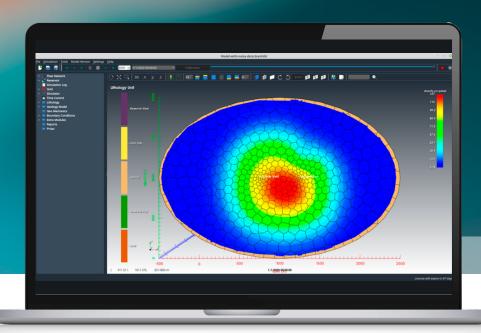# SEEQUENT

Volsung

Volsung 2024.1

new release

Release Notes

Volsung is Seequent's advanced geothermal modelling and simulation software that is shaping the future of geothermal energy.

Volsung simulates the geothermal process from underground reservoirs to surface networks, integrating advanced capabilities such as microgravity and subsidence forecasts, tracer modeling, Monte Carlo analysis, and GPU parallel processing. These tools enable greater insight into your geothermal asset, empowering users to make well-informed, data-driven decisions to optimize system performance.

The 2024.1 release is the first minor update for Volsung since joining Seequent. It includes stability enhancements and help and support links to Seequent.com.

■ 2024.1

- Volsung is now part of Seequent's product range.
- New Volsung Help & Support page introduced.
- Updated legal terms in alignment with Seequent, and relevent links to the Seequent website.
- Example datasets accessible through the Seequent website.
- Enhancements in UI/UX, visualization, and reporting.
- The older license key files are no longer supported in Volsung 2024.1.
  Users need to contact support.volsung@seequent.com for a new LicenseSpring license.

Volsung Release History

This log records key updates in the Volsung software, focusing on significant changes and new features relevant to users upgrading to newer versions. It excludes minor adjustments and bug fixes that don't affect functionality.

■ <u>1.20</u>

- Change to new build number nomenclature. Volsung versions are now MAJOR.MINOR.DATE
- New license system for user- or key-based licenses. Old license files will continue to work for a while.
- Feedzones can be uni-directional.
- Layer-based geology model now also supports 3D volumes.
- Leapfrog LFM support for 3D volumes in layer-based geology model.
- Support for GOCAD files from LeapFrog.
- Improved meshing performance for geology model faults.
- Export timed reservoir data in CSV format recognized by LeapFrog.
- Minimum flowing time option for wellbore simulator heat loss calculations.
- Improvements in surface network model standalone mode. Existing models may need to re-run to reflect changes.
- Remove MESA3D package from installer. Users who require this package must install manually.
- Remove provisional grid/welltrack display feature.

■ <u>1.19.0</u>

- Move Linux base to Ubuntu 20.04/22.04. For older 18.04 operating systems snap installation continues working.
- Linear solver scale by accumulation/primary variables
- Boost performance for barrier meshing operations
- Table based barrier

■ <u>1.18.4</u>

- Fix GUI glitches

■ <u>1.18.3</u>

- Improve touchpad support; panning in 3D view with 'p' key, zooming in charts with right mouse button
- Fix locale issue

■ <u>1.18.2</u>

- Eliminate zeros on diagonal using automatic increment adjustment

■ <u>1.18.1</u>

- Fix cell selection glitch

■ 1.18.0

· Support for GeoJSON files for props and file based manifolds.

· Support for Map Projections.

· Support for GDAL (GeoTiff etc) files for props.

· Unify Delaunay2D offset parameter - some existing concave shapes may change.

· Unify nomenclature around flowing enthalpy - some reports may require re-setting their displayed quantities.

· New extra module to calculate flow associated with boundary conditions.

· Initial State Conditional Table to override initial states using algebraic conditions and equations.

· Calculate Superheat as a cell array in 3D viewer.

· Distance and angle measuring widgets.

· Cell threshold filter in 3D viewer.

· Swanhild second fractional dimension parameter.

· Improvements in surface network computational method.

· Import bulk flow rate data into the surface network.

· Import bulk wells (welltracks) into the surface network.

· Import bulk lithology units into the lithology data base.

· Cell Based Geology Model: Editing via tables.

· Lithology Data Base: Editing via tables.

