Olga

Dynamic multiphase flow simulator

Release notes

Version 2025.1

Copyright notice

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Introduction

The Olga* dynamic multiphase flow simulator models time-dependent behaviors and provides an additional dimension to steady-state analysis. Dynamic simulation is extensively used in both offshore and onshore field developments. From wellbore dynamics, for any well completion, to pipeline operations, for process systems containing any type of equipment, the Olga simulator provides an accurate prediction of key operational conditions involving transient flow.

These notes accompany the release of Olga 2025.1 from SLB. The notes describe changes in Olga 2025.1 relative to Olga 2024.2.

This document should be read by all users of the program. The complete program documentation consists of the Olga user manuals, Installation guide, and these Release notes. In addition, module specific User guides are available.

From SLB Software Support, you can view useful information about Olga, and view the knowledge base. You can access it from www.software.slb.com/support.

Please contact SLB if you encounter problems or missing functionality when using Olga, or any of the related tools included in the Olga software package.

Enhancements in Olga 2025.1

- Introduction of a new Olga solver - Olga for New Energy Operations.
- Re-introduction of PVTSim for compositional tracking.
- Update to the SlugTracking module.
- New oil-water-dispersion model.
- New closures for the turbulence parameters in the HD Stratified Flow Model.
- Run parametric studies in cloud.
- Update of Multiflash library.
- Gelling function for drilling fluids.
- Update of Symmetry library.
- Three new EoS for Multiflash compositional tracking.
- New tuning keys for slug and bubble initiation rates in Slug Tracking.

Introduction of a new Olga solver - Olga for New Energy Operations

Olga 2025.1 introduces the newly developed Olga for New Energy Operations (NEO) solver, created through the joint industry project (JIP) Olga CO2 REACH, to enhance CO2 handling capabilities. This solver is designed to deliver robust and accurate simulations of CO2 transport and injection, which is crucial for the effective design and operation of CCUS systems. The new Olga solver enables reliable and precise multiphase modelling with strong vaporization and condensation, essential for CCUS transport systems, leading to optimal capital and operational costs.

The new solver includes several improvements, such as increased implicitness between pressure and energy, and a reformulation of flash calculations to enhance numerical stability. The NEO solver operates in two stages: in each time step, velocities, pressure, and energy are updated first, followed by the masses. Since energy and pressure are solved simultaneously, the pressure computation is constrained by the energy equation, increasing the solver’s stability.

This new solver ensures numerical stability and reliable solutions, providing increased accuracy without compromising simulation speed.

The Olga NEO solver is only compatible with PH-flash and PH-tables.

Restart files must match the solver used. If you use the standard solver, the restart file must come from a standard solver simulation. If you use the NEO solver, the restart file must come from a NEO solver simulation.

The research and development of the new solver were funded by the CLIMIT program (climit.no) under grant no. 621254 and by industry partners within OLGA CO2 REACH joint-industry project.

(#1485670)

Re-introduction of PVTSim for compositional tracking

In Olga 2025.1, PVTsim from Calsep as an option for running compositional tracking simulations has been re-introduced. Calsep, a leading provider of PVT simulation services to the oil and gas industry, has completed PVT modeling projects worldwide. These projects involve EoS modeling of various reservoir fluids, including natural gas, gas condensates, near-critical fluids, black oils, and heavy oils. Currently, the PVTsim compositional tracking engine is available for PT flash only. As of now, PVTSim is only available on Windows, meaning it will not be available in our Petrotechnical Suite solution.

(#1247535)

Update to the SlugTracking module

In Olga 2025.1, we have enhanced the Slug Tracking module by introducing a new option to track the development and evolution of statistical mean slug properties. This new model, referred to as MEAN tracking, contrasts with the conventional INDIVIDUAL tracking model, which tracks the movement and properties of each individual slug.

The MEAN tracking model offers several advantages, including generally faster simulation and a reduced need for long simulations to produce a statistically meaningful number of slugs. However, because it does not resolve individual slug properties, MEAN tracking cannot provide distributions of slug properties, such as slug length. The speed-up benefits of MEAN tracking are particularly significant in systems with extensive hydrodynamic slugging. Additionally, the MEAN tracking option requires no post processing for extracting average variables (such as average slug length and slug frequency).

