MagLift - A gas well dewatering pump for 2⅜ inch production tubing

Iain Maclean
ZiLift Ltd
magLift  **Linear permanent magnet motor driven rod-pump**

- Unique linear PMM technology
- Economically produce deep, low-rate gas wells;
- Increase ultimate recovery and reserves by de-watering deeper mature wells;
- Rig-less solution – deployed and powered via wireline through tubing;
- Capacity: 100 BPD from 10,000ft through 2\(\frac{3}{8}\)” tubing;
- Integrated downhole monitoring
- An ideal choice for an improved environmental footprint
MagLift system

Low installation costs
- Wireline deployed through tubing
  2½” OD tubing is predominant
- Downhole assembly 1.8” OD max

Fully deplete reservoir (max. design depth 3,000m)
- Hydrostatic pressure up to 5,000psi
- Lift rate up to 100bbl/day
- Reservoir temp. up to 120°C

Reduced power consumption
- Permanent Magnet Motor

Low maintenance
- 2 years plus operational life without intervention
## System components

<table>
<thead>
<tr>
<th>Surface equipment</th>
<th>▪ VSD, transformer and filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wellhead Interface</td>
<td>▪ Cable Hanger</td>
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<tr>
<td></td>
<td>▪ Cable penetrator and cable connector</td>
</tr>
<tr>
<td>Downhole Wire Line Cable</td>
<td>▪ Armoured cable with power lines and monitoring communication</td>
</tr>
<tr>
<td>Cable Connectors</td>
<td>▪ Compact dimensions, electrical and strength requirements</td>
</tr>
<tr>
<td>Monitoring</td>
<td>▪ Custom designed and built PCBs</td>
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<td></td>
<td>▪ High temperature components</td>
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<tr>
<td>Positioning Electronics</td>
<td>▪ Position sensor</td>
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<tr>
<td>Pressure Compensation</td>
<td>▪ Pressure / volume compensation piston</td>
</tr>
<tr>
<td></td>
<td>▪ Dynamic rod seals.</td>
</tr>
<tr>
<td>Motor</td>
<td>▪ Linear permanent magnet motor.</td>
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<tr>
<td>Pump</td>
<td>▪ 1.8” OD rod pump</td>
</tr>
</tbody>
</table>
Downhole assembly

- Proven rod pumping technology driven by a new downhole linear permanent magnet motor

- 1.8" O.D. 49ft (15metres) total length (depending on pumping duty)
Linear motor

- Multiple stator modules matched to power for the required depth
- Oil filled motor is pressure balanced with the well fluid to compensate for thermal expansion

Downhole Linear motor & magnetic rod actuator
Linear Pump

- Pump shaft connected directly to linear motor rod
- Fluid is delivered into $2\frac{3}{8}$ ” tubing
- Pump stings into seal assembly
Downhole monitoring

- Pump inlet pressure
- Pump outlet pressure
- Temperature
- Motor winding temperature
- Vibration
- Motor control parameters
Testing - Linear motor

- Motor performance and control
- Position sensor development

Load profile representing pump force
Scaled to 2750m (9000ft) depth
Continuous running 21 days x 24hrs

Monitoring
- Motor force
- Temp rise

- Motor design confirmed (Jan 2011)
Testing - Seals

Seals Test Rig
• Dynamic Seals
• Pressure compensation seals
6 million cycles achieved

• Seal design confirmed (Nov 2011)
Testing – Flow loop system

- Full System Horizontal Test Rig
- Secure test facility
- Linear motor and pump performance
- Full drive system
- Full pressure and flow capability
- Elevated temperature
- Extended durability proving
- FAT of field systems

- Qualification of system in progress (Feb 2012)
## Early stage test Results

- **1.5m motor module**
- **Achieved to date**
  - 30 BPD
  - Approx. 4000 ft lift
  - Ambient temp 40 °C
- **Plan**
  - Increase pump rate
  - Increase ambient temp

### Extrapolating:

<table>
<thead>
<tr>
<th>Motor length</th>
<th>Depth @ 30 BPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5m</td>
<td>4,000 ft</td>
</tr>
<tr>
<td>3m</td>
<td>8,000 ft</td>
</tr>
<tr>
<td>4.5m</td>
<td>12,000 ft</td>
</tr>
<tr>
<td>6m</td>
<td>16,000 ft</td>
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</tbody>
</table>
magLift
Downhole permanent magnet linear motor rod-pump

- Economically produce deep, low-rate gas wells
- Increase ultimate recovery and reserves by de-watering deeper mature wells
- Retrofit through $2^{3/8}$” production tubing
- Rig-less solution – deployed and powered via wireline
- Proven pump technology
- Capacity: 100 BPD from 10,000ft
- Efficient power delivery from an innovative permanent magnet linear motor
- Low profile equipment footprint

- First field trials 2012
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