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# HALLIBURTON

## GOHFER® RELEASE NOTES

### GOHFER 3D 9.5.0.x

Original Release Date December 6, 2023



#### Build 39 (9.5.0.39) posted 07/02/2024

- **Bug Fix** - Fixed an error that could occur when adding single projects to the batch queue.

#### Build 32 (9.5.0.32) posted 04/17/2024

- **New 3D Graphics Package Available** that improves 3D graphics response and translation speed.
  - To use this new package, you must first add an environment variable. To configure, click the Start button, type "Advanced System Settings" into the search bar and hit Enter. In the Advanced tab, select the "Environment Variables" button and select New under User Variables. Enter **GOHFER\_NEW\_GRAPHICS** as the Variable Name and **TRUE** as the Variable Value. Select OK.
  - **CAUTION** - Performance of the new graphics package will be dependent on your machine graphics card and settings. If quality/performance with the new GOHFER graphics is poor or worse than original, set the Environment Variable Value to FALSE to revert to the previous GOHFER graphics.
- **Bug Fix** - Fixed an issue when importing microseismic events where the import screen does not show the column headers.
- Updated Help File

#### Build 23 (9.5.0.23) posted 03/11/2024

- **Bug Fix** - This update eliminates floating point errors that occur in batch runs due to numerical instabilities. No changes are required to user input data.

#### Build 21 (9.5.0.21) posted 03/05/2024

- **Bug Fix** - Fixed an issue where oilfield unit projects displayed the stress shadow cloud in metric units.

#### Build 19 (9.5.0.19) posted 03/04/2024

- **Log Processing** - Improved DTC correlation from resistivity (DTCRESIST) that helps linearize the trend and gives a better DTC fit over the whole log. Users should run Log Assistant with the new correlation to obtain the updated DCTRESIST curve.
- **Bug Fix** - Fixed an issue that occurred when trying to save a project after changes were made to a well survey or LAS that resulted in an error.

**Build 18 (9.5.0.18)** posted 02/19/2024

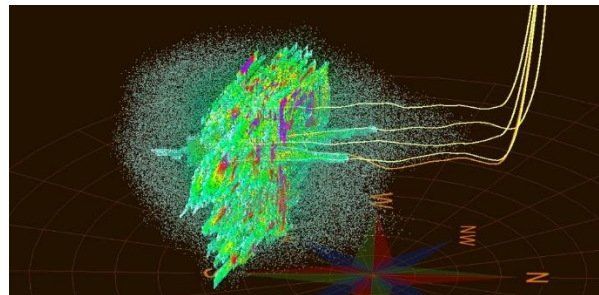
- **Wellbore Stability Calculations** –
  - Fixed significant bugs in the wellbore stability output
  - Added additional output curves including equivalent pore pressure mud weight and the stresses normal to the wellbore ( $S_x$  and  $S_y$ ) at each depth.
- **Stress Shadow** – Fixed an issue with the stress shadow in metric projects. It may be necessary to rerun the metric stages to generate the correct output, after opening and saving the grid setup.
- **Bug Fix** – Fixed an error that was caused by file names that included a "." that was being read as a file extension.

**Build 8 (9.5.0.8)** posted 01/24/2024

- **GOHFER LAS** – Fixed an issue where PHIE was set to PHIA if coal existed. It is no longer necessary to un-map VCOAL in this scenario.
- **Licensing** – Removed expiration date from opening GOHFER splash screen for both cloud and node-locked network licenses. Since the cloud license renews daily, the expiration date shown will not reflect the actual expiration date with equivalent maintenance term. To observe actual expiration date, go to WLADMIN from the start menu on host server or reference entitlement certificate received by customer contact.

**-----Original v9.5 Release (9.5.0.6) posted 12/06/2023-----**

- **Introducing Cloud Network Licensing!** – Same as an isolated network license except a customer managed on-premise or cloud server communicates with cloud server hosted by Thales reducing internal IT management requirements and overhead and providing more efficient servicing of your license.
- **New Stress Shadow Cloud!** – Added stress shadow cloud display for all wells and stages within a geologic section that can be overlaid with the fracture geometry in the GOHFER 3D output view as well as in the Treatment Configuration/Wellbore by selecting the stage at the geologic section level. Stress shadow can also be displayed on the grid map view as a "heat map" showing magnitude of shadow. Stress shadow min/max can be set in the view properties.



- **Stage Shadow Updates**
  - Stage stress shadow files are now being written at the end of each run which changes the way batch files are processed by eliminating the need to read each stage shadow file.
  - Stage Shadow grid in Grid Output has been replaced by the Shadow Stress grid which now shows cumulative stress offset over entire grid (not just where fracture is active).
- **Pore Pressure Depletion** is now displayed in the map view as a "heat map" or gradient function instead of a monochrome area.
- **Pore Pressure Map** now shows depletion from both Wellbore Depletion input and imported pore pressure depletion model (GSLIB).
- **Fracture Conductivity Outputs** in GSLIB format have been removed since these formats cannot be correctly imported to reservoir simulators. Output files in cmgcsv.csv format are recommended.

- **Bug Fixes**

- Fixed BHT estimate that occasionally caused errors in production forecasts.
- Fixed issue when well surveys do not start at zero TVD/MD.
- Fixed issue with missing formation tops lines in output grids for some grid configurations.
- Removed limits on number of proppant and fluid lines in the input dat file (still limited to 10 actual proppants or fluids in a stage).
- Fixed a specific case when a well offset in the survey returned a value of exactly -999.25.
- Fixed an issue with offset computing grid display for longitudinal cases that distorted the map view.
- Fixed an issue with editing the wellbore string diameter in Well Construction and Geologic Section that could result in inconsistencies.

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# HALLIBURTON

## GOHFER® RELEASE NOTES

### GOHFER 3D 9.4.0.x

Original Release Date December 28, 2022



#### Build 32 (9.4.0.32) posted 04/06/2023

- **Drawing Tool** - Updated the "Draw Straight" tool in the LAS, Diagnostics, and Pumping Schedule (not in Grid Setup). This tool can be used to fill-in missing data in the input file or to correct discontinuous data that can occur when gauges are isolated or disconnected, especially during DFITs. Previously, drawing a free-hand line with the pencil tool to fill in missing data could be difficult and can lead to noisy derivatives.
  - In the LAS, instead of drawing a constant line over a selected depth range, the drawn line starts at the mouse-down point. Holding mouse down and moving the cursor extends a line to the end position of the cursor at any angle. Mouse-up sets the line at the indicated length and angle.
  - In the Diagnostics and Pumping Schedule it is possible to select an input curve in the Pressure-Time Data plot and turn on the draw-straight tool. Position the cursor on the data, mouse-down and move the cursor to the desired end-point. Mouse-up to set the line. In the diagnostics, the straight line works in either logarithmic or Cartesian time scales.

#### Build 30 (9.4.0.30) posted 03/30/2023

- **Well Construction** - Added the ability to designate each well as a "**Monitor**" well. The single reference well and any treatment well may be a Monitor Well. An output csv file is generated for each Monitor Well in the project with each simulation. The generated data is useful for comparing time of fracture arrival at specific monitor well locations to fiber data, offset pressure gauges, or sealed-wellbore responses. Output files are designated as <Design name>.<monitor well name>.csv. Each file contains a header row with job elapsed time and list of measured depths along the monitor well corresponding to the point of intersection of each fracture plane propagated from the treatment well. There are two sets of data at each MD intersection point.
  - 1<sup>st</sup> set - fracture width at each point of intersection with the monitor well as a function of treatment job elapsed time.
  - 2<sup>nd</sup> set - fracture fluid pressure at each intersection point and time.A graphical display of the monitor data will be added in a future release.

#### Build 28 (9.4.0.28) posted 03/22/2023

- **Grid Setup** - Fixed an issue which could result in well logs not being displayed in the grid for the horizontal logs track.
- **Depletion Model** - Fixed an issue with deleting a depletion model.

**Build 26 (9.4.0.26)** posted 03/15/2023

- **Production Forecasting** – Removed a conditional check that makes the “stimulated” production case no worse than an unstimulated well with no skin. GOHFER Production forecast compares un-stimulated production with a positive skin with post-frac stimulated production. Previously, the assumption was made that any frac, no matter how poor, would, at a minimum, bypass skin and could not produce worse than a zero-skin radial-flow completion. We have learned from experience that it is possible to damage a reservoir (especially one that is naturally fractured) by pumping an ineffective fracture treatment.

**Build 24 (9.4.0.24)** posted 03/14/2023

- **Production Forecasting** – Fixed an issue with the output water rate in the Production module. The water rate calculations are correct but were inadvertently divided by the number of frac stages.

**Build 23 (9.4.0.23)** posted 03/10/2023

- **Depletion Model** – Increased the storage and memory allocated for the depletion model.

**Build 22 (9.4.0.22)** posted 03/01/2023

- **Grid Output** – Fixed an issue where the longitudinal frac did not fall on the perfs in the 2D grid output. This problem was specific to deviated wells with long continuous perforated intervals. The issue has been fixed so the fracture appears in the correct connection to the well in both the 2D and 3D grids.
- **Wellbore Stability** – For clarification, the only pertinent output curves in the LAS are the calibrations to UCS, FA, and Cohesion. All the other output curves are used in the actual wellbore stability computations and do not apply to the actual treatment wells. In order to avoid confusion, these other output curves have been moved to the grid Intermediate Calculations folder. The wellbore stability output in the Grid Setup tab are correct and remain unchanged.
- **New Well Type** – A new well type (Monitor) is available In Well Construction that can be assigned in addition to Treatment and Reference. At this time, in build 22, selecting Monitor well will have no impact on a simulation. In a future build, it will be used to generate files for pseudo waterfall plots of fracture interactions as a function of time for any wells specified as monitor wells.