The MEAN tracking development received funding from the PETROMAKS 2 program of the Research Council of Norway as project no. 317814 and further industrial support through the Olga Verification and Improvement Projects (OVIP).

(#1408901)

New oil-water-dispersion model

In Olga 2025.1, we have introduced a new POLYDISPERSED oil-water dispersion model for Olga HD. The model simulates dispersion concentration profiles in partially or fully dispersed two or three-phase flow for each cross section of the pipe using an advection-diffusion equation expressing the balance between turbulent diffusion and gravitational settling. It also incorporates the effects of droplet size distribution by considering a small number of representative size bins and employing a computationally efficient quadrature to calculate an average over the size distribution. In this release we also account for circular geometry while averaging concentration profiles over a pipe cross section. The treatment of laminar flows has also been improved.

The model enables predictive modeling of oil-water flow regime, presence/absence of continuous phase layers and improves results for wall shear stress, all of which are key characteristics for assessment of corrosion risk in pipelines. The oil-water dispersion model has been validated against experimental measurements of oil and water distribution and is tuned for the best performance against two-phase oil-water and three-phase field and laboratory data together with the updated Olga HD turbulence closures.

The option to switch back to the pre-mixed oil-water dispersion model previously used with Olga HD and referred to as SIMPLE has also been preserved. The models can be selected by changing OWDISPMODEL key value under Case Definition > OPTIONS > Flow model.

The development of the new oil-water dispersion model received funding from the PETROMAKS 2 program of the Research Council of Norway as project no. 317814 and further industrial support through the Olga Verification and Improvement Projects (OVIP).

(#1514929)

New closures for the turbulence parameters in the HD Stratified Flow Model

Olga 2025.1 introduces new closures for the turbulence parameters in the HD Stratified Flow Model, representing the scaled apparent turbulent eddy viscosity on either side of the gas-liquid and liquid-liquid interfaces. Similar closures are commonly implemented in many CFD models.

The turbulence parameters account for turbulent momentum mixing at the interfaces, linking the turbulent fields across the gas and liquid layers, while also providing boundary conditions for turbulent flow within each layer.

The turbulence parameters govern the shape of the velocity distributions, directly influencing wall and interfacial frictions, critical factors in determining holdup and pressure drop.

(#1534852)

Run parametric studies in cloud

Olga 2025.1 introduces an important update to the parametric study functionality; the possibility of running parametric studies from the Olga desktop version in the cloud using Flow Assurance Workspace. This way, you can utilize indefinite computer power in the cloud for parametric studies.

(#1397484)

Update of Multiflash library

The KBC Multiflash™ library has been upgraded from version 7.4 to 7.5. This new release introduces a suite of tools designed to aid in modeling fluids for Carbon Capture and Storage (CCS) applications. A new tab provides shortcuts to select appropriate models, including CPA, CPA with hydrates, CPA with EOS-CG for volume properties, and EOS-CG. Additionally, the Lennard-Jones viscosity model has been developed to enhance viscosity predictions for CO2-rich fluids and is accessible exclusively from this tab. A model for the density of salt aqueous solutions is also utilized in the creation of Olga tables.

For the CO2 component, updated temperature-dependent correlations enhance accuracy for properties such as saturation pressure, saturated liquid density, and ideal gas heat capacity.

When using Multiflash 7.5 in Olga’s compositional (CompTrack) module, the new density model for aqueous solutions is applied if salts are present.

Besides these Olga-related enhancements, the new version also includes several other improvements and minor bug fixes.

(#1472334)

Gelling function for drilling fluids

Prediction of gelling build-up and break-down is now available for fluids defined as a drilling fluid. The yield stress of the drilling fluid is adjusted according to the build-up and break-down time which can be specified in the corresponding keys under the DRILLINGFLUID keyword after selecting GELLING=ON. The adjusted yield stress is then applied to calculate potential for trapping gas bubbles in the mud, assuming no-slip.

