The Use of Subsea Gas-Lift in Deepwater Applications

Subash Jayawardena, George Zabaras, and Leonid Dykhno
Shell Global Solutions (US) Inc.
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• Gas Lift Delivery System Design
  – Dedicated GL riser vs. Shared GL riser
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Why Gas-Lift is Needed - Production enhancement

Effect of gas lift on flowline pressure

low water cut

- Blue line: 0% WC, no GL
- Pink line: 0% WC, 20MMSCFD GL

Manifold pressure, psi vs Liquid rate, BLPD
Why Gas-Lift is Needed - Production enhancement

Effect of gas lift on flowline pressure

- high water cut
- 75% WC, no GL
- 75% WC, 20MMSCFD GL
Why Gas-Lift is Needed - Production enhancement

Effect of gas lift on flowline pressure

- **75% WC, no GL**
- **75% WC, 20MMSCFD GL**
- **FWHP**

Liquid rate, BLPD

Manifold pressure, psi
Why Gas-Lift is Needed - Flow stabilization

OLGA results
Flow rate to host & flowline pressure

Field Data pressures w/ & w/o gas lift
Why Gas-Lift is Needed - Flowline depressurization

Trend data

- FL pressure - with gas lift assist
- FL pressure - without gas lift assist

Production
Shut in
Blowdown

HDP
W/o gas lift
With gas lift

psia

Time [h]
Gas Lift Delivery System Design

- **Shared Gas Lift Risers**
  - Uses of gas lift
  - Flowline operating conditions
  - Host limitations

- **Gas Lift Injection Location**
  - Geometry (FL, well location)
  - Uncertainty of reservoir performance
  - Blowdown

- **Insulation**
  - Cooldown time

- **Cost Considerations**
Operating Envelope

- GL Rate Needed (how much and when)
  - Production enhancement
  - Flow stabilization
  - Depressurization
- Source of lift gas
- Available pressure and temperature
  - Heating & compression
- Flowline Pressure
  - With and without gas lift
  - Dead oil filled
- Cooldown time considerations
- Consider all credible scenarios
Flow Assurance Concerns

- Hydrates in GL system
  - Prevention
  - Remediation
- Asphaltene Destabilization
- Thermal Considerations
  - Arrival Temperature
  - Cooldown time
- Slugging
- Erosion in flowline
- Available Gas - quality
- Low Temperature Concerns – J-T cooling
  - Engineering and procedural solutions
# Case Studies

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Selected Solutions

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- **Location**
  - Well & host locations, flowline size and uncertainties about production rates
- **Shared vs. dedicated**
  - Host limitations, flowline geometry
- **Insulation**
  - Arrival temperature and cooldown time, reservoir temperatures
- **Timing**
  - Uncertainty about gas-to-liquid ratio, uses of gas lift
Systems Suitable for Gas-lift

- Oil systems
- High water cut and/or low GOR → GLR < 500 scf/STB
- High water depth → 3000 to 6000+ ft
  - Watch for J-T cooling
- Downhill flowlines
- Some Uphill flowlines
- Low to moderate viscosities
Conclusions

• There is no *one size fits all* design of gas lift system.
• Need for integrated subsurface – flowline modeling over the field life
  – Accurate modeling of multiphase flow in large diameter, deepwater
    risers
  – Understand the uncertainties about the reservoir performance
• Defining the operating envelope of gas lift system – include all credible
  scenarios.
• Shared gas lift risers are possible, but not always.