**Build 21 (9.4.0.21)** posted 02/24/2023

- **Transverse Fractures** – Resolved an issue with a message that could appear that indicated more transverse fractures will be generated than the number of perforation rows in the input table. This can occur when input perforations fall of a node boundary. There will now only be one transverse fracture for each perforation cluster as long as the cluster start-stop is less than a node length.

**Build 20 (9.4.0.20)** posted 02/22/2023

- **Petrophysical Analysis** – Fixed an issue where the longitudinal grids were blank due to the PHID curve not being output from the LAS. This issue only impacted projects using a geomodel and where GR is computed from PHIN-PHID (GR\_ND). The Grid Setup has been fixed so when there is no PHID, and GR\_ND is the selected curve, the longitudinal grid will be populated using the GR curve from the LAS. PHID will not automatically be output to the LAS. To output PHID to the LAS, open the LAS, and set Output to LAS as TRUE under the PHID curve properties. If the PHID grid is output from LAS and GR\_ND is the selected curve, the GR\_ND will be computed from the local PHIN and PHID grids and may be 3D spatially variable if those curves are provided by the input geomodel. Otherwise, the computed GR curve will be used over the entire grid and will not be spatially variable within each layer. The PHID curve is now in the Grid Properties group in the LAS.

**Build 19 (9.4.0.19)** posted 02/13/2023

- **Production Analysis (GPA)** – Fixed an issue when running a production analysis with rate control that resulted in the returned pressures being blown up. For oil reservoirs, either rate or pressure control works well. For gas reservoirs, running on rate control gives a better pressure result. Ensure that the input dimensionless data fits the type-curve. If it does, then the reservoir and frac descriptions are correct.
- **Pumping Schedule** - Auto Insert stages has been modified to a 15-second minimum time-step replacing the previous 30-second minimum to avoid missing important changes in data. All default resolutions remain the same.
- Updated help documentation and installation guide.

**Build 13 (9.4.0.13)** posted 01/19/2023

- **Design Output Summary** - Added both net and gross fracture height, flowing area, and propped area to the design output summary. The net and gross fracture height are used for calculation of flowing area and gross flowing area, and the same for propped areas.
- Fixed an issue where the perfs not displayed on the grid message appears if the PZS offset in the perfs table is not populated.

**-----Original v9.4 Release (9.4.0.10)** posted 12/28/2022-----

- **Wellbore Stability Calculations** - Added fracture extension pressure curve to the wellbore stability calculations along with breakdown and minimum mud weights. Improved the convergence for the minimum mud weight.
- **Fixed issue with the net pay estimate passed to Production** - This update also affects the reported fracture height, flowing area, and propped area in the job summary. Previously, the gross fracture heights were reported for each transverse fracture and used in the area calculations. These heights were not adjusted for contact with net pay in the grid. The previous net pay passed to production was based on the fracture height of the transverse fracture with the largest effective flowing length. With stress shadow included, this occasionally turned out to be the toe frac in the stage, which also had the smallest height.
- **Consistent Frac Height Determination for Production** - The proppant cutoff length passed to production and used to estimate well spacing has been the average of all transverse fractures. For consistency, the fracture height for each transverse fracture now represents the fracture height contacting grid cells marked as net pay. The Net Pay Height for production is now the average of all the transverse fractures net-pay contacted heights within the stage. The fracture summary table shown in the stage design summary and in the production Stimulation Properties are now consistent, and show the same values that also represent input to the production calculations. The Production Output shows a table of Transverse Fracture Results that is the output of the production calculations and is not the same as the input data table. This table does not show fracture height which is assumed to be the same as the input value.
- **Flowing Area / Propped Area** - For clarity, the Flowing Area reported in the stage summary is the sum over all transverse fractures Flowing Length\*Fracture Height\*4. Similarly, the Propped Area is the sum over Proppant Cutoff Length \* Fracture Height \* 4. The "4" in each case represents both faces of both wings of the fracture. As the table only reports the larger of the two asymmetrical fracture wings, the results should be used for relative comparison of designs and are not summing up the area of each cell in both fracture wings.
- Fixed an issue where an access violation error could occur when closing the grid setup after viewing the engine output.

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# HALLIBURTON

## GOHFER RELEASE NOTES

### GOHFER 3D 9.3.0.x

Original Release Date November 29, 2021



#### **Build 103 (9.3.0.103)** *posted 11/01/2022*

- Update that applies the near-well minimum breakdown pressure at each perforated node, based on the same calculations in the 3D Grid Breakdown Pressure view. This remove the limitation of losing transverse fractures if the perforated nodes are adjacent. Open-hole treatments can now be simulated with perforations over a long continuous string.

#### **Build 97 (9.3.0.97)** *posted 08/30/2022*

- Fixed issues with the geosteering feature including correctly displaying the treatment well horizontal logs in the grid, for geosteering, when turned on in the Options. Added color highlighting of the lateral LAS and making the LAS consistent with the well survey.
- GOHFER now accepts "Epoch time" (seconds since 1970) in imported csv job files.

#### **Build 93 (9.3.0.93)** *posted 08/05/2022*

- Implemented a change to the proppant holdup calculation. This change fixes the unrealistic proppant movement during shut-in as well as stops proppant settling during closure and minimizes the artificial overflush of proppant away from the fracture. The default coefficients (editable directly in the DAT file via the HOLDUP card) do not change the pumping results from the previous release version.

#### **Build 87 (9.3.0.87)** *posted 07/15/2022*

- Updated the impact on proppant movement during overflush and after shut-in. Lab data demonstrates that the proppant does not move much. The proppant holdup factor is now set to a large number when the input prop concentration is zero or when rate is zero. This should avoid the "proppant hole" around the perfs. This also stops or greatly reduces the artificial settling during shut-in, especially for slick-water treatments. Most simulators show all the sand at the bottom of the fracture, however, since fractures are not perfectly vertical or smooth, sand is likely entrained over the entire propped height on ledges and irregularities.
- The thermal heat flow and warmback model was modified to account for the volume of fluid injected through each perf cluster and the local leakoff through each node in the active fracture grid. Width of the fracture, cumulative volume lost at each cell, and current local leakoff rate determine the heat flow back from the reservoir to the fracture fluid during shut-in. The Reservoir Conduction Factor in the Geologic Section inputs acts to scale the heat flux. Default is 1 and values greater than 10 are not recommended.



- Updated auto-save feature. The auto save now saves as a screen is entered, instead of when it is left. This allows only the other screens on which the new one is dependent to be saved.
- Fixed a bug where the Grid thought it had been changed when it had not.
- A progress bar has been added when calculating all grids (can be a long process on some projects).
- Replaces the use of Internet Explorer with Edge for displaying Google Maps.
- Fixed an issue with the Formation Tops that primarily shows up with metric projects.

#### **Build 81 (9.3.0.81) posted 03/23/2022**

- Updated ANIS (Anisotropy) and STRESS\_MAX calculations:
  - The ANIS (Grid) =  $\text{ANIS}(\text{LAS}) * \sin(L)$  where L is angle between well azimuth and azimuth of max stress. The ANIS (LAS) curve may not equal ANIS (GRID) values unless the max stress azimuth (frac plane) is exactly perpendicular to the well azimuth. ANIS (LAS) shows total x-y stress difference. ANIS (GRID) shows anisotropy applied to the longitudinal grid plane.
  - $\text{STRESS\_MAX} = \text{STRESS\_TOTAL} + \text{ANIS}(\text{LAS})$  for any angle between the well and max stress.
- Edited the default settings in Sentinel licensing Wechoid.exe to the appropriate locking criteria
- Added 2 Sentinel licensing utilities to the C:/ProgramData/GOHFER3D directory:
  - Wcommute.exe - Licensing troubleshooting tool
  - RMSRepairUtil.exe – tool to repair license issues that may result from abrupt/unexpected machine shutdowns

#### **Build 75 (9.3.0.75) posted 03/08/2022**

- Updated calculation for BHP that prevents spikes in the pressure when the datum point is not at the grid top. New calculation gives the same results for BHP at the perfs and at surface. BHP at other locations it will be different on non-vertical wells. This change may affect existing pressure match projects. Calculated surface pressure should remain unchanged.
- Fixed an issue with deletion of a wellbore depletion model.
- Fixed a conversion error issue that was erased when the pumping schedule was opened.

#### **Build 70 (9.3.0.70) posted 02/25/2022**

- Fixed issue with the Wellbore Stability calculations in METRIC projects only. The units and curves for UCS and COHESION were not saved to the LAS and thus were not being sent to the Wellbore Stability calculations in the Grid Setup resulting in blanks and incorrect calculations.

#### **Build 68 (9.3.0.68) posted 02/11/2022**

- Fixed issue with Data Analytics Reports production results reporting 0
- Fixed issue with the user defined reservoir fluid viscosity entered in the geologic section reservoir properties not getting passed to the simulation leakoff calculations correctly.
- Added Auto Calculate options for oil/gas compressibility and oil/gas viscosity in the Reservoir Fluids section of Production Forecasting
- Added Calculation options in LAS processing for Divide, Subtract, and Invert. For Divide and Subtract, the curve order is important. First curve is divided by second and second curve is subtracted from first.