(#1368609)

Update of Symmetry library

Symmetry library is updated from 2023.3 to 2024.3. A new bulk speed of sound calculation method based on isentropic compressibility is now available, providing consistent and reliable results for these scenarios. The estimation method for interactions between low Cn paraffins (Cn < 7) and methanol in the APRNG2 Z Factor matrix has been improved. The new estimation method can be accessed by selecting the option **V 5.0** from the Hydrocarbon Interaction Parameters Estimation Version. Additionally, PT flash convergence for sensitive systems has been enhanced by automatically reducing the damping factor after a preliminary number of iterations. Lastly, the runtime performance for adding and recalling the REFPROP property package has been improved.

PH flash now considers the density derivatives:

- Derivative of density with respect to pressure at constant enthalpy and composition.
- Derivative of density with respect to enthalpy at constant pressure and composition.

(#1383185)

New Equation of States

Three new Equations of states (EoS) are now available when the Multiflash PVT package is used for compositional tracking simulations in Olga. These are:

- Gerg-2008 Infochem extension model.
- EoS CG model.
- EoS CG Infochem extension model.

(#1512445)

New tuning keys for slug and bubble initiation rates in Slug Tracking

Two new tuning keywords, SLUGBIRTHRATE and BUBBLEBIRTHRATE, are introduced in Olga 2025.1. These tunings multiply the slug and bubble initiation rates in Slug Tracking, respectively. The SLUGBIRTHRATE tuning is only effective when SLUGTRACKINGMODEL = OLGA2015 and HYDRODYNAMIC = ON are selected, while BUBBLEBIRTHRATE tuning is only effective when SLUGTRACKINGMODEL = OLGA2015, HYDRODYNAMIC = ON, and INITBUBBLE = ON are selected.

(#1522963)

Fixed issues in 2025.1.0

Compositional

Error in scaling flash rate of water

The flash rate of water was wrongly scaled up for the STEAMWATER-HC option, except when you had specified the scaling factor via the keys TCONDENSATION or TVAPORIZATION. This has now been fixed. The error was present in OLGA 2023 and 2024.

(#1475520)

Handling of both incipient hydrocarbon and water phase

In rare cases where there was no water phase and one of hydrocarbon phases (either gas or oil) did not exist, you could use the incipient water phase to calculate the physical properties of the missing hydrocarbon phase. This could lead to numerical instability when the operating conditions were close to the boundary of the hydrocarbon phase envelope. Now, a test has been added to detect this situation and the incipient water phase composition is not used for calculating the properties of the missing hydrocarbon phase. Light hydrocarbon components are constructed to calculate gas properties if the gas phase is missing, and oil hydrocarbons are constructed to calculate oil properties if the oil phase is missing.

(#1376429)

Corrosion

NORSOK corrosion rate calculation at high temperature

In previous versions, there was a bug that lead to an erroneous calculation of the corrosion rate at temperatures higher than 90 degrees Celsius when NORSOK M-506 model is used. This has now been fixed.

(#1230154)

Compatibility

TRACERTRACKING and HYDRATEKINETICS compatibility

In earlier versions, an error in the input rules prevented simulations to start running when both TRACERTRACKING and HYDRATEKINETICS were active. The compatibility has now been fixed.

(#985064)

FEMTherm

Ambiguity in default value of MESHFINENESS corrected

In previous versions, the default value of MESHFINENESS in the SOLIDBUNDLE keyword depended on how the SOLIDBUNDLE was added. Now the default value is always set to 64. The Olga User Manual is also updated to give better guidance on how to find an appropriate value for MESHFINENESS.

(#1305132)

Flow Calculations

Bug in EVRRHOMIX calculation

In previous versions, there was a bug in the calculation of mixture density used in the erosional velocity calculation. This bug affected cases where there is a counter current flow. This has now been fixed.

(#986028)

Fluid

In previous versions, whenever the oil and/or water viscosities were smaller than the gas viscosities, Olga modified these viscosities to be slightly larger than the gas viscosities. This led to viscosities that were not founded in EOS calculations. This modification has now been removed, and Olga is correctly using the EOS viscosities.

