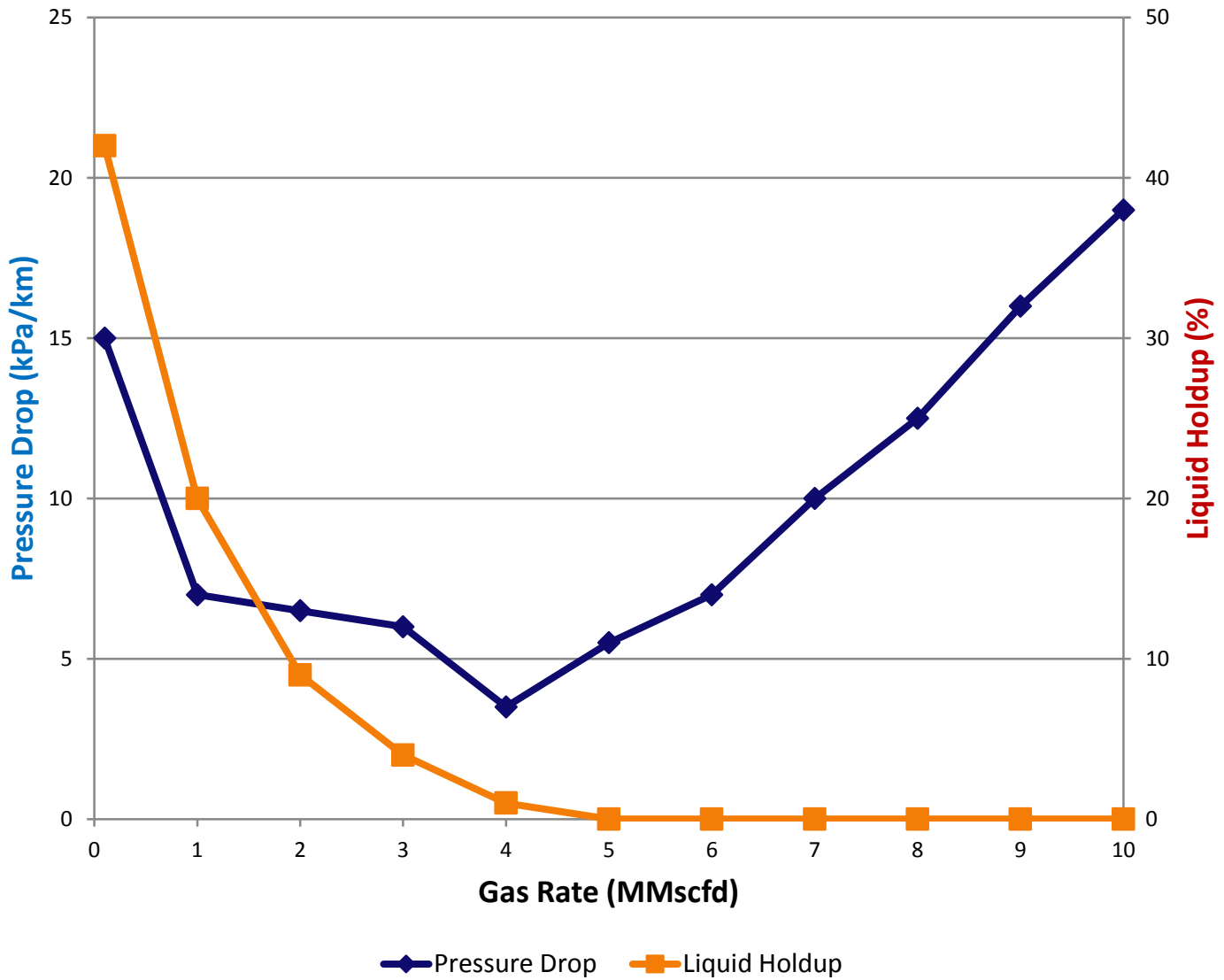


Gas Gathering Operating Envelope



FLOW ASSURANCE

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Our people have expertise primarily from the Coal Seam Gas Industry in Australia, but with some experience in LPG. Our skills are in the development of models for greenfield and brownfield installations to overcome the flow assurance challenges of liquid hold up, low gas rate and low gas pressure, water from dewatering and hydrate formation.

Our people have core competencies that include:

- ✓ Steady state and transient modelling
- ✓ Hydrate management studies
- ✓ Scenario modelling to determine optimum design

Our team have worked on projects that have included:

- ✓ Initial route selection and Pipesim steady state modelling of gas and water gathering lines including low point drains and high point vents.
- ✓ Flow Assurance studies for offshore multiphase pipelines and onshore sales gas pipeline networks.
- ✓ Flow assurance for well flowlines.
- ✓ Completion of a hydrate management study for an LPG plant.
- ✓ Flow assurance study for an upstream pipeline network, involving
 - Transient and steady state hydraulic simulations of differing operating scenarios for different pipeline routes
 - Determination of:
 - Line-pack and survival times;
 - Compressor discharge pressures;
 - LNG Facility arrival pressure;
 - Line sizing;
 - Mid-line compressor power/location;
 - Free-flow capacities
- ✓ Flow assurance concept study for a pipeline conversion from dry to wet operation (steady-state model with PIPESYS extension and OLGAS correlation) focussing on hydrate and liquid inventory management, involving:
 - Correlating the model against the operating pressure profile using available data and the pipeline route information;
 - Modelling a range of desired sales gas rates to determine the liquid inventory profiles;
 - Yielding MEG injection rates at desired concentrations to achieve hydrate safety margins;
 - Approximating liquid hold-up to estimate pigging frequency and to use for slug catcher design options.
- ✓ Water line surge, water hammer and vacuum analysis.