#### **Build 62 (9.3.0.62) posted 01/11/2022**

- Added functionality to RMS Utility to allow use of "localhost" license for network licenses that are installed on license server with GOHFER running on the same server.

#### **Build 60 (9.3.0.60) posted 01/10/2022**

- Fixed issue with accessing network licenses located on a terminal server (TERMINAL\_SERVER\_FOUND error) and made a change to trap and show the error in the tree where the access violation is shown



**Build 58 (9.3.0.58)** posted 01/07/2022

- Added error trapping (XML files) to debug issue with accessing network licenses located on a terminal server

**Build 56 (9.3.0.56)** posted 12/10/2021

- Added Support for IP addresses to be used server location for network licenses

**Build 54 (9.3.0.54)** posted 12/09/2021

- Updated Installation & Licensing Guide

**Build 51 (9.3.0.51)** posted 12/03/2021

- Fixed issue with the uninstaller still trying to uninstall the beta version.

**Build 50 (9.3.0.50)** posted 12/01/2021

- Updated Installation & Licensing Guide

**----Original v9.3 Release (9.3.0.49)** posted 11/29/2021----

**Upgrade to Sentinel RMS Licensing**

We are excited to announce the upcoming release of GOHFER v9.3 with Sentinel RMS licensing. Sentinel RMS will replace the existing Sentinel LDK platform. A new activation will be required in order to access GOHFER v9.3.

GOHFER v9.3 and Sentinel RMS will greatly improve the software activation process and enhance the customer experience. A new online customer portal will be used to distribute and activate your GOHFER licenses at your convenience as well as provide the ability to revoke a license and re-activate it on a new machine as needed. A new GOHFER\_RMS.exe utility will be available in the software that will provide the following:

- Access to the customer portal
- Ability to apply and revoke licenses
- Commute (detach) and return network licenses to/from a user machine
- Point to network server to access a network license

The GOHFER Installation & Licensing Guide has been updated with the new activation process and features.

**\*EOL (End-Of-Life) Announcement - Sentinel LDK Licensing**

Support for Sentinel LDK Licensing will no longer be available beginning April 1, 2022. Licenses for GOHFER versions that used Sentinel LDK Licensing (GOHFER v9.2 and below) will no longer be able to be updated/extended. Current software maintenance holders should update to v9.3. Perpetual license holders with discontinued software maintenance have the option to pay back maintenance to obtain access to v9.3 or receive a final perpetual LDK license for their last authorized version upon request.

**Log Processing**

- Added new Anisotropy LAS curve (ANIS) and Anisotropy grid. Anisotropy works same as before with added visibility. ANIS = CFOP by default.
- Added new STRESS\_MAX LAS curve and grid. The stress acting normal to the longitudinal grids is adjusted from STRESS\_MAX by the angle between the min and max stress azimuth and wellbore azimuth. The max stress normal to the longitudinal fracture plane is displayed in the STRESS\_MAX longitudinal grid and 3D views.
- Updated lithology model and equations. Removed VSANDINT. VSAND is used to obtain total lithology fraction sum to 1.0 after the others are calculated.

**Treatment Configurations**

- Fixed a bug for longitudinal fractures not displaying in the correct place in the 3D grid

**Engine Output Viewer**

- Fixed an issue with GOHFER crashing when entering a negative pump rate.
- Fixed an issue with the displayed frac length and frac width in the vector plots

**Batch Queue**

- Fixed some issues with adding jobs individually to the batch queue.

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# HALLIBURTON

## GOHFER 3D RELEASE NOTES

### GOHFER 3D 9.2.0.x

Original Release Date August 31, 2020



#### **Build 55 (9.2.0.55)** posted 08/24/2021

- Fix issue with the variable tortuosity for both vertical and horizontal wells with either single or multiple perforation clusters. Positive and negative tortuosity erosion factors may be more sensitive than before and may need to be reduced in magnitude.

**NOTE:** This fix will have a *significant* impact on any pressure matches performed in projects created in the last 6 months or more and will almost certainly require that the input tortuosity be changed.

- Added the ability to thin an imported structure map file if it is too dense causing slow response. On the map import window, a "Thin" button has been added to the left of the data field that allows the user to specify map density.

#### **Build 50 (9.2.0.50)** posted 07/26/2021

- Added check of node size in Geomodel import to round up the node sized from the imported model. Changed default to 30 M or 100 ft.
- Added a minor change in the Engine Output Viewer to correctly shown the value of the input data curves at the correct time when a time shift of the job start is applied. The problem was caused by job data files that had elapsed time in seconds instead of minutes. The plots of the data have always been correct. Issues was only observed when placing the cursor over a dashed input data line that showed the data at the selected point but at a time shifted by the start time offset. Fixes both old and new projects.

#### **Build 48 (9.2.0.48)** posted 06/15/2021

- Fixed an additional issue to correct the range for the export of the GSLIB file from the Grid Export.

#### **Build 47 (9.2.0.47)** posted 06/14/2021

- Fixed an issue where the GSLIB file from the Grid Export was indexed from 0. Now indexed from 1 same as the GSLIB output from the Engine and Treatment Configurations.
- Fixed access violation that occurred when trying to export the Grid Setup with Depletion before viewing the depletion.

#### **Build 46 (9.2.0.46)** posted 05/28/2021

- Fixed an issue in the new wellbore depletion model that only affected Metric projects. An incorrect unit conversion was being applied to the input depletion. The error does not occur when depletion is drawn in manually.

**Build 45 (9.2.0.45) posted 05/20/2021**

- Fixed an issue with entering wellbore depletion in "Single Vertical Treatment Well" project types resulting in an infinite loop since there is no 3D space to put the depletion. Wellbore depletion for vertical wells will only work and should only be applied in "Multiple Treatment Well / Enable Transverse Fractures" project types. There is no drawback to modeling vertical well simulations using "Multiple Treatment Well / Enable Transverse Fractures" project type.

**Build 44 (9.2.0.44) posted 04/30/2021**

- Updated/improved screenout model.

**Build 41 (9.2.0.41) posted 04/28/2021**

- Fixed an issue when a BHP datum is specified by the user, the offset head and pipe friction from the top perf to the BHP gauge was not calculated correctly. The reported BHP curve in the vector plot and other output is now corrected. Also, previously entering a BHP datum of zero gave unknown results. Now, a Datum MD of zero is interpreted as 0.1 ft MD to avoid divide by zero.
- Fixed an issue with how the tortuosity factor and change with erosion is handled. The perf erosion and change of tortuosity at each perf node are now handled correctly based on the amount of proppant that passes each perf'd node. The \*.BIN.csv file reports the updated tortuosity and perf conditions (d, and Cd) at each perf'd node.
- Corrected a noted issue with the grid-to-well pressure balance. At each step, the wellbore pressure at the perfs should equal the perf-node grid fracture fluid pressure plus the sandface pressure drop at each cell. The calculated well pressure at each perf'd node now balances correctly and the reported sandface pressure drop is correct.

**Build 36 (9.2.0.36) posted 03/25/2021**

- Eliminates some recursion and redundancy in the GPA Production Analysis/Oil/PVT properties where water gravity, salinity, Bw, TDS, among other things, were affected by multiple inputs that could be conflicting or confusing. Eliminates conflicting inputs and all water properties are consistent.
- In older versions of GPA, the water density used for the BHP estimate was hard coded to 1.0 and adjusted for temperature. 9.2.0.36 uses the correct input water density adjusted to the input BHT.

**Build 35 (9.2.0.35) posted 03/23/2021**

- Fixed an issue with the Wellbore Stability correlations (LAS Processing) for FADTC, UCSDTC, and COHESION and corrects the calculations of the minimum mud weight to prevent borehole collapse in the Grid Setup/Wellbore Stability tab for each well, by MD.
- Corrected the file name for the \*.cmgfrac (previously \*.cmg.h5) output file generated from the Tools menus under Treatment Configurations, Export Combined CMG Data.
- Improved/reduced the build time for adding jobs to batch. Tests reveal a 2-3x improvement.

**Build 31 (9.2.0.31) posted 03/02/2021**

- Fixed an issue with the variable skin damage estimated over time that is applied to the type-curve model to correct cleanup using the difference between the dimensionless production data and the type curve. Converge Pseudo Plot and Semi-Log Plots and generate type curve and production match. On the Cleanup Analysis plot, set smart line through best early linear skin points. Under ProductionAnalysis1 (or name of the test) in GPA, set Wellbore Cleanup to "True". Data will be adjusted and should better fit the type curve. Re-run production match and forecast with Wellbore Cleanup=True.

**Build 29 (9.2.0.29) posted 02/23/2021**

- Fixed issues with importing geomodel into GOHFER:
  - Model was not importing correctly if the null value was not -9999
  - Model was not importing correctly with the "diagonal" area when the first row contained too few points.