· Flow Path Segments in the wellbore model can modify parameters over time.

· Make tool bars dockable.

· More advanced data checking in table views.

■ 1.17.8

· Bug fix GPU driver crashes

· More efficient loading of barriers/faults

■ 1.17.7

· Bug fix Extra Block list

■ 1.17.6

· Fixes for Modor batch mode

■ 1.17.5

· Fix glitch in navigator panel sliders.

■ 1.17.4

· Fix lag behaviour in 3D viewer for Windows.

■ 1.17.3

· Fix error in PortParser for flow network port objects.

■ 1.17.2

· Fix glitches.

· Add output pressure from table option to pressure controller object.

■ 1.17.1

· Fix glitches.

■ 1.17.0

· Improved widget sizing for non-HD screen resolutions.

· Improved support for high-dpi displays.

· BiCGStabKK solver for accelerated GPU computing under Windows.

· Add Modor batch mode.

· Add Modor Monte-Carlo mode.

· Add Garg et al (2004) pressure drop correlation.

· Add "Universal" surface model object.

· Add "Universal Generator" surface model object.

· Add "Wellbore Modelled Injector" surface model object.

■ 1.16.3

· Fix minor glitches.

· Bugfix faulty primary variable initialization for pure water with aqueous tracers.

· Bugfix incorrect snap paths on remotes.

· Cleanup of obsolete snapshots on AWS.

■ 1.16.1, 1.16.2

· Fix minor glitches.

■ 1.16.0

· New installer system.

· Add linear heat exchanger boundary condition.

· Gudrun XML support via Python modules to build wellbore models programatically.

· 1D Reservoir for wellbore simulator supports temporal change.

· New Atli application to couple Gudrun with PEST.

· New Gunnar application to couple Brynhild with PEST.

· Allow surface network to run simulation without reservoir model present.

· Add deliverability source to surface network to mimic a well with a parabolic/elliptic deliverability curve.

· Times can now use "-inf" or "+inf". This is less error prone than using something like "-1e99".

· Undulated grid layers.

■ 1.15.0

- Support for new NVIDIA Ampere architecture GPUs. New minimum graphics driver version is now 460. Note this unfortunately drops support for older NVIDIA GPUs with compute capability less than 3.5.
- Installation support for Ubuntu 20.04 and Snap.
- User can select license file location - no admin privileges required.
- Automatic determination of NVIDIA-null requirements during installation.
- New EOS for H2O, salt and non-condensible gas.
- New reservoir properties along welltrack report.
- New reservoir properties for reservoir slice report.
- Signy thermodynamic table tool now accessible from command line and python.
- Minor bugfix in Gudrun's heat loss logic.

■ 1.14.3

- Bug fix - deletion of surface network objects crashes.

■ 1.14.2

- Bug fix - mobility pressure correction missing in table.
- Bug fix - Swanhild linear/channel boundaries.

■ 1.14.1

- Bug fix in python libs due to modified xml format.

■ 1.14.0

- New Swanhild GUI for numerical pressure transient analysis.
- Discreet method for flux integrator.
- Fixed state boundary conditions now more flexible, can change state to disabled/enabled over time.
- Make surface network editor zoomable, improve look and feel.
- Realistic, wellbore-modelled surface spring feature.

■ 1.13.1

- Bug fix in vtkProbeFilter - fixes faulty interaction of shapes near undulated surfaces.

■ 1.13.0

- Summation over flow rates in flow rates report; this includes mass-weighted enthalpy/component mass fraction summation.
- Flux integrator for calculating the flow over surfaces in the model.
- Reservoir viewer can show delta-Pressure, delta-Temperature.
- Time interval filter for wellbore/wellhead data.
- Bug fix in Chisholm-Orkiszweski pressure drop correlations Reynolds number calculation.
- Bug fixes for wellbore simulation injection modes; improves stability of searches.
- Introduce mobility pressure correction for feedzones.

■ **1.12.2**

· Bug fix running TOUGH2 compatibility mode.

■ **1.12.1**

· Bug fix feedzone enthalpy correction factor.

■ **1.12.0**

· Wellbore model editor: Cross section widget. Streamline treatment of flow path segments.

