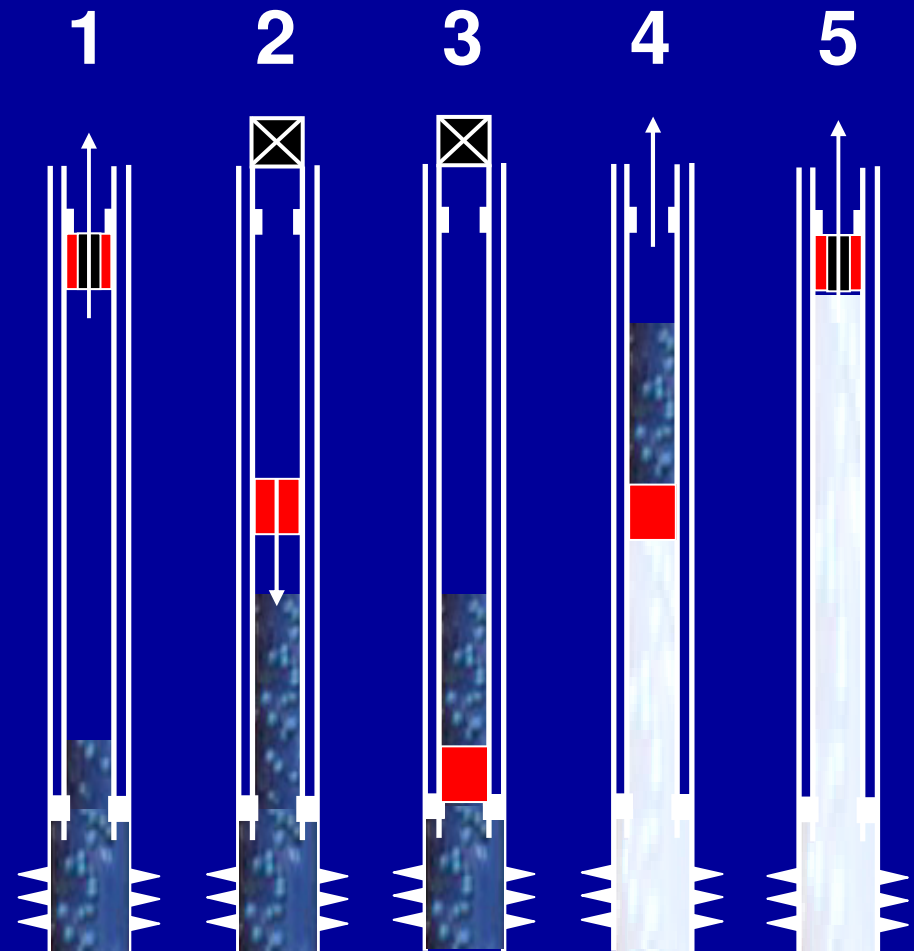
Lowest plunger running depth

Significant liquid hold-up in tubing



Plunger lifting below subsurface safety valve: operating cycle

1. Liquid Loading
 - Plunger hangs in open position under SSSV
 - Liquid in liner+tubing builds up
 - Flowrate declines
2. Shut-in
 - Well automatically shuts in (ROV)
 - Plunger falls
3. Shut-in build-up
 - Plunger reaches bottom and closes
 - Short build-up
4. Unloading (plunger travel)
 - Well automatically opens (ROV)
 - ΔP lifts plunger+liquid in closed position
5. Flowing well
 - Plunger hangs in open position under SSSV



Plunger lift design: SafetyLift System Components

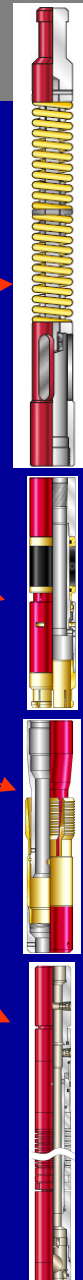
The SafetyLift System is comprised of four major components:

- **Bottom Hole Assembly**
- **Plunger**
- **Upper Landing Assembly**
- **Remote operated valve with Controller Unit**

Plunger lift design: SafetyLift System Components

Bottom Hole Assembly

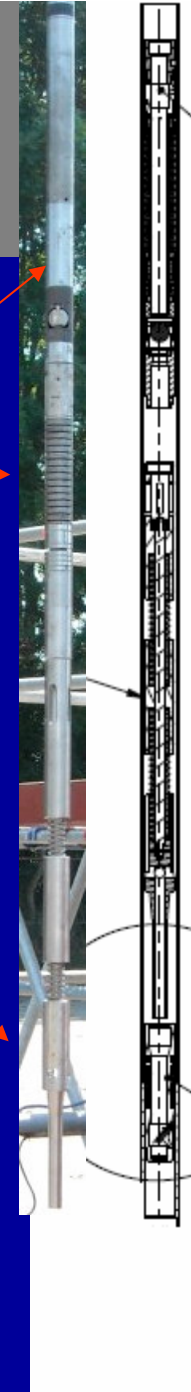
- Standard Double Bumper Spring
- G-PackOff-Optional
- Type 'A' Tubing Stop
- MP-1 Standing Valve Optional
- Installed using standard wireline procedures
- Installed at a pre-determined depth in relation to the well perforations



