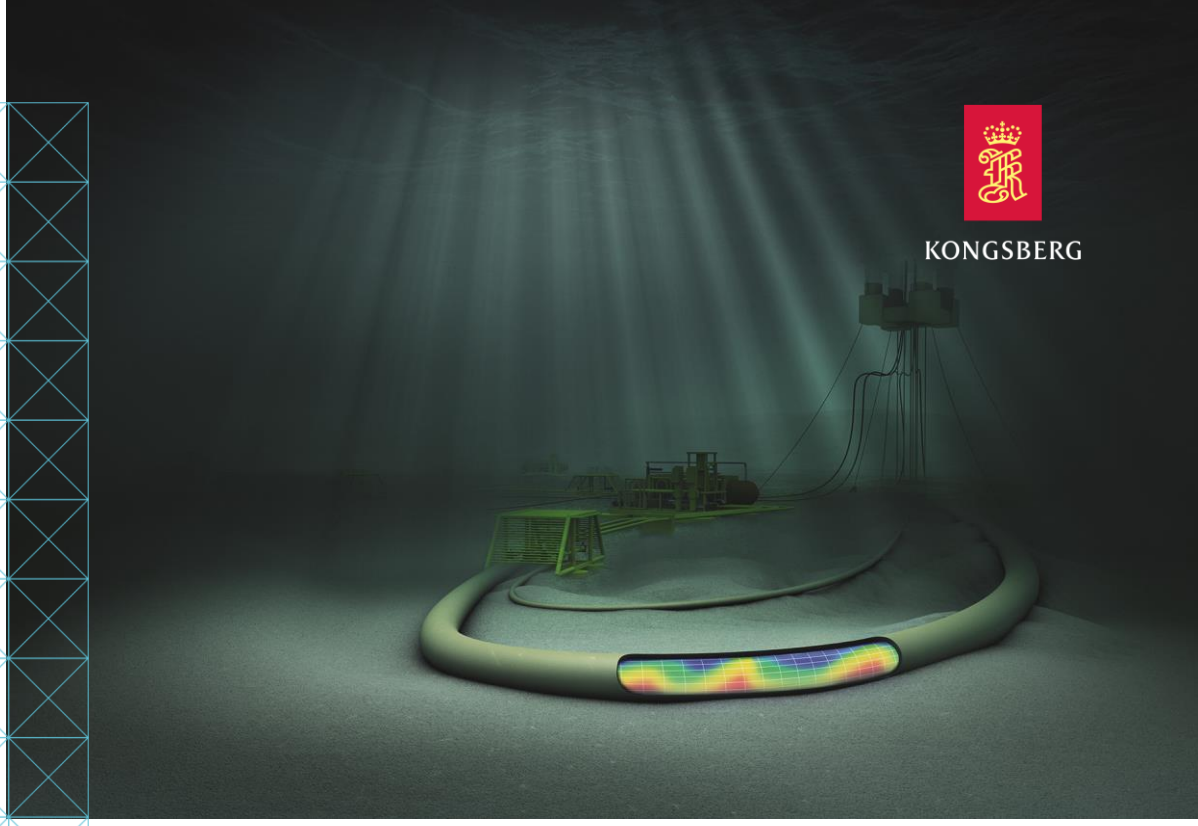
LEDAFLOW



HIGHLIGHTS

- First commercial release in 2011
- Provides a step change in fidelity, accuracy and usability to transient multiphase flow simulation
- Used by many operators and their service companies worldwide
- Routinely applied for Flow Assurance and Production Engineering studies
- Seamless link to the K-Spice Dynamic Process Simulator for unrivalled Integrated Simulation
- Used in numerous Multipurpose Dynamic Simulators and Real-time Production Assurance Systems
- All-inclusive software – no additional modules

LedaFlow® Advanced Transient Multiphase Flow Simulator

LedaFlow is the product of many years of innovative development by SINTEF; sponsored, guided and supported by TOTAL and ConocoPhillips, commercialized and developed further by KONGSBERG.