**Build 27 (9.2.0.27) posted 02/04/2021**

- Fixed label in GPA Forecast Inputs (THP updated to Forecast BHP)
- Updated help file

**Build 25 (9.2.0.25) posted 02/01/2021**

- Fixed "table out of range" or insufficient memory error export issue when attempting to export grid data from the grid setup
- Fixed an issue in GPA encountered when running the History Match/Forecast on rate control that was not returning the correct FBHP.
- Added a minor change to how the Help .CHM file is invoked in an attempt to avoid random crashes reported when attempting to open the HTML based help

**----Original v9.2 Release (9.2.0.4) posted 08/31/2020----****Well Construction**

- Updated State Plane Conversion Tool website links

**Log Processing**

- **\*NEW\*** **Expert LAS processing system**
  - Auto-calculate options simplified to one check box
  - GR and GR\_ND correlations and GR\_Min and GR\_Max are automatically set
  - New "SmartAverage" calculation mode assigned to PHIA, DTC, PR, and YME
  - New "Maximum" calculation assigned to RESIST to automatically find and use the deep resistivity (now plotted on log scale)
- Added Wellbore Stability correlations to LAS
  - The correlations compute the FA (Friction Angle), UCS (Unconfined Compressive Strength), and Cohesion and are applied to each well, using its directional survey and the cells it transits in the grid.
- Added PHIDDTTC curve

**Treatment Configurations**

- Added manual refresh to 3D Wellbore/Treatments view while job is running

**Grid Setup**

- **\*NEW\*** Pore-pressure depletion input table. Follows input well trajectory and  $\ln(r_e/r_i)$  pressure distribution with inner and outer radii of depletion
- Default Transverse Aspect set to 4

**Design**

- Design type and fluid type is now entered on the design level screen
- Added perforation erosion factor to the design reservoir properties
- Added Run Engine Options section

**\*NEW\* Batch Server**

- Batch run on external distributed, multi-core processors (cloud computing)
- Option to run batch jobs locally, or submit to an external system
- Job status is reported back to the source computer while batch jobs are running
- Results sent back to source computer at the end of batch execution
- For normal batch runs, the "Complete All Jobs" message is now automatically displayed at the end of batch execution

**Production**

- Fixed the production forecast and production analysis BHFP calculations to improve stability

**Engine Output Viewer**

- Added ability to edit the effective conductivity cutoff value

- Added information for design summary report. Replaced average and max width with average conductivity and average proppant concentration over proppant cutoff length
- New Data Analytics Report (Treatment Composite/Data Analytics). Automatically compiles all treatment results from all runs in all geologic sections into a single file for analysis in external programs (Spotfire, etc.)
- Perforation erosion, with editable perf erosion rate, fluid distribution, and other data added to new summary output file (\*.BIN.csv)
- Added new output to all Engine Output grid data properties tables
- One-Click export of all fracture data to \*.cmgfrac file
  - Export fracture conductivity at each grid cell, tied to perforation location in each treatment well, with specified fracture azimuth
  - Location of each grid cell specified relative to wellbore and perf location
  - Export all fractures/wells/stages from Treatment Configuration/Wellbore tab
  - Exports individual stage data, with triplets file, at selected time-steps
  - New file format less than 10% of GSLIB file size / eliminates gaps in data
  - File \*.cmgfrac format is fully integrated for input to CMG

### **\*NEW\*** Production Optimization

- The GOHFER Production Optimization feature (accessed from the design level) provides a quick, convenient and robust method to optimize completions based on spacing (well spacing or frac spacing) and by length (frac length or stage length). Using a consistent set of inputs for well, reservoir and economic properties, GOHFER Production Optimization allows for multiple treatments to be created varying fracture treatment properties such as proppant concentration, horizontal well properties and materials. It will then provide plots comparing the treatments across a spectrum of user defined spacings or lengths. This can be used to determine an optimum, economic completion to add value to your asset.

### **Fluid Database**

- Updated system fluid library
- Added fluids for generic borate-guar crosslinks from 15-40 ppt, 80-100F
- Added generic linear guar from 10-40 ppt, 60-180F

### **Miscellaneous**

- Updated Sentinel Run-Time Environment (v8.11)
- Updated installation & licensing guide
- Updated help documentation
- PVT oil and gas correlations added to documentation
- New installation options for batch server
- Misc. bug fixes

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# HALLIBURTON

## GOHFER RELEASE NOTES

### GOHFER 3D 9.1.3.x

Original Release Date May 1, 2019



#### Well Construction

- Fixed an issue with the last depth in the 3D survey being greater than the 2D survey due to a rounding error. Only shows up with the transverse + longitudinal.
- Added ability to allow the user to enter a null value for the GeoModel. Handles cases where a null is not automatically detected. The default null value is -9999.0.
- Fixed an issue with the longitudinal fracture orientation for wells that kick out left or right. GOHFER now uses projects from the median MD as opposed to the intersection point where the wellbore intersected the top of the grid.

#### Treatment Configurations

- Fixed lockup on Validate Designs in Treatment Configurations. It would lock up if the user had drawn on the grid.
- Removed Tools – Options menu item in Treatment Configurations

#### Pressure Diagnostics

- Updated exponent in G Function permeability equation to 1.9
- Fixed issue with the highlighted (red) values of the non-computed diagnostics outputs

#### Grid Setup

- Fixed grid labeling issue
- Made Modulus Stiffness Factor savable
- Fixed an issue with stage shadowing and a stage shadow file sometimes not being created
- Included the Flowing Area and Propped Area in the design summary
- Fixed an issue with the display of the Structure Line not always being displayed.
- Fixed an issue with the BD Mud Weight and BD Gradient in both oilfield and metric projects
- Fix for the Stage Shadowing not saving the Shadow Break
- Fix to automatically save a change to the Use Closure Width
- Fixed an issue with AVH was being used in the transport instead of the PHOLDFACTOR
- Fix for formation top lines not being drawn correctly with structure on longitudinal fractures when there was only 1 transverse frac
- Fixed an issue with the total stress not being computed if the Pore Pressure depletion was from the main Geologic model.
- Added UNIFORM card to DAT file that adjusts for aspect ratio and other parameters related to more uniform growth from node to node.



### **Engine Output Viewer:**

- Fixed triplets file export issue
- Fixed vertical well output viewer issue
- Fixed an issue with using a user defined proppant cutoff ½ length
- Fixed an issue with Tortuosity that was most pronounced when running a simulation with only one node perforated
- Fixed issue to the sandface pressure drop calculations when using both transverse and longitudinal fractures from the same perforated node. Was previously computing too low a total pressure drop.
- Fixed issue with a high calculated BHP in N2-quality pumping schedules that would blow up simulation
- Fixed an issue that resulted in left/right fracture growth bias
- Fixed issue with acid treatments to correct differences in aspect ratios and a change to limit time steps to 0.1 seconds
- Fixed an issue with the thermal model where it not outputting the right temperature at perfs in the vector plots, and had the wrong perforation locations for injection in the heat flow calculations.
- The acid reaction model was changed to run small time steps when live acid is injected. This is necessary because the acid reacts faster than it transports, so the normal time step algorithm failed.
- Fixed a bug causing phantom conductivity when the frac got to the left edge near the top of the grid.
- Re-added the creation of the triplets.csv file with each simulation.

### **Engine Composite**

- Fixed units and plot issues in Metric Engine Composite

### **Production**

- Frac Type input will no longer be changed to Longitudinal when the Well Orientation is changed from Vertical to Horizontal.

### **GOHFER Production Analysis (GPA)**

- Fixed the Copy All and Save to File in Production Analysis
- Fixed an issue in GPA with chopping off the data after the first few lines

### **Fluid Database**

- Updated guar fluids (Generic/Guar folder)
- Fixed an issue with the polymer gel loading as there are 2 entries in the fluid database. One is used in production and the other in the simulator. Both now give the right output in the grids and affect the production calculations.

### **Miscellaneous**

- Added visual theme options for users to choose from
- Added Halliburton branding
- Updated Sentinel Run-Time Environment (v7.92)
- Updated help documentation
- Fixed an issue when opening multiple Perfs screens and then exiting GOHFER or closing the project without closing all screens first could result in an invalid pointer assignment
- Fixed an issue with the positioning of the opening splash screen. Discovered that if the top of the monitor was not at 0, the splash screen was not centered properly over the main GOHFER screen
- Fixed issue with occasional unlicensed product error
- Updated support for high resolution monitors and multiple monitors
- Misc. bug fixes (including memory leaks)
- Added a check box with the option to completely uninstall the Sentinel driver

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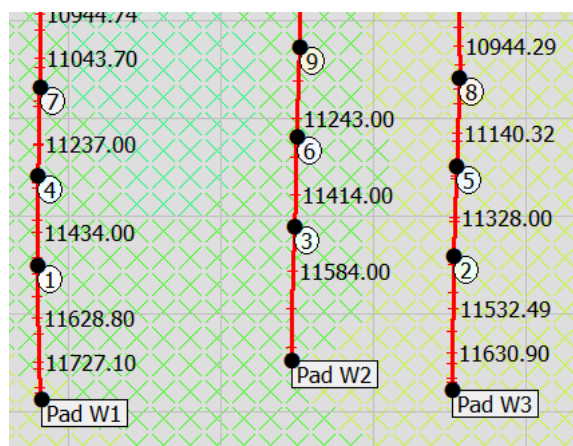
## GOHFER 3D 9.1.0.x

Original Release Date July 6, 2018



### Highlighted GOHFER 3D v9.1 Features:

- **Design Template/Design Creation** - can be used to generate multiple designs very quickly instead of having to make designs one at a time. This is useful to quickly create and populate multiple pumping schedules, perforation configurations, fracture spacing and clusters per stage for multiple stages across multiple wellbores.
- **Automatic Stage Shadowing** - this new feature is used to graphically set the order in which the fracture stages will be pumped across multiple wellbores and automatically set the stage shadow order accordingly.