HOW: SafetyLift System Components

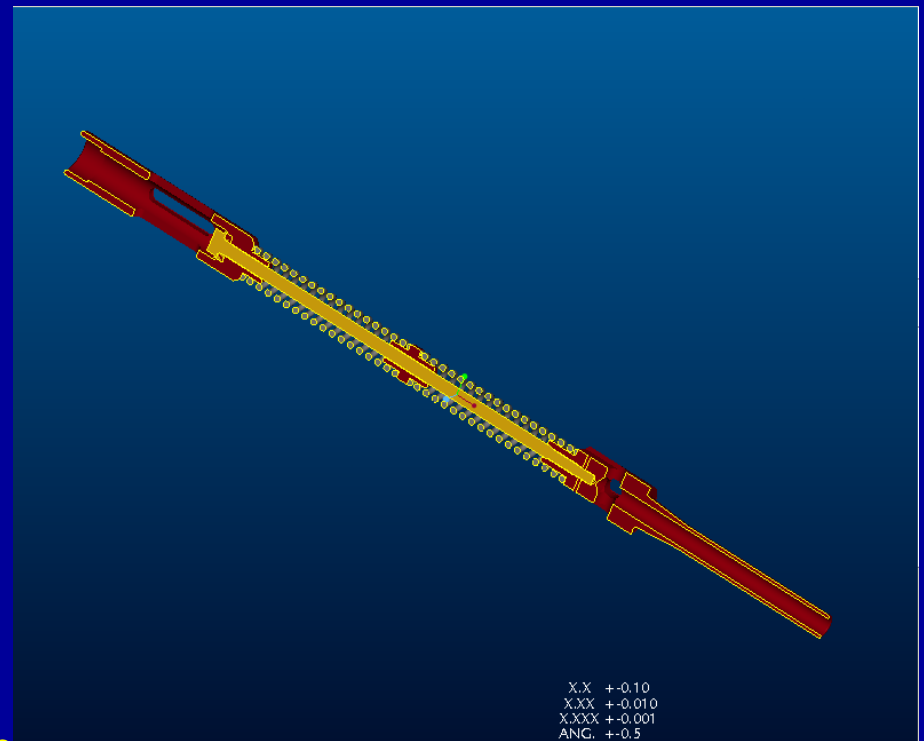
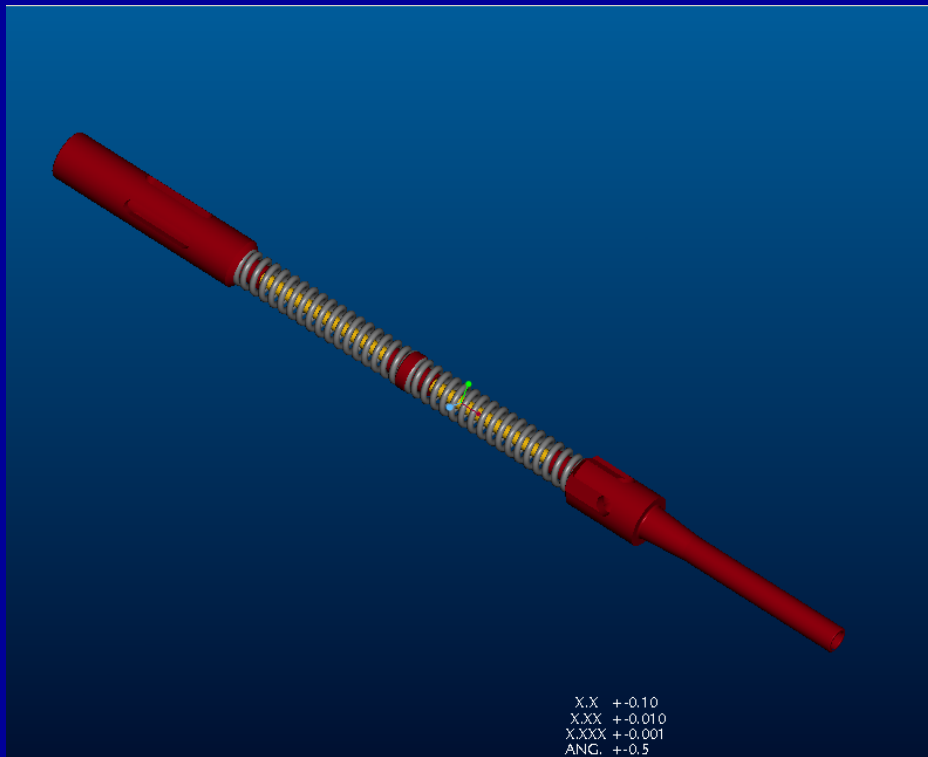
Final Upper Spring Design

- MP-1 Standing Valve threaded directly to tubing retrievable SSSV
- Inverted Bumper Spring designed for SafetyLift™ plunger.
- Installed directly attached to SSSV in one run.