· Generate reports from within Brynhild. Two basic report types (text document, number of makeup wells) implemented; more report types to follow.

· Surface Network Optimization: Simple optimization method to scale back producers using a common factor to meet plant target.

· Fixed-fraction producers can now be used as makeup wells and be automatically throttled during scenario time to meet plant target.

· New pressure control object for the surface network.

· Lokalization: Use the user custom date format for printing times in GUI applications (e.g. M/d/yyyy for US dates or d/M/yyyy for most other countries).

· Surface Network: Add mass rate controller object.

· Wellbore Simulation: Add simulation modes to determine the bottom productive index given flowing wellhead conditions.

· Specialized radial grid and source/sink for numerical pressure transient analysis.

· Hadgu pressure drop correlations implemented.

· Manual Voronoi XY grid generator added; all Voronoi site coordinates need to be specified manually for this generator.

· Add model version control feature.

· Add simplified linear permeability-height product to feedzone table output to make wellbore model calibration easier.

· Add CPULC linear solver backend.

■ **1.11.0**

· New cell-based geology model. This model allows to assign lithology units for each cell.

· Steady-state detection parameters simplified to make more intuitive.

· Optional enthalpy correction factor for feedzones.

· Feedzone modification factors, e.g. chronological change in productive index.

· Selection of period (NS/Calibration/Scenario) for TOUGH2 compatibility mode; allows different surface network behaviour.

· Importing/exporting of wellbore and pipeline models between Brynhild and standalone applications Gudrun/Sigrun.

· Unions and Splitters: Make number of ports a user option.

· Language/Country settings and customized date input format.

· Basic GeoMechanics framework, including simple poro-elastic model.

· Minor bug fixes and improvements.

■ 1.10.0

- Add INDOM section support for TOUGH2 input files.
- Add fixed state volume threshold for automatically converting TOUGH2 elements with large volume to fixed states.
- Global switch for changing visibility of labels for wells/pipes in the 3D viewer.
- Interpolation of initial state conditions for sector models and regridding.
- Microgravity: Add option to calculate exact gravity factors for all polyhedron cells.
- Wellbore modelled wells: Add wellhead pressure flow control feature.
- Add AUTOUGH2 flavour. Note: Only very limited number of features (DELG, RECH) supported yet. Contact support if you require additional features.
- Minor bug fixes and improvements.

■ 1.9.0

- Add support for PEST/BEOPEST.
- Minor bug fixes and improvements.

■ 1.8.0

- Create the Andvari pipeline simulator and the Sigrun GUI using it.
- Add Andvari pipeline as object in surface flow network.
- Improve surface network convergence/performance.
- Add slice images to reservoir viewer; this allows importing images like MT or conceptual model ideas for direct display in 3D scene.
- Add surface image to reservoir viewer to display infrastructure, maps etc.
- Add micro-earthquake (MEQ) display/animation to reservoir viewer.

■ 1.7.0

- Use MKL Sparse/BLAS implementations for CPU solver.
- Bug fix in Duns & Ros pressure drop correlations Region III.
- Implement Saturation-weighting for calculation of pressure gradient.
- Write primary variables to Results.sigurd and provide sigurdcmd.py tool to extract INCON from any time zone in the output file.

■ 1.6.0

- Changed order of primary variables in EOS with H2O+NCG to improve linear solver performance.
- General visual/user interaction improvements.
- T2Fafnir: Introduce DELV (well-on-deliverability) feature (restricted to one completed layer).
- T2Fafnir: Warn users when using enabled blocks with many connections (e.g. atmosphere) on the GPU. Users should use fix state instead if possible, else GPU matrix format will run out of memory.
- Bug fixes for reading more variants of MULGRID files.
- Create Coordinate Transformation Tool for translating/rotating points in 3D space.
- Introduce Locale, i.e. regional customization. This is mostly around decimal point issues, i.e. you can now use "," instead of "." as decimal point if your locale system settings specify this.
- Introduce custom zoom, accessible through Brynhild menu "Settings/Preferences". Useful for non-standard screen resolutions, for example 4k screens. The zoom factor will apply to all applications in the Volsung package.

■ 1.5.0

- Changelog created.