- **Performance Enhancements** -
  - In Grid Setup added parallel processing for computing the calculated grids.
  - Added parallel processing to improved 3D display. The display is simplified while rotating and moving with the mouse for improved response.
  - Previous versions had about 1/3 of the computations in the engine using parallel processing. This version has about 2/3 of the computations running in parallel.
  - Engine Priority - In the Run Engine Options, the priority level of the simulation can be set. Recommendations are shown below based on number of cores.

Setting	Priority	Recommendation
Background	low priority with ½ the cores	Recommended setting for dual core
Foreground	normal priority with all the cores	Best for most users
Max Performance	high priority with all the cores	Quad core or above recommended

## Well Construction

- Site Location now defaults to the Reference Well location. This addresses issues with wells not being landed in the right TVD section of the grid. If there is no reference well location, then use the center of all the treatment wells as the site location.
- Added import function for a Surface Map that either loads from a GSLIB or csv file.
- Added option to Clear or Remove Surface Map
- New Zoom/Drag controls added to Map View
- Increased geologic model size limit
- GSLIB Viewer
  - Wellhead locations now displayed on map view in viewer
  - Save or extract a surface map layer or structure map to be used in the GOHFER 3D project
  - Select or reduce the size of the geomodel area to be imported into a GOHFER 3D project
  - Select the desired properties from the geomodel to be imported into a GOHFER 3D project
  - Displays total number of layers
- Fixed an issue with copying/pasting easting, northing, and elevation from a spreadsheet into the Well Construction well locations table.
- Added CLAT (completed lateral length) to each treatment well wellbore string information. It should be set to the length of the lateral that can be frac'd without the stages running up the build section.
- Ability to read/import our own exported GSLIB file

## Log Processing

- GR\_STEER has been replaced by GR\_TOTAL. GR\_TOTAL is an input into GR as an omitted curve. The GR log assistant has been moved to GR\_TOTAL for setting GR Min/Max.
- GR\_ND is a new input for GR computed from PHIN – PHID and can be used as a surrogate spectral gamma ray. The GR log assistant is used to scale GR\_ND.
- For vertical well simulations, added the ability to assign the same well as the Reference Well and Treatment Well. In this scenario, the unassigned well can be removed from the project column and the grid will be constructed from the remaining well.
- Change  $R_w$  default for  $S_w$  to 0.02.

## Grid Setup

- Added ability to import a depletion model to either the pore pressure or pore pressure offset grid (very similar to the main geologic model)
- Ability to export selected input grid properties as a geologic model in GSLIB format
- Fixed an issue where if there is no structure, any user drawing did not get into the engine correctly

## Engine Output Viewer

- Proppant Cutoff Length can now be seen on both the Proppant Concentration and Effective Conductivity output grid. Proppant cutoff length can only be altered on the Effective Conductivity grid.
- Fixed an issue with the 3D display of single vertical fractures.
- Removed triplets.csv file and replaced with triplets.gslib file
- Ability to export selected output grid properties in GSLIB format for all desired simulations (via Treatment Configurations screen)

## Batch Queue

- Jobs in the Batch queue are indented when shadowed by a design.
- A right click on a Geologic Section adds all the designs in the section to the batch queue.
- A right click on a Stage that is not shadowed has a new item to add all designs in the shadow group to the batch queue.
- After batch queue has run, right-click on batch message allows all jobs to be completed by opening them all and generating the output summaries

### Pressure Diagnostics

- The x-axis on the Test Events plot is now defaulted to logarithmic scale
- The permeability estimate from G at Closure is initially calculated using a default closure-pore pressure of 1500 psi. Once closure pressure and PZS is set from the analysis, perform the after-closure analysis (ACA) to determine the correct value for the ACA pore pressure. This updates the pore pressure in the Reservoir Properties section. To get the final G-perm it is no longer necessary to go back to the G-function and move the closure line to re-calculate the results.
- Fixed an issue where changing the pore pressure in the est. reservoir properties did not update the diagnostics Pp (while diagnostics was open). Had to previously close and reopen diagnostics to refresh.
- Can now select (from dropdown menu) the associated treatment well for an individual diagnostic analysis
- Added setting of CFOP value in G Function, Log Log and Sqrt plots

### Miscellaneous

- Updated Sentinel Run-Time Environment (v7.80)
- Updated help documentation
- Updated system requirements posted to <https://barree.net/gohfer/system-requirements.html>

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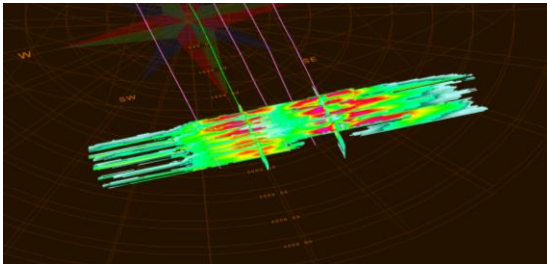
## INTRODUCING GOHFER 3D 9.0!

Original Release Date May 30, 2017

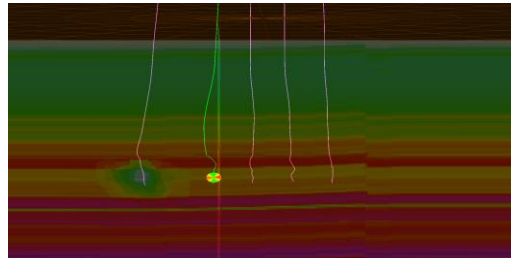


### New GOHFER 3D 9.0 Features

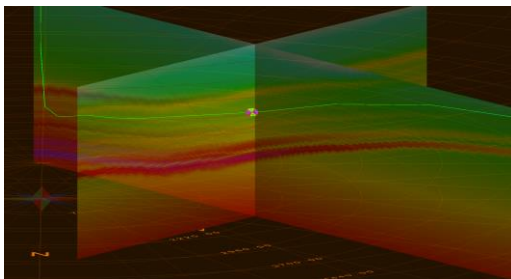
- Ability to add multiple wells, including vertical and horizontal, in the same project
- Fracture stress shadow interference between each fracture and stage on each well
- Can simulate: Multi-layer completions / Zipper-fracs/ Offset Depletion Effects
- Full 3D geo-mechanical earth model input (from Petrel GSLIB file)
- Optional input of 2D surface map with reference well logs
- Geo-steering of laterals and engineered completions
- Full processing of log or "core" from 3D earth model



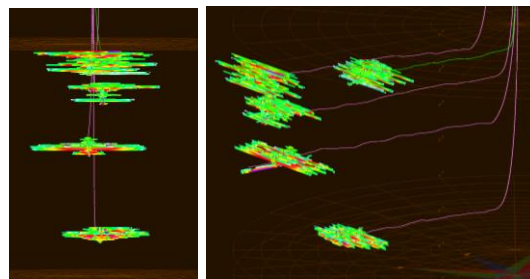
*Zipper-Frac Interference*



*Offset Well Depletion Effect on Total Stress*



*Example Total Stress Imported from 3D Model*



*Multi-Layer Completions*

### Well Construction

- Can define coordinate system and site/ well locations
- Ability to convert latitude and longitude to state plane
- Ability to lookup state plane zone by county
- Ability to display location on map
- Ability to view surface map (and layers) of all wells
- Removed option to Add Reference Survey and LAS option in Well Construction
- Removed option to Convert Treatment LAS to Reference LAS option in Well Construction
- New Project Type options:
  - Single Vertical Treatment Well / No Transverse Fractures
  - Multiple Treatment Wells / Enable Transverse Fractures
- Wellbore string inputs now accessible from each individual well under Well Construction or from the well tab under Geologic Section
- Disabled MD/TVD mode in survey. MD/INC/AZI required.
- Added GSLIB viewer

- Added link to State Plane and UTM conversion tools
- Fixed an issue with right click paste in Well Construction/Well Locations table

### Log Processing

- Reference LAS input data options:
  - Reference well logs only (no geologic model available)
  - Reference well logs and core sample(s) taken from an imported geologic model
  - Core sample(s) taken from an imported geologic model (no reference well logs)
- Moved PORE\_P\_LAS and STRESS\_TOTAL\_LAS to bottom of PORE\_P\_SRC and STRESS\_TOTAL\_SRC so they will no longer be automatically used if they are mapped. To use these curves, the user must manually move these to the top of the list.
- Moved LAS Assignments to the top in LAS Processing/GOHFER Curves column
- Added a change to prevent user from shifting or scaling PORE\_P\_SRC or PORE\_P\_EST
- Added the following new LAS curves:
  - AVH / PHIS / YMEAS / DTCYME / NETPAYEST / SWEST / BIOTS\_VPHIE

### Grid Setup

- Simulation mode options:
  - Transverse Only
  - Transverse + Longitudinal
  - Longitudinal + Transverse
- Default node size now set to 5 ft
- Further separated and reorganized grids into separate folders (Grid properties and Intermediate Calculations)
- Tabs for each wellbore
- Ability to see multiple wells in transverse grid tabs
- Added Map view option to grid setup
- Ability to add faults in map view
- Ability to view geologic model scatter plot in map view
- Added the ability to change the map layer in Treatment Configurations/Wellbore tab
- Addressed issues with renaming designs affecting stage shadowing
- Ability to export grid data to geologic model in GSLIB format
- Added a Fit to Ruler option in the Engine output for Node Width
- Removed V/H Factor from the PZS and PHOLD grid. Now handled by the AVH grid.
- Renamed Baseline Conductivity output grid to Effective Conductivity
- Each simulation now generates a triplets file in gslib format (\*.triplets.gslib) in addition to the triplets.csv file
- Added the option to select which curves to export to the triplets file
- Added wellbore stability calculations and ability to export the data