HOW: SafetyLift System Components

New design Upper Spring Assembly



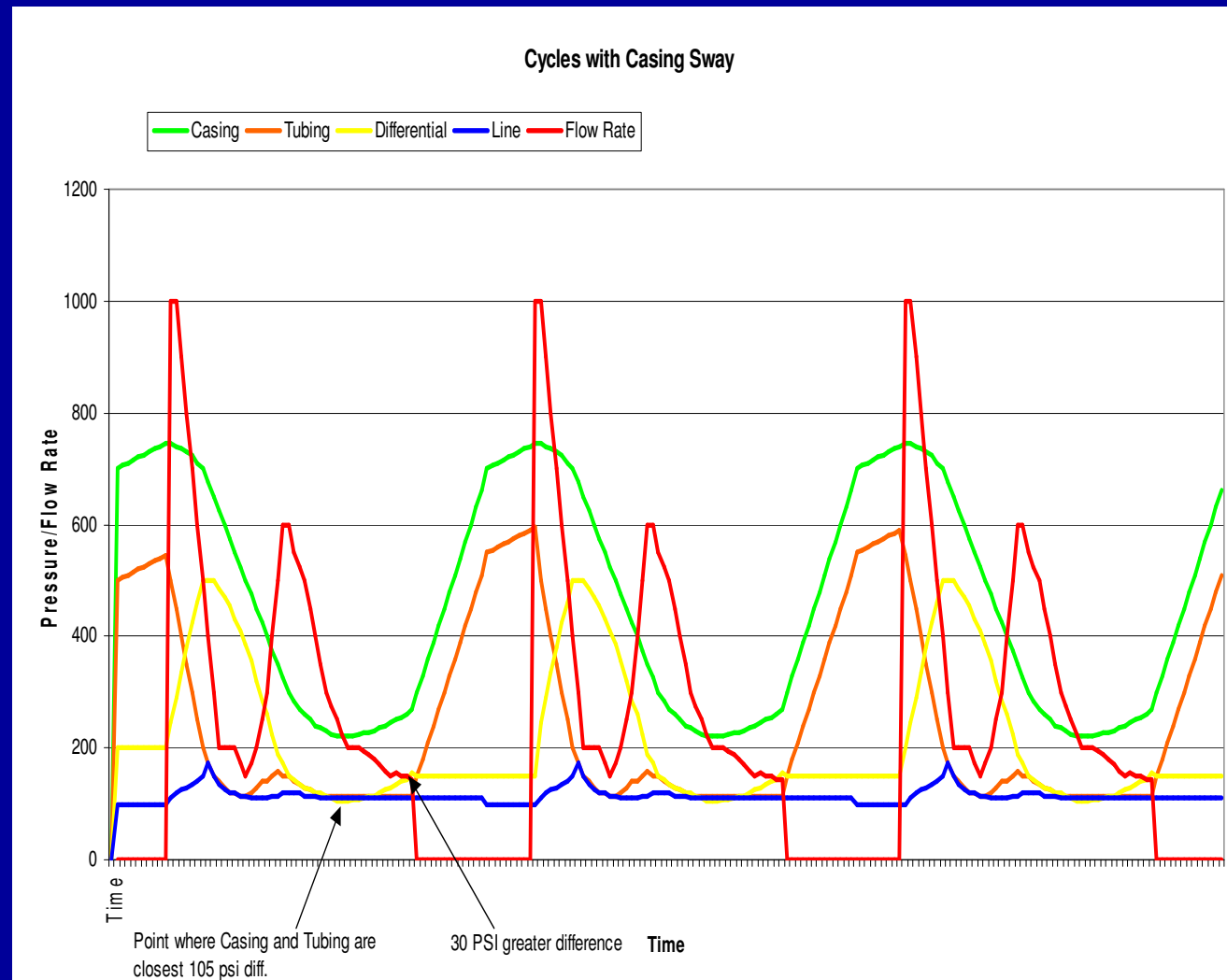
Plunger lift controller: SafetyLift System Components

Controller

- Control system to determine plunger arrival in upper assembly:
 - Flowing THP, system pressure and flowrate measured
 - Typical peaks in signals identified and arrival determined