(#1442131)

Minor fix in slug flow model for downward angles

In previous versions, there was a minor bug in the calculation of slip in the slug body which created a small discontinuity for downward inclinations. The effects in terms of prediction accuracy were generally insignificant, but the discontinuity caused Olga to crash in a limited number of cases. The slip calculation is now corrected.

(#1467705)

Non-physical oil and water velocity

In previous versions, in very rare cases, the slug unit cell flow model converged to an invalid solution, which lead to a velocity and pressure excursion. This has now been fixed.

(#1487402)

Viscosity of oil and wax mixture

In previous versions, the procedure of calculating the viscosity of oil and wax mixture could diverge, resulting in invalid oil phase viscosity (extremely high and inconsistent with the waxy oil rheology model). Now, the Reed and Pilehvari method is used to calculate the effective viscosity oil and wax dispersion.

(#1487402)

Inhibitor tracking

Inhibitor tracking

In previous versions, the loss of inhibitor to the gas phase was not considered when calculating the fluid composition for sources, pressure nodes, and initial conditions. This resulted in the inhibitor fraction in the water phase being less than what is specified in the input. This has now been fixed.

(#989118)

Input

Material conductivity lower limit adjusted

In previous versions of Olga, the lowest material conductivity that could be given as user input was zero. But the value zero could lead to a code crash. To avoid this, the material conductivity is now required to be above zero.

(#984890)

Leak

Sequence of updating internal leak

In previous versions, a source from an internal leak was updated before the leak was updated. This could lead to the mass rate at the to-position not being synchronized with the mass flowrate of the leak. This has been corrected.

(#1376429)

Output

Initial values of output variables

The initial values of the global variables RELGT, RETOT, RETOT0, RMLGT, RMOUT, RMTOT, and RMTOT0 were incorrectly set to zero. The error affected only the output. The error has now been corrected.

(#1470242)

Assign correct unit for ANGLE output variable

In previous versions, a proper unit (degree/rad) was not assigned to the output variable ANGLE (pipe angle relative to gravity vector). As a result, you did not get information on the actual unit used in the plot (rad was used by default) and there wasn't the flexibility to change the unit. This bug is fixed, and **degree** is set as the default unit to make it consistent with the INCL variable.

(#1472225)

Particle flow

Bug fix for advanced particle flow model

In previous versions, an uncontrolled crash happened when the bed height was approaching the pipe diameter. This has now been fixed.

(#1455747)

Restart run for particle flow model

In previous versions, the restart data from the particle flow model was not used when updating the flow model for the first time step. This has now been fixed.

(#1476543)

Compositional tracking with advanced particle flow model

In previous versions, the masses trapped in a particle bed were not considered when calculating the local flashing terms to reach the phase equilibrium when advanced particle flow was selected. This has now been fixed.

(#1476543)

Advanced particle flow model

In previous versions, there was error in getting the wall shear stress for a diminishing layer, which gave stationary bed for vertical flow when the liquid layer was diminishing. The wall shear stress is now calculated correctly in these conditions.

(#1482155)

Petrotechnical Suite (PTS)

Handling of corrupted plot files in PTS simulations

In previous versions, for PTS simulations, corruption of lines in the plot files had been observed, which could lead to errors when refreshing plots during the simulations. Now, the Olga GUI plotting tool ignores corrupted lines when reading trend and profile data. If corrupted lines are detected, once the simulation is finished, Olga will automatically fetch complete plot files, where all plot data are intact.

(#1497344)

PH Flash

PH flash when PVT table is used

The enthalpy could get outside of the PVT table range when iteratively finding the flashing amount. Previously, the code would exit with an out of table range message. Now, the enthalpy is limited to be within the PVT table range in flash calculations.

(#1472178)

Pump

Centrifugal Pump Curves

In previous versions, the efficiency of a pump could be set to 0 (zero) in the pump-curve. This caused an issue in the calculation of power and torque, which led to uncharacteristically high temperatures for centrifugal pumps operating in regions with low efficiency. Now, the efficiency of a pump is limited downward to 0.1%, which removes the numerical issue.