### Engine Output Viewer

- **ALL** simulations are now asymmetrical. Symmetrical fractures are no longer simulated.
- Fixed an issue metric projects that displayed the perf MD at the bottom of the screen in oilfield units instead of metric units
- Fixed an issue with the pipe friction calculation for BHP in the engine
- Fixed an issue with the Ruler for proppant cutoff length not working on vertical well projects

### Pressure Diagnostics

- Removed option to override auto-calculated hydrostatic head in the Well Configuration inputs
- Updated equation for permeability estimate from G Function

### Production

- Fixed an issue with the New Fracture Data Available message not updating properly
- Addressed an issue where production would not open after running simulations in batch mode

**Production Analysis (GPA)**

- Redesigned and reorganized input and output results screen
- Rename Num Transverse Fracs to Number of Stages
- Added context sensitive help

**Fluid Database**

- Updated Fluid Database
- Fixed an issue with the pipe friction plot calculations

**Proppant Database**

- Updated StimLab database of proppants
- Proppant grading is now provided to inform users of differentiation in terms of quality/timeliness of conductivity data

**Miscellaneous**

- Ability to convert previous projects to v9.0
- Ability to view all wellbores, fractures and map view layers on the Geologic Section/Wellbore tab
- Updated Sentinel Run-Time Environment (v7.60)
- Fixes and enhancements to the Undo Feature
- Fixed an issue with remembering a user adjusted Modulus Stiffness Factor
- Updated HTML based help file



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## GOHFER 8.4.0

Original Release Date June 3, 2016



### Log Processing

- Added included/excluded range check box to all Log Assistant Limit Depths options

### Grid Setup

- Added new geosteering feature to correlate reference well GR and treatment well GR to locate the well more accurately and adjust geologic structure automatically
- Added Structure/Geosteering Keyboard Actions menu item to the Grid Setup/View menu
- Enhanced grid copy, paste and move drawn grid cell features
- Fixed an issue with the stress grid potentially not being initialized correctly in the engine when using transverse structure

### Perf Editor

- New Add perfs feature to automatically generate multiple perf clusters based on cluster spacing

### Run Options

- Redesigned Run Options screen
- Added option to *Use Closure Width for Stress Shadowing* - uses the closed fracture profile to generate the stage stress shadow. Use this option if there will be a significant time between fracture treatments (several days for example).
- Added new stability options
  - Time steps - increase stability or faster execution speed
  - Minimum Fracture Width - cells below this minimum width will not be included in material balance
  - Minimum Fluid/Proppant - controls which nodes are included in the material balance

### Engine Output Viewer

- Added optional Thermal or heat flow model for the wellbore and fracture which accounts for cooling effects on breakdown. Both vector and a grid temperature profile output is available in the engine output viewer.
- Added the ability to generate a .CMG file for vertical wells in addition to horizontal wells
- Fixed an issue with saving the Baseline Conductivity output grid to an .AVI file
- Fixed an issue with the display of the summary output of total fluid loss

### Batch Run

- Restart file - created whenever a job is terminated prematurely. Have option to run simulation from restart file instead of from beginning of the job
- Can now generate a 1 batch queue with designs from multiple projects
- Jobs may now be added directly from the Batch Queue Screen
- Batch Queue may now be reordered by dragging the jobs up or down the queue
- Added right click actions for the simulations in the queue
- Can now add simulations to the batch queue while it is running
- Added notifications for a queued job being out of date

### **Production**

- Added warning when running production if there is no frac in net pay.
- Default Well Spacing for horizontal simulations is now  $2 * \text{Proppant Cutoff Length}$
- Fixed issue with mapping of secondary fracture rate curves

### **Production Analysis (GPA)**

- Restricted the minimum abandonment rate to a non-zero value to avoid an error
- Fixed error on the Rate decline or decline curve when selecting "B" before anything else

### **Pressure Diagnostics**

- Added Blowdown analysis - used to estimate the wellbore compression at the beginning of pumping which provides a good value for the decompression at shut down. This can be used to estimate the amount of tortuosity required to match blowdown and determine a more accurate ISIP.
- Renamed PDL plots to Fissure Leakoff
- Now either calculates/reports a PDL Coefficient (if positive slope) or Transverse Storage Coefficient (if negative slope) in the Fissure Leakoff Analysis
- Fixed an issue with the tortuosity units in the Blowdown analysis in metric projects
- Fixed an issue with the Fissure Leakoff analysis plot not being added to report
- Fixed an issue in the Blowdown Analysis when plotting result curve for metric projects
- Fixed an issue in the PDL Analysis with the display of the Transverse Storage Coefficient in the Results

### **Miscellaneous**

- Fixed an issue in metric projects with drawn values on the transverse grids were not being converted properly
- Fixed error that occurred if you clicked Save with no screen open
- Improved proppant transport to reduce overflushing and settling effects during shut-in
- Fixed issue with stage shadowing for wells with depth unit in meters
- Fixed issue with microseismic data rounding errors
- Added Windows 10 compatibility GUID to GOHFER.exe manifest
- Changed GOHFER to use a 32-bit format when reading the Open GL display

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## GOHFER 8.3.1

Original Release Date December 8, 2015



### Upgrade to Sentinel LDK

- Upgraded licensing technology from Sentinel HASP to Sentinel LDK.
- Ability to easily adjust the expiration date, key memory data or add/subtract network seats without the need for a new C2V file.
- Licenses are now re-hostable which means a standalone or network license SL (soft license) can now be transferred from one machine to another by the end user. It will no longer be necessary to cancel and reactivate a license when moving to a new machine.
- The Sentinel Run-time Environment Installer to v7.41 and Sentinel License Update Utility provided in 8.3.1 will be required to be installed in order to perform all license activations from this point forward.
- The following GOHFER modules may now be licensed/purchased individually:
  - GOHFER Petrophysical Analysis
  - GOHFER Fracture Simulation & Production\*
  - GOHFER Pressure Diagnostics
  - GOHFER Production Analysis (GPA) – rate transient analysis
  - GOHFER Real Time

\*(requires the purchase of GOHFER Petrophysical Analysis)

### Survey

- Added a Reset button to the Treatment and Reference Surveys to clear the survey and reset to default values.
- Fixed issue with pasting into Survey not refreshing the calculated columns correctly

### Grid Setup

- Fixed issue with using the drawing tools in the Transverse grids
- Fixed issue with the Formation Tops when adjusting geologic structure in the grid setup

### Perfs

- Included Add button to perf menu to easily add multiple Perf Clusters by starting depth, cluster spacing and number of clusters

### Engine Output Viewer

- Updated/improved the Proppant Cutoff Length calculation
- Made new Output Grids (added in 8.3.0) available on the 3D grid view
- Fixed issue with the display of proppant ramp in Engine Output for metric projects

### Production

- Frac Height (in Production/Stimulation Properties) is now determined from by the tallest frac instead of "best" frac.

### Production Analysis (GPA)

- Added a new bottom hole pressure calculation
- Change BHP to default to 0 if it cannot be calculated
- Fixed an issue with the Input File Preprocessor in GPA causing an incorrect time shift
- Added conversion of Months to Days for Production Analysis input files

### Miscellaneous

- Added a legend on the Production Composite and Engine Composite
- Improved the File/Project Cleanup Screen

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## GOHFER 8.3.0

Original Release Date August 31, 2015



### INTRODUCING GOHFER PRODUCTION ANALYSIS (GPA)!



- Uses actual production data to analyze post-frac performance and assess stimulation effectiveness.
- Includes rate transient type-curve analysis, decline curve analysis, production forecasting to ultimate recovery and flow regime identification.
- Determines fracture spacing and effective well spacing for horizontal wells along with the fraction of the lateral producing.

**NOTE:** GPA will be available for purchase as an add-on to GOHFER 8.3. Purchase of the entire GOHFER product suite is not required to acquire GPA. Existing GOHFER users will receive limited term evaluation copies of GPA with their 8.3 license update.