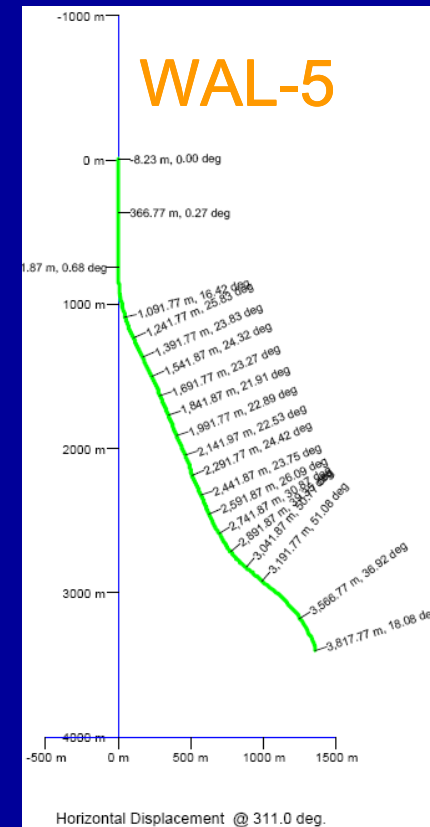
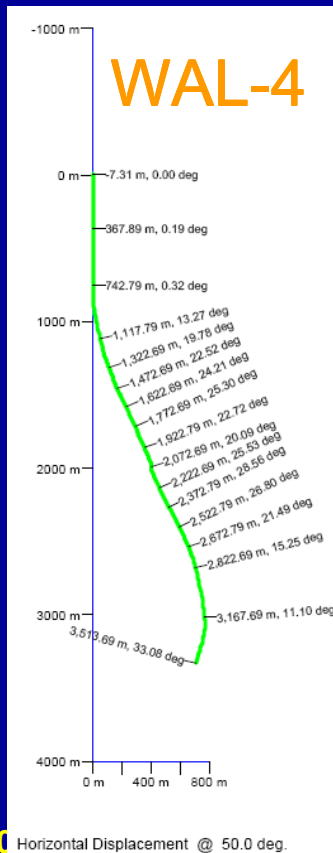
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Plunger lifting below subsurface safety valve: First Field Trials

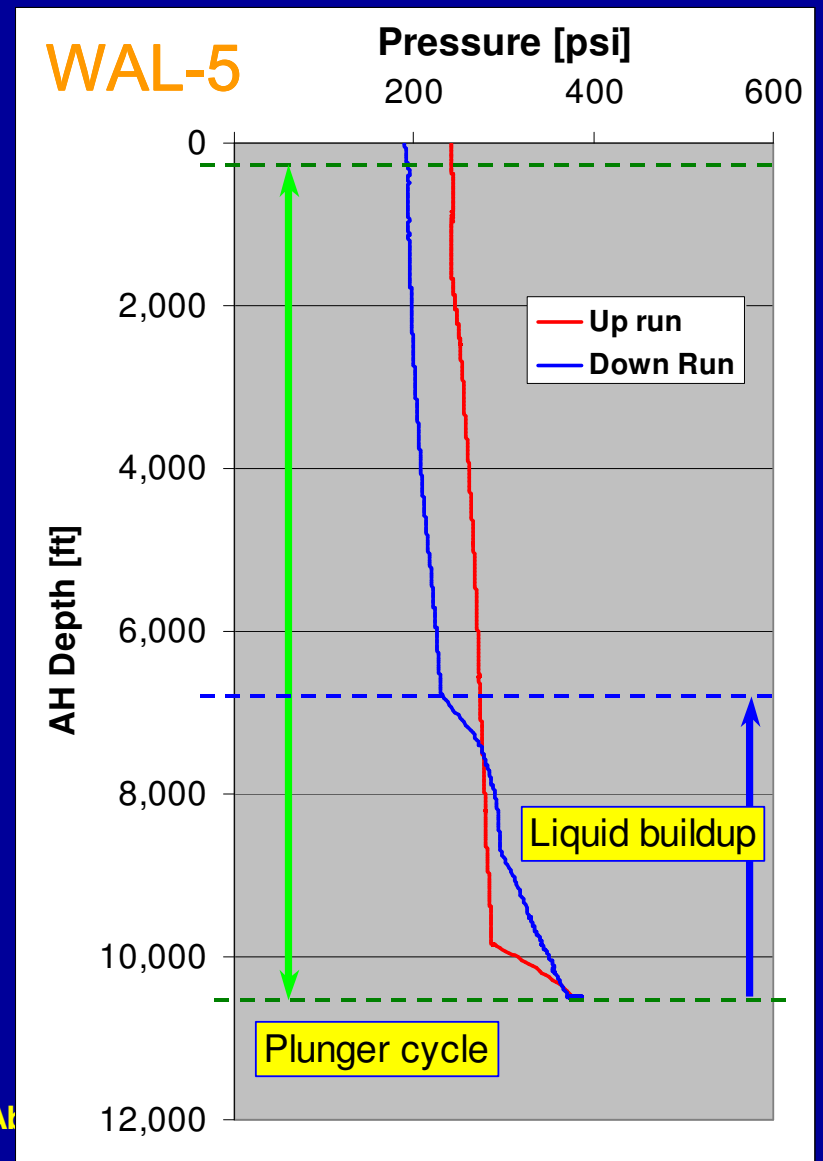
- Plungers collapse to install below landing nipple safety valve (2.75” minimum ID, expand to 2.922” tubing ID)
- Two 3½” wells selected for first trials with tubing loading problems (diagnosed with FPGs & acoustic logging)