(#1445244)

Single Component

Single Component model

The algorithm for generating the pressure points of a PVT table for the single component model has been improved by considering dependency of saturation temperature on pressure and/or allocating more pressure points near the critical point.

(#1365449)

Source

Pressure driven source

In previous versions, you could specify SOVAPHASE as well as DIAMETER. Now, SOVAPHASE can only be specified together with key TABLE. In addition, LIQUID is now used as the default input for SOVAPHASE when a valve characteristic is specified by a table.

A bug which led to code crash when the back pressure of a pressure driven source was higher than the pipe pressure when a gas sizing equation was used, has also been fixed.

(#986438)

Correction of the momentum equation for sources

Sources are now always considered to enter radially into the pipe/well. The momentum equation is then modified and (minor) differences in results are observed around sources, reservoir contacts, and leaks into other pipelines.

(#1493320)

SLUGTRACKING

Minor fix in the bubble zone velocity linearization in SLUGTRACKING

In previous versions, in the slug tracking, there was an inconsistency in the linearization of oil and water phase velocities in the bubble zone compared to the gas phase counterpart. This could yield erroneous results in limited cases where either the oil or water phase fraction was very small. The inconsistency has been removed.

(#1477070)

Bugfix for slug tracking when having multiple sources in same section

In previous versions, slug tracking only accounted for the last source term if multiple sources were located in the same section. Now, all sources are accounted for.

(#1480025)

Error in velocity calculation for slug tracking when section boundaries are closed

Within a flowpath, boundaries between two active sections (excluding nodes) may be considered as closed in certain conditions, such as: VALVE closing to the fully closed position, CHECKVALVE preventing flow reversal, or PUMP operating with no flow. Previously the velocity calculation for slug tracking did not consider these zero flow conditions correctly. This has now been fixed.

(#1531171)

Correction of the Slug tail profile calculation

The calculation of tail profile in the slug initiation frequency model (Slug Tracking module) previously did not consider the possibility of bubble nose reversal. This has now been fixed

(#1543570)

Tuning

Enable wall friction tuning for liquid-liquid dispersed flow with little gas

In three-phase flow with little gas, liquid-liquid flow can happen in bubbly flow, or the slug zone of a slug flow (with gas being fully dispersed into the oil and water layers). There was a bug in which friction tunings were not applied when the liquid-liquid phases were dispersed, or one of the liquid phases was close to non-existent (effectively forming a pseudo-single phase liquid flow). Friction tunings are now applied in these cases.

(#1414387)

TUNING for LAM_WWALLI, LAM_LGI and LAM_WOI

Due to a fault in logic, the tuning parameters were not set correctly for LAM_WWALLI, LAM_LGI, and LAM_WOI when using controllers rather than setting them directly. This gave different results when using controllers to tune these parameters compared to using them directly. This has now been fixed, and both types of simulation now give the same value.

(#1465145)

Minor fix on surface tension tuning

In previous versions, a bug was present when tuning surface tension values (SIGGH, SIGHW, and SIGGW). This lead to incorrect tuned values. Surface tension tuning has now been corrected.

(#1532910)

Effect on heat transfer in the pipe wall when tuning pipe diameter

In previous versions, the overall radial heat transfer coefficient (Q2) in the pipe wall was not affected by a diameter change caused by tuning. This has now been fixed. If you tune the diameter, Q2 changes accordingly.

(#1416782)

Valve

Valve critical flow for NOSLIP option

In previous versions, NOSLIP = ON was not used in limiting the mass rate to the critical mass rate through the valve when the valve flow was critical This caused the section boundary mass flowrate being different from the valve critical mass flowrate. Now, NOSLIP = ON is applied correctly.

(#1518580)

Wax deposition

Wax deposition initialization error

Previously, Olga failed with an initialization error when WAXDEPOSITION was defined under FA-models in FLOWPATH, but at the same time was switched OFF in OPTIONS. This bug has been fixed by forcing Olga to ignore the WAXDEPOSITION definitions in FLOWPATH for such cases, consistent with how it is handled in the Olga GUI.

(#985188)