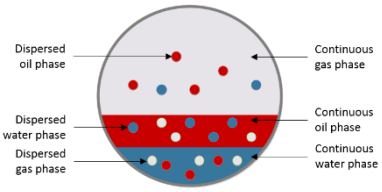
LedaFlow is based on models that are closer to the actual physics of multiphase flow. It increases the resolution of modelling, solving mass, energy, and momentum conservation for each of the three phases of multiphase flow (oil, gas and water). This improves the accuracy in simulation of critical transient events and consequently provides a step change in the understanding of fluid behaviour. More physically correct models also provide better scalability.

Multi-field approach

LedaFlow solves the mass balance equations for all nine fields (gas, oil and water in the bulk and two dispersed fields per phase) while momentum and energy equations are solved for the three continuous phases. This detailed approach enables closer matching to laboratory and field data.

Advanced thermal modelling

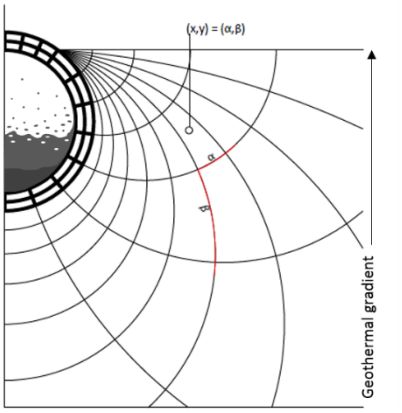
As LedaFlow solves separate energy equations for all three phases, much more accurate information can be determined during stratified flow and during blow down conditions where the temperature of the slower moving liquids at the bottom of a pipe can differ considerably from the gas flowing above. In addition, a buried pipe model provides the user with a heat conduction model from the inner surface of the pipe through to the exterior surface of the soil. This is particularly important for estimating corrosion rates and pipe-wall temperatures, information that is critical for material selection and for hydrate risks prediction.



Multi-field approach

Slug flow modelling

LedaFlow uses a Unit Cell Model for modelling terrain and riser induced slugging. It also includes Slug Capturing which is the first commercially available solution to accurately predict hydrodynamic slug behavior without user input. It captures the initiation and growth of waves and hydrodynamic slugs using higher-order numerical methods. The analysis of slugs is facilitated by slug statistics and slug size tools.



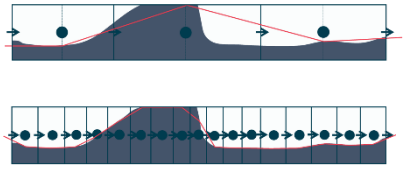
Advanced heat transfer modelling

Model validation

LedaFlow has been extensively validated against the best available and most comprehensive experimental data sets to ensure that the models are as representative as possible. It is continuously improved and verified especially through the LedaFlow® Improvements to Flow Technology (LIFT) program which has been running since 2013. Members of LIFT have included Chevron, ConocoPhillips, ENI, Equinor, ExxonMobil, Lundin, Shell, Total and Woodside.

Latest software technology

LedaFlow is designed with an intuitive user interface to improve productivity. 3D visualization is available which makes understanding of the multiphase flow easier. LedaFlow also has a comprehensive relational database to ensure that all cases are stored and readily available. Scripting allows the user to programmatically control LedaFlow to build and edit models, execute commands, introduce logic, extract data and write data back to LedaFlow.



Slug flow modelling

LedaFlow applications

LEDAFLOW FEATURES (non-exhaustive list)

Composition tracking	Tracks the composition changes due the difference in velocity between phases, the interfacial mass transfer and the merging of different fluid compositions. Based on Multiflash™.
Wells	Modelled with inflow performance relationships and user defined inflow zones. Advanced options such as fractures and viscosity correction. Accurate thermo-hydraulic modelling of flow in an annulus combined with gas lift valve tables enables transient gas lift simulations.
Custom fluids	Tracks the concentration of hydrate inhibitors (MEG, MeOH, EtOH) or any single component, such as drilling muds, tracers and dead oil, in all three phases.
Wax deposition	Simulates creation and melting of wax. Used to determine the pigging frequency required to keep wax deposits under control. Takes into account the changes in pressure and temperature as well as the effect on fluid properties.
Hydrate transport	Calculates the formation and transport of hydrate particles. Used to evaluate the possibility to operate inside the hydrate risk region by taking into account the effect of inhibitors, changes in temperature due to heat of reaction and effect on fluid properties.
Pure steam/water	In-built steam thermodynamics package. Flexible wall feature allowing for more accurate water hammer studies.

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