Well paths



Tubing Loading: WAL-5

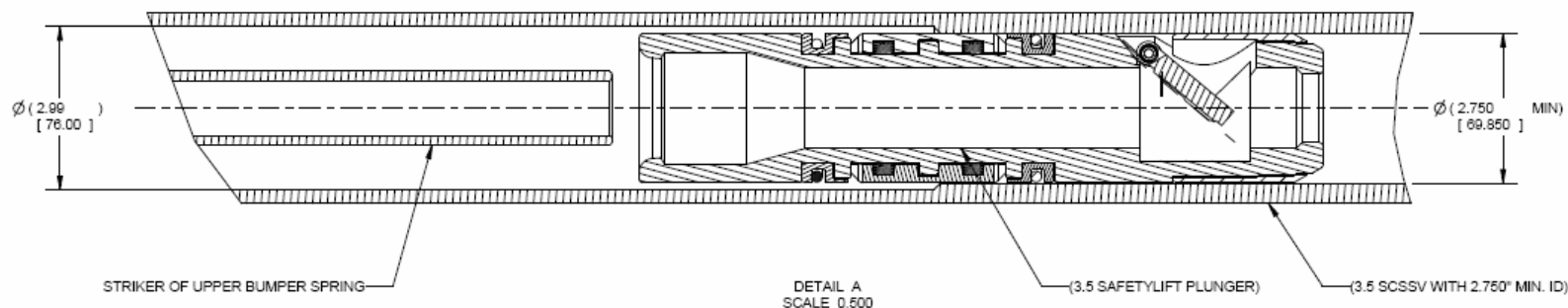
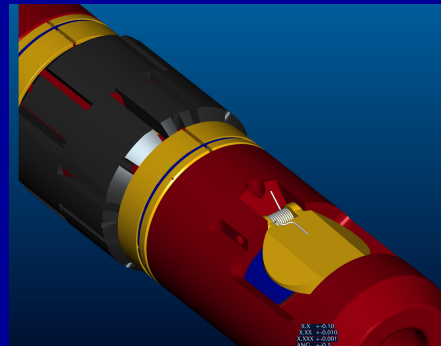
- Flowing pressure gradient (down) followed by SPG (up) shows clear signs of tubing loading
- Confirmation that a plunger can unload liquids from bottom up to SCSSSV
- Liquids drain very fast in the fractured carbonate reservoir: Need standing valve to catch liquids so plunger can be effective



WAL-4/5 plunger lift installation

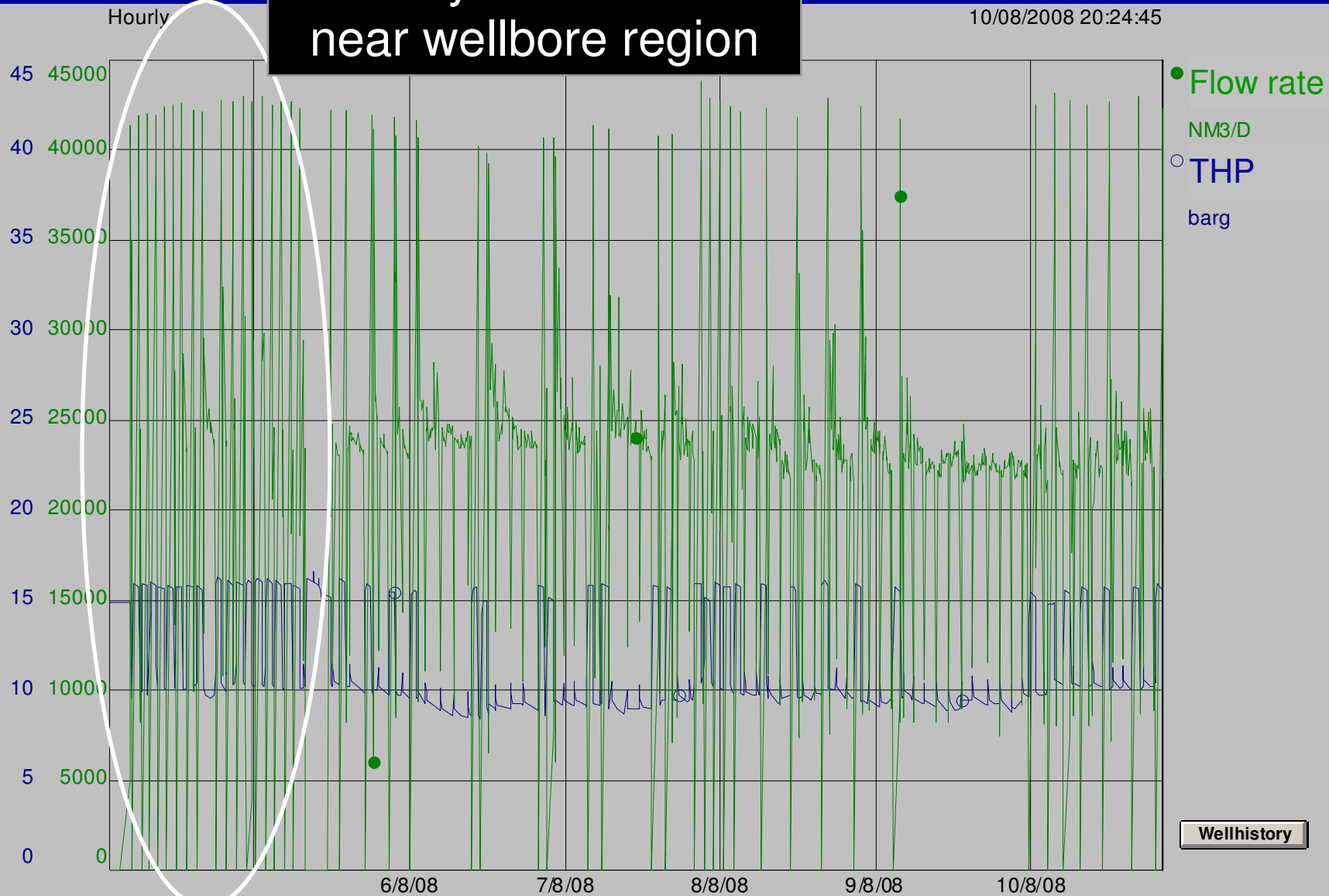
Patented Padded SafetyLift™ Bypass Plunger