#### Log Processing

- Fixed error that occurred when right-clicking to remove an input curve

#### Well Construction

- First line of 3D survey fully is now editable to allow for surveys not starting at MD/TVD=0
- Added folders for improved presentation of information (Well Information / Location / Project Settings / Ball Seats)
- Added State Plane Coordinate System as alternative for UTM Coordinates
- Added Ball Seat table used to define ball seat depths (MD) and diameter. Values used in ball seat pressure drop calculations

#### Geologic Section

- Rock Compressibility in the Est. Reservoir Properties now has the option to be Auto Calculated or overridden and entered manually
- Fixed issue with Zone in the Est. Reservoir Properties not being remembered
- Fixed issue with OBG in the Est. Reservoir Properties that did not automatically update the calculated Total Stress grid

#### Grid Setup

- Moved Formation Tops to Grid Setup
- Ability to edit Formation Tops line thickness
- Added ability to apply geologic structure transverse to wellbore in horizontal simulations
- Added ability to draw structure starting at different locations in the grid
- Added Ruler that displays length/height/average value of user selected area/grid
- Added option to display Gamma Ray curve and/or lithology along left side of grids
- Added ability to display Horizontal Treatment LAS along bottom of grid with ability to edit visible curves
- Added ability to Undock/Dock individual grids
- Fix refresh issue in grid when changing # columns.
- Add ability to display/hide curves on Input Data tab/image
- Added user selection of curves to display on Input Data tab/image

### **Pumping Schedule**

- Added the ability to generate a proppant ramp pump schedule
- Added an automatic actual pump schedule generator with time and sensitivity filters to quickly generate stages from actual job data files
- Fixed issue with the Ball Drop Copy >> function

### **Engine Output Viewer**

- 3D output grid view now in orthographic projection in 3D instead of perspective by default
- Added new Vector Data curves:
  - Ball Seat Pressure Drop
  - Cumulative Injected Slurry Volume
  - Cumulative Pumped Proppant Mass
  - Total Fracture Proppant Mass
  - Fluid Loss (to) Storage
  - Proppant Loss (to) Storage
- Added new Output Grids:
  - Transverse Stress (simulations w/ multiple transverse fracture only)
  - Shadow Pressure (simulations w/ Stage Shadowing only)
  - Total Velocity
  - Cumulative Injected Slurry Volume
  - Fluid Loss to Storage
  - Proppant Loss to Storage
- Baseline Conductivity output grid now displayable in 3D view
- Added Ruler:
  - Displays length/height/average value of user selected area/grid
  - Can be used to show and set Proppant/Acid Cutoff Half-Length / average proppant concentration / averaged etched width / Gross Frac Length
- Improved algorithm for calculating proppant/acid cutoff half length
- Added Show/Don't Show Perfs option on grids.
- Additional information provided in selected output grid properties menu including average, min, max value for the current time step and selected fracture.
- Added logarithmic axis option in the axis properties for the engine output vector plots

### **Production**

- Fixed an issue with the reported rate units in the Production1Metric.csv file
- Improvements to importing/displaying actual production history
- Actual production pressure history can now be used for Well Control Flag
- Added the ability to simulate multiple production scenarios for each design
- Added fracture data status message to indicate when new fracture data (proppant cutoff half-length/proppant concentration) is available via Ruler adjustments

### **Diagnostics**

- Can now add multiple Diagnostics analyses for each Geologic Section
- Renamed the PDL event line to FO (Fissure Opening) on the G Function Plot
- Renamed PDL Coefficient Analysis to Fissure Leakoff
- Negative slope of the Fissure Leakoff Analysis will not produce an associated Transverse Storage Coefficient
- Added a close button to each analysis window
- Rock Compressibility in the reservoir inputs now has the option to be Auto Calculated or overridden and entered manually
- Revised the calculation for the reservoir temperature in the reservoir inputs

### **Fluid Database**

- Added editable pipe friction plot for each fluid

### **Perfs**

- Added ability to import ball seat locations for perfs if entered in Well Construction

### **Real Time**

- Fixed an issue with acquiring real time space delimited network files
- Added ability to save RT plots to reports
- Fixed Save/Copy picture feature on RT plots
- Added support for additional time formats

### **Reports**

- Fixed an issue with adding the Baseline Conductivity output grid image to report
- Gas compressibility, Gas Viscosity and Total Viscosity now added to the reservoir fluids section of the production report
- Improved reporting of Transverse Fracture properties
- Updated Design summary display to show the same table of fractures as the report

### **Input File Preprocessor**

- Can now paste data directly into Input File Preprocessor. This will avoid the need to save data from a spreadsheet to temporary csv file.
- Added a new Conversion – Fixed Step on the time column. Can be used if GOHFER cannot read the time/date. Options are steps of 1/60 or steps of 1.

### **Treatment Composite**

- Added Engine Composite to compare vector data from multiple designs/geologic sections in a project
- Can now import actual production history into the Production Composite for history matching

### **Acid Fracturing**

- Fixed issue with FCD and conductivity calculations in horizontal and transverse fracs

### **Miscellaneous**

- Added support for Windows 8.1 variable screen resolutions
- Added a repair for projects that have been renamed by user
- Save As function can now be used save to zip file for archive or backup
- Improved overall simulation stability
- Added support for multiple processors. Simulations may run as much as 30% faster
- Fixed a bug that allowed PC to go into sleep mode during a long batch run
- Addressed floating point overflow errors
- Added Delete All option to all tables (accessed via right-click)
- Added yellow icon markers to the project column to indicate that one or more of the input screens has changed since the Design was last saved. Design may need to be executed again to generate new output to reflect the changes to the input data.
- Added green icon markers to the project column to indicate that the engine output viewer (results) have not been viewed (only applies to simulations run in batch mode).

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## GOHFER 8.2.6

Original Release Date February 25, 2015



### Log Processing

- Fixed issue with editing and remembering the LAS Assistant Limit Depths
- Fixed TVD conversion issue for mixed unit projects (Meters/Oilfield)
- Disallowed entry of 0 for Null value for the LAS
- Add YMEPHIA to the list of Best Fit curves on the YME Log Assistant
- Fixed scaling issue with metric logs

### Well Construction

- Added right click menu in project column with option to open In Windows Explorer – Allows browsing to the directory containing the GOHFER files.
- Fixed issue if azimuth was all 0's that resulted in Unable to Read Perfs error
- Fixed an issue where the wrong average azimuth was being calculated when there was an azimuth change of > 180 without going past zero

### Pumping Schedule

- Fixed issue with saving the pump schedule
- Fixed issue with start time being later than time 0.0

### Grid Setup

- Fixed issue with using transverse or longitudinal aspect ratio in the grids when modeling a single transverse fracture
- Fixed refresh issue when performing an Undo on the grids
- The "depth", as tracked by the cursor, is now labelled correctly. It was being labeled as time until a grid was chosen

### Engine Output Viewer

- Fixed issue with stress shadowing on vertical wells
- Replaced Effective Conductivity output grid with Baseline Conductivity to facilitate exporting fracture conductivity from GOHFER to a reservoir simulator (see help file for more detailed explanation)
- Fixed issue in projects with long metric horizontal wells where structure was not displaying the longitudinal frac properly in the longitudinal output grid
- Fixed issue with Engine Output not calculating the intersection of the wellbore with the top of the grid correctly

### Production

- Fixed production NPV Issue where the treatment cost was multiplied by both the number of fracs and by the number of stages
- Fixed issue with horizontal production when modeling only a single transverse fracture
- Updated internal calculations for Embedment and Spalling
- Fixed some inconsistencies in transverse fracture production

### Diagnostics

- Re-enabled option to double-click in order to open an Analysis window
- Fixed issue with drawing on curves that are not in the project units



### **Fluid Database**

- Updated fluids.csv file with updated friction factors for slickwater
- Added adjustable effects of crosslink delay factor to graph
- Fixed issue with  $U_0$  (zero shear viscosity) auto-fit in fluid database that resulted in a negative  $g_L$  (transition shear rate)
- Removed redundant question when prompted to save fluid that was being deleted, which could cause the fluid to not be deleted

### **Real Time**

- Added support for the following time format with MMDDYYYY HH:MM:SS (space in between) in comma delimited file formats
- Mouse over shows values on Real-Time plot

### **Miscellaneous**

- Fixed an inadvertent limit on the number of allowable transverse fracs
- Fixed a bug where adjusting the Transverse Storage Coefficient had no effect on results. Issue impacted vertical well simulations only.
- Fixed issue with copying and deleting designs
- Implemented stage stress shadowing options for the batch run process
- BHP Datum now displays <Grid Top> instead of negative value for default
- Sorting of transverse fractures is now the same in both the Engine Output Viewer and Production
- Grid lines are now optional on Time base plots and settable per axis
- Lithology track on Perfs, Grid Setup and Engine Output are now drawn fresh rather than being pulled from the image written by the LAS processing
- Fixed issue with Plot the Column feature in the Input File Preprocessor
- Fixed issue with some csv files that were not importing correctly because of time steps less than 1 second.
- Fixed a bug that was preventing purging of the Debug log
- Fixed "Not a Valid Date and Time Error" issue observed in international locations
- Implemented new Delphi compiler that eliminated most third-party controls for windows and tree structures
- Updated icons on the toolbar and menus

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## GOHFER 8.2.4

Original Release Date September 2, 2014



### Log Processing

- Rearranged hierarchy for PR and YME Log Assistants to reflect PRDTC/PRACT/PRPHIA and YMEDTC/YMEACT/YMEPHIA
- User defined Auto Fit depths (top/bottom) in Log Assistants is now saved and added as a global variable
- Fixed bug associated with opening a 2<sup>nd</sup> LAS file after processing the initial LAS file

### Well Construction

- Default Stress Anisotropy is set to the CFOP (Critical Fissure Opening Pressure) grid
- Added ability to define the wellhead location elevation, northing and easting
- Added utility to convert latitude and longitude to UTM coordinates
- Added ability to import directional survey using the input file pre-processor to select and map data

### Treatment Configurations

- Added ability to mark formation tops and manipulate formation top label and line on grid
- Added ability to import microseismic data and plot with grid output in 3D view
- Added BHP Datum to dictate the TVD depth used to determine the GOHFER calculated BHP curve displayed in the engine output viewer time plot
- Addressed issues with saving and renaming geologic sections and designs
- Acceptable transverse exponent value range now 2 or less (previously limited to between 1 and 2)
- For horizontal transverse fracture simulations, added ability to simultaneously model the longitudinal fracture component along the wellbore
- Both transverse and longitudinal frac components can be modeled in vertical wells with low stress differential.

