

LedaFlow is the new generation multiphase flow simulator that meets significant market demand for improved flow assurance simulations for flowlines and wells. LedaFlow is the product of ten years of innovative development by SINTEF. Sponsored, guided and supported by TOTAL and ConocoPhillips and now commercialised and developed further by KONGSBERG.

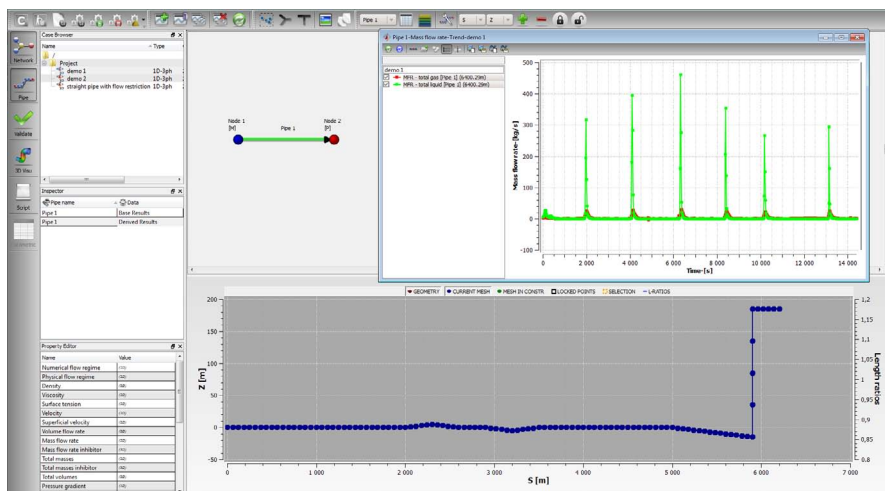
### Value Proposition

With the introduction of LedaFlow, there is an independent and cost-effective alternative dynamic multiphase flow simulator. Based on models that are closer to the actual physics of multiphase flow, LedaFlow provides a step change in detail, fidelity, quality, accuracy and

flexibility over current generation multiphase flow simulation technology. These models have been extensively validated against the best available and most comprehensive experimental data set in the world.

### Increased resolution

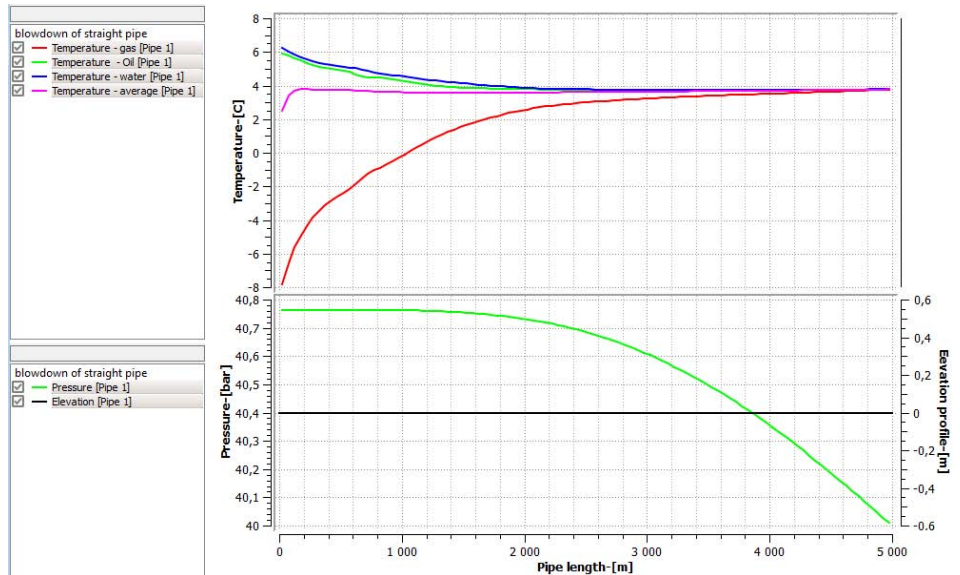
LedaFlow increases the resolution of modelling solving mass, energy and moment conservation for each of the three fluid phase. This provides a step change in understanding and improved accuracy in critical transient events. The independent temperatures for the gas, oil, and water phases provide a more accurate picture of the temperature and allow for better prediction of hydrate and wax formation. LedaFlow multi-field / multi-fluid approach rigorously represents each of the nine fields (continuous gas, continuous oil, continuous water, gas bubbles in water, gas bubbles in oil, oil droplets in gas, oil droplets in water, water droplets in gas, water droplets in oil) present in multiphase flow.



*LedaFlow graphical user interface with riser induced severe slugging case*

## Products

- LedaFlow Engineering is a steady-state and transient multiphase flow simulator and engineering tool. Designed for 2-phase and 3-phase applications.
- The LedaFlow Point Model is available as a plug-in to other steady state simulators, now available with PIPESIM.
- LedaFlow Integrated is a transient multiphase engine integrated with KONGSBERG's K-Spice® or 3rd party applications, for use in e.g. operator training simulators or online production management systems.



LedaFlow indicates significantly lower gas temperatures compared to average temperatures at blowdown

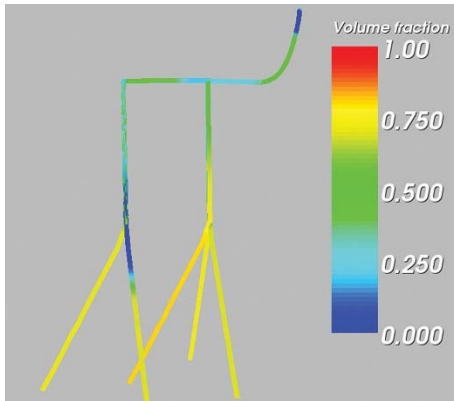


Image showing a complex well network manifolded at the seabed with a flexible riser up to a FPSO vessel.

## Highlights from LedaFlow release 1.1

### Model features

- Standard multiphase thermo-hydraulic calculations. The slug flow regime is modeled allowing for the simulation of severe/terrain slugging effects.
- Compositional tracking. Tracks

individual components of fluid composition along the pipeline. Allows composition to vary along the pipeline due to difference in velocity between phases, interfacial mass transfer and merging of different fluid compositions throughout the network. Based on the integrated GUTS thermodynamic engine.

- Inhibitor tracking. Tracks the concentration of hydrate inhibitor (MEG, MeOH, EtOH or any single component) in the water and gas phase.
- Slug capturing. A predictive tool capturing the initiation of hydrodynamic waves and slugs. Included as pre-release.

### Database Storage

- Output for all variables stored in the database
- Save engineering time by quickly adding variables to reports without

case re-runs

- Quick restart of simulations

### Script Language

- Enables the standardization of flow assurance workflows and decisions
- Provides power users a text-based configuration
- Smart parametric studies – use results from one case and decide the next case to run
- Output results directly to excel or other data format
- Sharing and storing of cases

### Graphical User Interface

- Intuitive, easy-to-use and quick-to-learn engineering tool
- Used for modelling and data processing (plotting tool, statistical analysis)
- Import existing multiphase models to leverage previous engineering.

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