- Body Components machined to drift through 2.750" diameter of the Safety Valve Landing Nipple
- T-Pad Elements specially designed for increased collapse
- Plunger designed with fewer connections than standard plunger for increased reliability



Results WAL-4, 1st week...

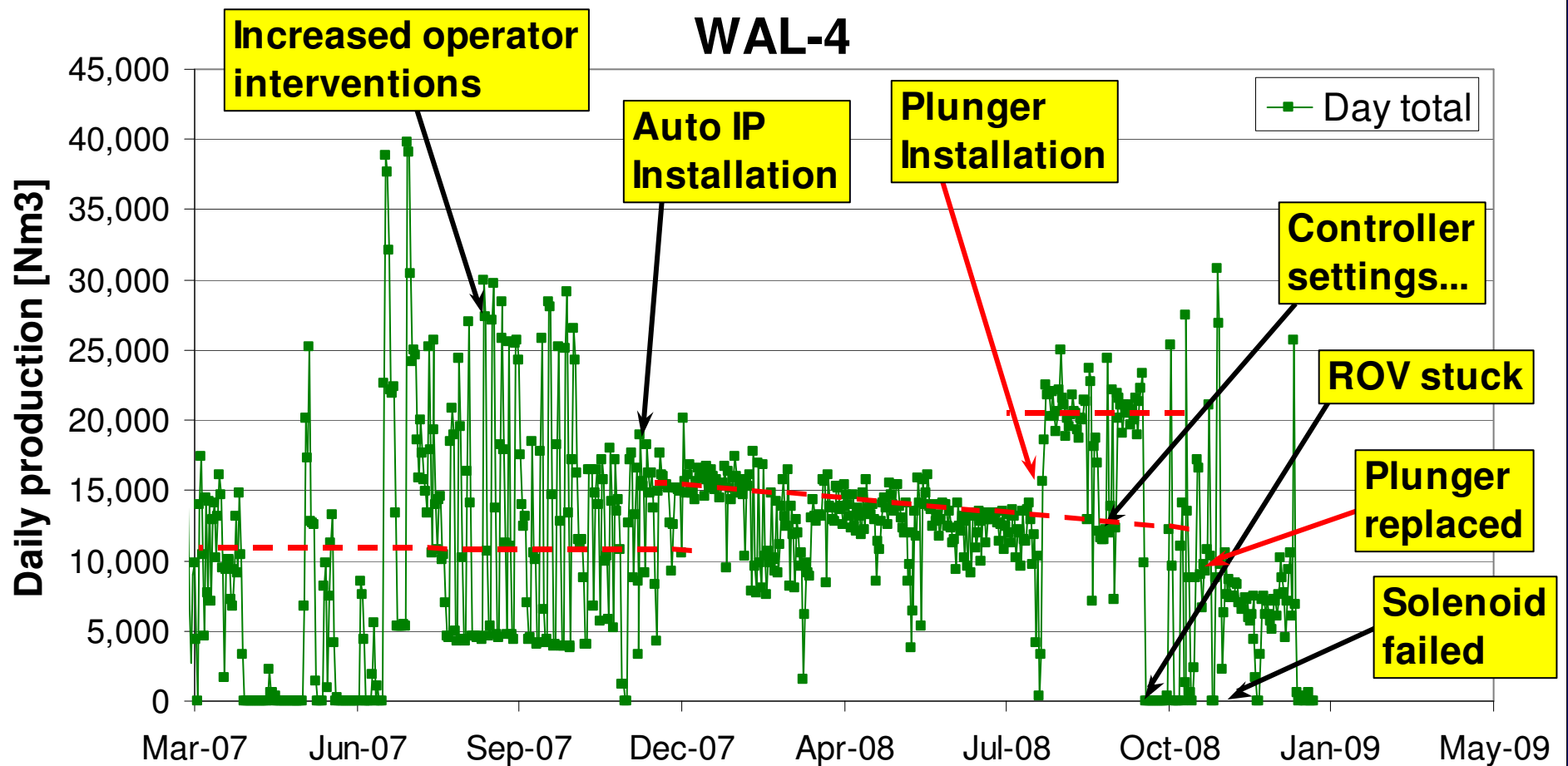
Short cycles to unload near wellbore region



