Downhole Pressure Measurement

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Downhole Pressure Measurement

Methods commonly used in ExxonMobil US Operations (onshore and offshore)

- Chamber Pressure Gauge
- Company Operated, Truck Mounted BHP Unit
Downhole Pressure Monitors

- Gas filled pressure chambers (Halliburton PTS) have been in use at SYU (Offshore California) since 1984 (Hondo Platform) & 1993 (Harmony & Heritage Platforms)

- Have installed over 60 downhole pressure gauges

- Installed in all new drillwells unless not mechanically feasible (eg. dual strings or ESP’s)
ExxonMobil SYU Project Overview
Offshore California, US

- **Starting Dates**
  - Hondo Platform 1984
  - Heritage & Harmony Platforms 1993

- **Installation Types**
  - Chamber Pressure System 60
  - Chemical Injection 46
  - Subsurface Safety Valves 86
  - 1” Diluent Tube 9

- **Maximum Installation Depth** 19,400 ft

- **Failures (Chamber Pressure System)** 1
  - Kinked capillary line on installation
Gas Lift Optimization Using Downhole Pressure Monitors

• Downhole gauges measure pressure at depth real time.

• Changes in gas lift injection rates and/or viscosity reducer result in changes in gauge pressures associated with changes in liquid production rates, enabling real time production optimization.

### Gas-Lift Rate

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<thead>
<tr>
<th>Rate</th>
<th>Start Date/Time</th>
<th>End Date/Time</th>
<th>Duration</th>
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<td>1/27/04 9:07:50 AM</td>
<td>6.91 Day(s)</td>
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</tr>
</tbody>
</table>

### BHP

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Start Date/Time</th>
<th>End Date/Time</th>
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<td>875 PSIG</td>
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<td>825 PSIG</td>
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</tbody>
</table>

### Gas Lift Rate

- 1.4095 MSCFD

### BHP

- 890 PSIG
Pressure Transmission System (PTS)

No Electronics        No Moving Parts
SYU Typical Installation

Surface Equipment
Real Time Pressure Read-out

1/8” Capillary Tube (Pressure)
1/4” Safety Valve Tube
3/8” Chemical Injection Tube

Chamber
Internal Sensing
Chamber Design

Capillary Tubing

Ports are on the inside tubing of the chamber.
Chamber Gauge Operation

- Helium gas is used to transmit pressure from chamber to surface.
- Surface pressure is corrected for weight of the gas and temperature effect to calculate gauge pressure at depth.
- Gas is injected down capillary at the surface until surface pressure begins to decrease indicating that system is full of gas from chamber to surface. Any excess gas escapes into the tubing.
- At that time, injection is stopped: Surface pressure + Wt. of gas corrected for temperature = Gauge pressure at depth
- Subsequent changes in surface pressure indicate changes in pressure at gauge depth.
Other Chamber Gauge Information

- System should be periodically purged, leak checked and transducer checked.
- Accuracy depends upon transducer calibration, and estimated or measured downhole temperatures.
- System is suitable for harsh environments
  - Temperature > 800F (425 C)
  - Corrosives – chamber metallurgy same as tubing + SS capillary tube
  - Vibration resistant
- Check System Integrity From Surface
  - Transducers and data recording devices can be checked from surface without well intervention
  - Chamber integrity can be checked without system retrieval

For more information on Halliburton PTS, contact: rick.pruett@welldynamics.com
Single Operator, Self-contained Truck Mounted BHP Unit
EMPC/USP Onshore BHP Operations

- Managed and scheduled by Subsurface Engineering Artificial Lift Team
- Two Operators, Two BHP vehicles
- One man operation*
- Wireline BHP Acquisition using Amerada and memory gauges
  - Static (Shut In) pressures
  - Pressure Buildup testing
  - Flowing Pressure Traverses
  - Tag Fill
- Echometer diagnostic equipment
  - Fluid Levels
  - Pressure Buildup data collection
* use two man crews when working in H2S fields or remote locations with unreliable communications.
Self-contained Truck Mounted Units

• USP BHP Operations
  – Over 25 years operating company wireline equipment
  – Run 500-700 Pressure surveys/year

• BHP Tools

• Benefits
One Man Operation

- Custom built design based on prior learnings (i.e., Crane, platform, etc.)

- Sliding platform eliminated need for ladders/climbing and improved safety.

- Hand operated crane permits safe one man operation!
BHP Nerve Center
Data Acquisition

1. Specialize in Data Accuracy
2. Use Recommended RP 11V5 guidelines
3. Trained Expertise & Equipment
4. Interact with Reservoir, S.S., A/L, and field, on specific job information
BHP Tools

- EMR – Electronic Memory Recorder
- Computer Software (WellTest 2002/ZipWin Report)
- Microsoft Access BHP Database
- Echometer diagnostic equipment
Welltest Solutions 2002 Graph
Benefits

- Cost Savings
- Reservoir Surveillance
- Artificial Lift Optimization
- Production Troubleshooting
- Viable to production re-designs
- Availability

For more information contact: rodney.k.bane@exxonmobil.com
Questions?