Feb. 1

Results WAL-4

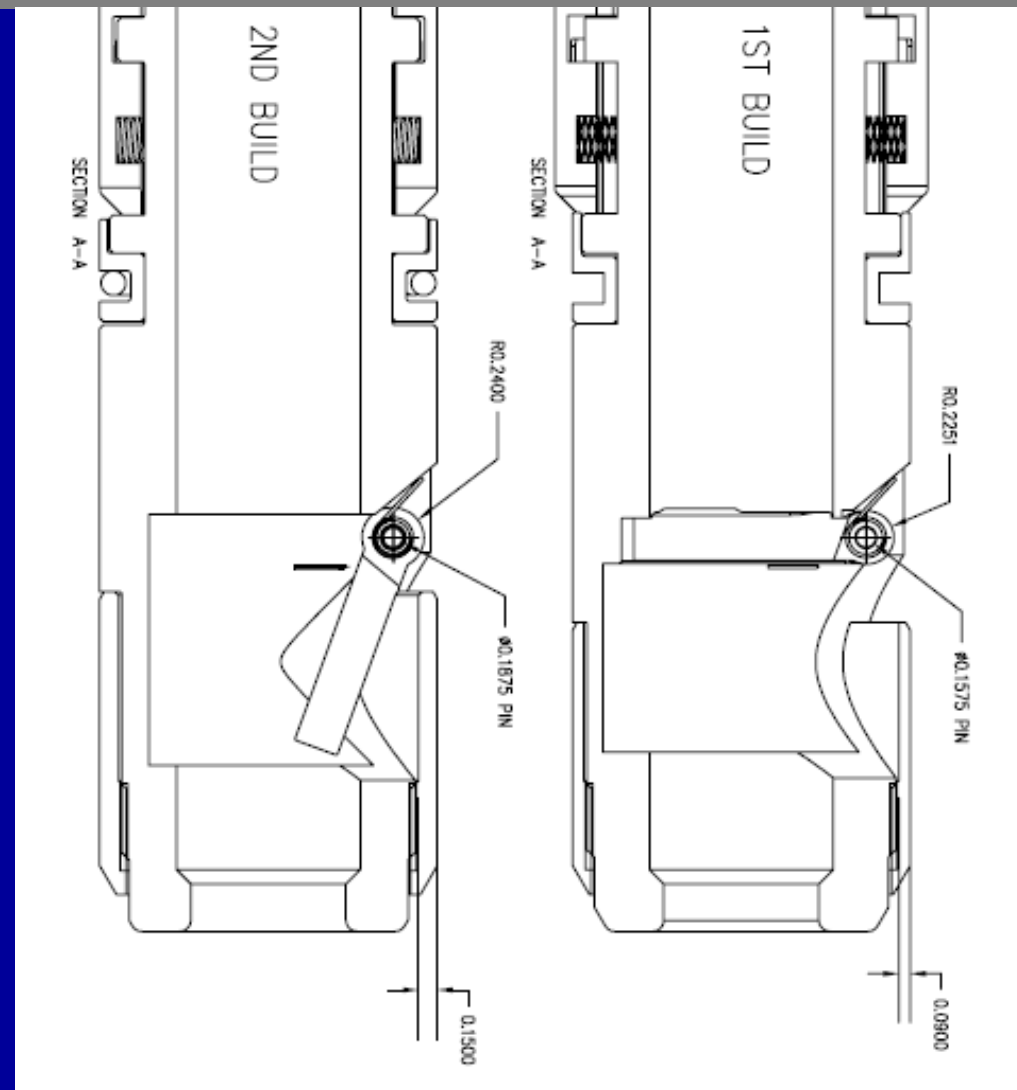
- Production from 12,000 to 20,000 Nm³/d [700 Mcf/d] after 1st installation
- Trouble-free operation, 500+ cycles before first replacement Nov '08



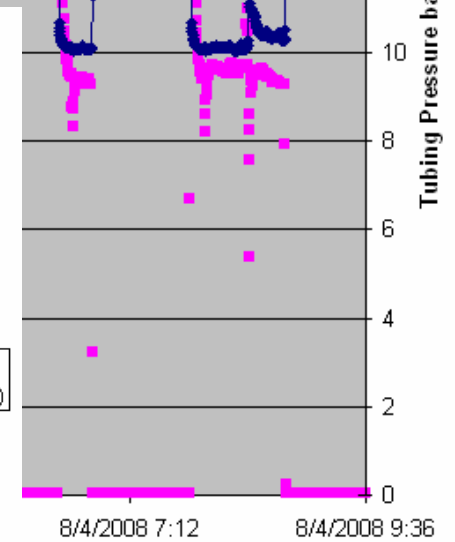
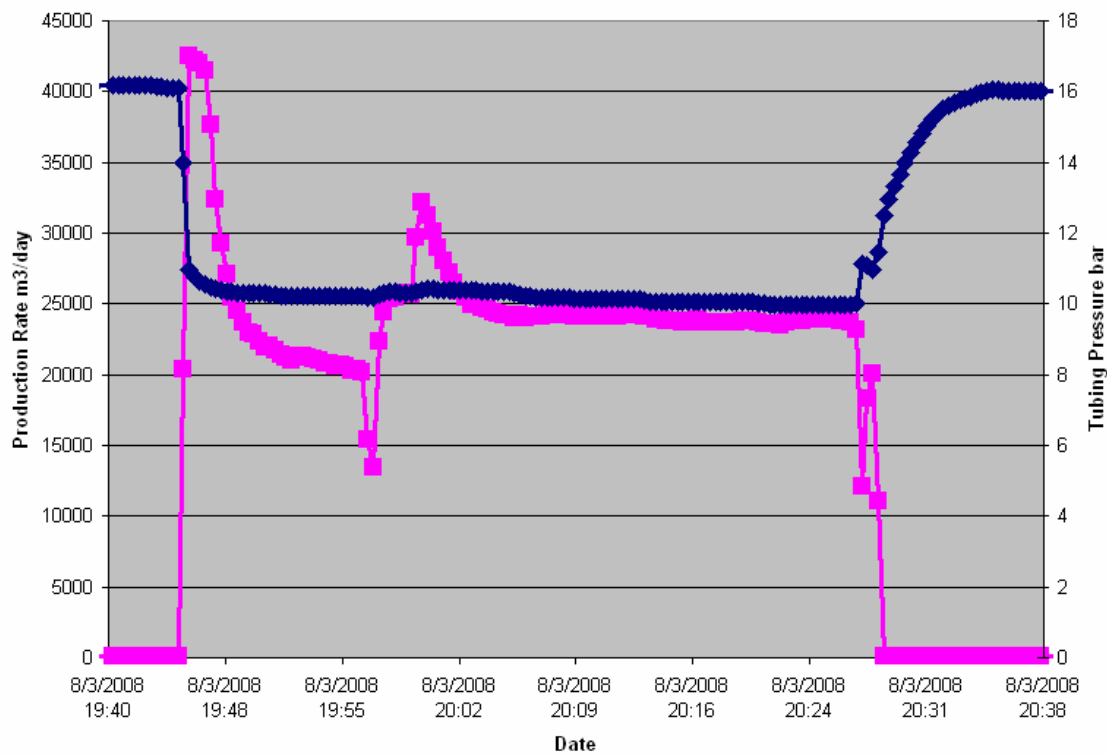
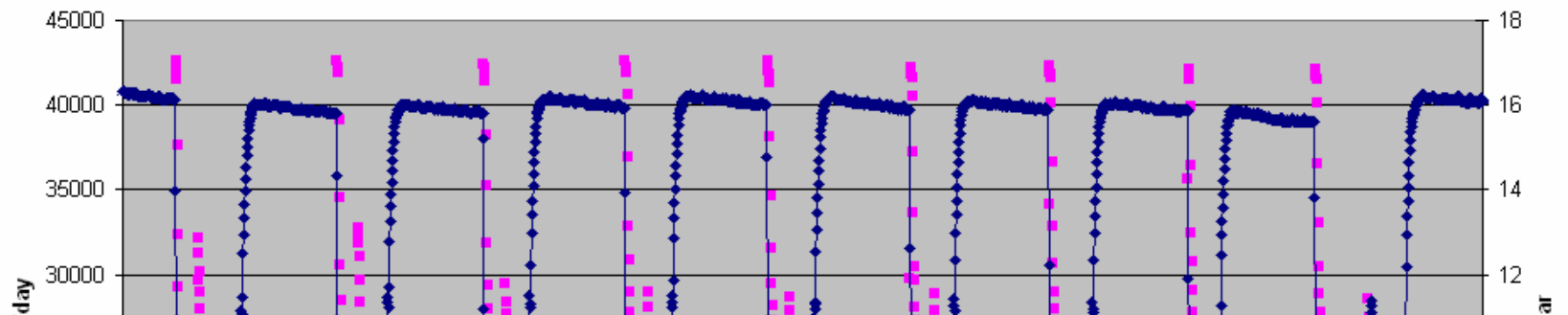
WAL-4/5 plunger lift installation

Improvements for New Design

- Increased Pin Diameter with calculated improvement to impact strength of 42%
- Increased width of protective sleeve for high speed impact protection.
- Tightened Tolerance in plunger body ID for pin for minimal movement during impact.



Production Cycles



Conclusions & Way Forward

- **Field evidence that plunger design works.**
- **Re-designed plunger to improve impact resistance of internal flapper. To be installed in both wells (Q1 09) after confirming suitability based on recent experience**
 - Update – Reinstalled, successful in operation for 4 months before failure.
- **Follow-up installations: 2 new wells in Q1 2009 & 1 in Q2**
 - Update – Implementation issues, continued focus to install.
- **Offshore implementation once plunger reliability has been proven (due to higher cost of interventions)**

SafetyLift System



QUESTIONS?