### Pumping Schedule

- Fixed issue with CSXP (sand exponent) friction calculation. Default value is now 0. When opening existing projects, the user will be asked to open and save the pumping schedule to refresh the CSXP.
- Fixed bug in foam pumping schedules that changed inadvertently changed the proppant concentration and foam quality

### Diagnostics

- Changed *dp at Closure* label to *Process Zone Stress* on all associated diagnostic plots and results
- Results screen – Irrelevant or results not found denoted in red
- Results screen – Added Pore Pressure Found (True/False) result
- Added table to step down analysis results displaying a breakdown of the pipe, perf and near wellbore friction.
- Fixed issue with smart line not appearing on G Function plot the first time it was opened

### **Grid Setup**

- Added ability to determine fracture orientation (breakdown pressure / breakdown angle) to any location in the grid with secondary detailed display
- Added separate aspect ratio for the transverse grid. Different aspect ratio may now be used for the grid along the wellbore and the transverse grid
- No longer lose user drawing or structure in grids when a change is made to the grid node size and aspect ratio or the grid top/bottom. These are still lost if a change is made to the perf type (symmetrical/asymmetrical).
- Added grid properties options to the grid right-click menu for both the grid setup and the output grid

### **Engine Output Viewer**

- Improved Effective Conductivity output grid calculation to avoid extremely low values.
- Added AVI movie capability. Output grid data in 2D or 3D view may now be saved as a movie file.
- Transverse fracture grid output now displays in asymmetric view
- Added longitudinal output grid for the longitudinal fracture component along the wellbore in transverse fracture simulations (when selected)
- Added user defined UTM coordinates to the XYZ Triplets file
- Added ability to generate time-stamped output XYZ Triplets file at any time during the simulation
- Added pipe friction curve to the engine output viewer vector data

### **Production**

- GOHFER horizontal production now calculates production from each frac generated from each cluster and displays production results (plots) for each fracture simulated.
- Added stage lateral length and well spacing inputs. GOHFER now automatically calculates the total lateral length, frac spacing, the per fracture drainage area and aspect ratio and the stage and total drainage area.
- Added Treatment Composite module that will cumulate production from separately executed stages and generate a total well production rate. Capable of also comparing production from multiple designs
- Added user option to include/exclude unstimulated well production results

### **Proppant Database**

- Updated StimLab Proppant Consortium proppant database

### **Fluid Database**

- Updated system fluids database file

### **Real Time**

- Added an un-dockable user defined numerical display window of incoming data
- Added ability to place cursor over any point on a curve to view the specific value

### **Miscellaneous**

- Context sensitive help (press F1 to access)
- Updated HASP driver (6.64)
- Added silent installation option (/s)
- Fixed issue with accessing Sentinel License Update Utility with 2<sup>nd</sup> installation option
- Fixed numerical front instability that resulted in a sensitivity to the aspect ratio
- Fixed issues with cutting and pasting into editors throughout GOHFER

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## GOHFER 8.2.3

Original Release Date December 9, 2013



### Log Processing

- Added ability to depth shift an entire input LAS
- Now accepts LAS file with a start/stop/step of FEET or METERS.
- Added option to run auto log assistants upon exiting the initial log processing window.
- Changed the default Kmult in the LAS inputs PERMEST from 100 to 20.
- Added new curve titled Slowing described as DTSLOW-DTFAST. This DTC slowing correlates well to TOC% in shales, or any hydrocarbon pay zone. It is a good pay indicator and a useful curve to know where the measured DTC/DTS are suspect.
- Added ability to add a reference survey and LAS if one was not selected in the original project options.
- Added ability to convert a treatment LAS to reference LAS if reference LAS was inadvertently processed as a treatment LAS.
- Fixed issue where the Depth range was incorrect on the display of the LAS Outputs in TVD.
- Input curves (data brought into the model from an external LAS or CSV file) are now plotted with dotted lines by default.

### Well Construction

- Added Stress Anisotropy to the Wellbore Configuration. If non-zero it overrides CFOP in the Breakdown Pressure Calculations
- Added Azimuth of Max Stress for of angle transverse fractures
- Added query with option to "Enable Transverse Fractures" when exiting the well construction section.

### Survey

- Added interactive 3D rotatable well survey view with MD, inclination and azimuth input option

### Treatment Configurations

- Added Wellbore Pressure Breakdown and Orientation calculations
- Changed Treatment Stage name to Geologic Section
- Added a new Input Data tab on the Grid Setup.
- Change the units on the Transverse Storage Coefficient to inverse pressure

### Perfs

- Removed TVD/Offset option
- Fixed issue with double headers appearing on plot

### Pumping Schedule

- Fixed ball drop timing issue and issue with multiple balls in the wellbore simultaneously
- Added a force save on the pumping schedule when doing an acid frac schedule. Fixed occasional issue with acid output not appearing after running an acid frac simulation.

### Diagnostics

- Defaulted the log-log plot the minimum time axis to 1 minute.
- Added the ability to save the diagnostics summary output page to reports as an image.

### **Engine Output Viewer**

- Added an Effective (Damaged) Conductivity output grid
- Engine Output Viewer now remembers plot settings changed while the engine is running
- Added interactive 3D rotatable grid output viewer
- Added option to draw a single wing of a symmetrical fracture in the 3D output view to provide better visibility of multiple transverse fractures if spaced close together.

### **Production**

- Added new filtercake deposition model related to permeability of the formation. Filtercake erosion and removal calculations are dependent on the Reynolds Number established during transient flow during production, and the specified residual filtercake percent.
- Added time dependent conductivity
- Adjusted reservoir fluid inputs to only reflect those associated with user defined oil or gas reservoir.
- Plot scales are now saved on the production plots.
- Tubing diameter in metric projects changed to mm.

### **Proppant Database**

- Updated StimLab Proppant Consortium proppant database.
- Added compare proppants feature that allows multiple proppants to be plotted on the Proppant Conductivity plot of measured conductivity vs. stress. Compares proppants based on the user defined calculation parameters.

### **Fluid Database**

- Fixed sensitivity when adjusting exponent lines

### **Input File Preprocessor**

- Fixed an issue with selecting the last column of any input file.
- Added ability to handle the following time stamp – MM/DD/YY hh:mm:ss

### **Reports**

- Fixed various issues with data being reported in oilfield units for metric projects

### **Real Time**

- Fixed an access violation if you open the real-time plot before connecting to a data source.

### **Miscellaneous**

- New installation setup package
- Added 64 bit installation option. Now have 32 bit and 64 bit options.
- Modified the engine to use a variable automatic courant number that makes it run faster and with more stability.
- New graphics package with enhanced control over curve, axis and label properties
- Made fix to issue with proppant disappearing from the grid
- Fixed issue with tortuosity if a negative rate was used in the pump schedule
- Fixes for occasional floating-point errors

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## GOHFER 8.1.5

Original Release Date May 3, 2013



### Log Processing

- Added the following curves as mappable generated curves to allow source curves to be mapped and remembered in the names and history:
  - BIOTS\_V
  - SW
  - CFOP
  - YMES
  - NETPAY
- Changed the defaults for DTMA and DTFL for metric projects to 590 and 197 respectively to better match Oilfield defaults.
- Added new Tools menu item titled - **Reset All LAS Processing**
  - Intended for updating older projects (can be used on recent ones as well)
  - This feature resets:
    - All GOHFER Curves
    - All Output Curves
    - All Parameter Info to defaults.
  - After resetting, the LAS is saved and the screen is closed.
  - The LAS processing must then be reopened. At that time all the input files will be remapped as if the user was opening them for the first time.
  - Userdraw files are kept and mapped automatically.
  - All previous user processing except for Userdraw is lost.
- Revised the PORE\_P and STRESS\_TOTAL curves
  - New Curves
    - PORE\_P\_SRC
    - STRESS\_TOTAL\_SRC
      - SRC stands for source - selects the source for the pore pressure or total stress from either the input curve or the associated internally calculated (EST) curves
  - PORE\_OFFS and STRESS\_OFFS take the SRC and the EST curve and output the difference
  - PORE\_P and STRESS\_TOTAL sum the OFFS and EST curves and output the sum. These curves are written to the output LAS.
  - User may offset/draw on the PORE\_OFFS or STRESS\_OFFS curves.
  - User may draw on the PORE\_P, STRESS\_TOTAL curves, but the draw is translated to the associated OFFS curves.
- Removed X Shift, Scale, Power from the PORE\_P and STRESS\_TOTAL curves.
- In Track 2 when *Scale All Curves the Same* is selected the min and max scales of all the curves are used instead of the scale for the first curve.
- Changed the default calculation in DTCACT to copy.
- Added **Auto Log Assistant**.
  - This runs and auto fits all the DTC, PR and YME log assistants.
- Rearranged the log assistant screens. Only shows the parameters for the selected fit rather than disabling the others.
- Made change to Spline interpolation to limit to the same range possible with linear interpolation. This fixes some averaging issues that were causing negative perm.
- Fixed repair issue where repair failed if no LAS.

- Changed equations for PZS\_PHIE and CFOP\_PHIE such that the "scale" factor is always between 0 and .9. On loading old projects the new Contrast value is calculated to match the previous scaling factor.
- PRGRScale multiplied by 1000 for display to avoid scientific notation
- New defaults for PRGRScale and PRGROffset
- New defaults for YMEGRScale and YMEGROffset
  - New equations for some of the correlations require that the Log Assistants be run for older projects.
- New equations for lithology allowing partial coal
  - New defaults for GDAnhd and GDDolo

## Perfs

- Fixed some range check errors in the Perfs.
- Fixed bug where Perfs would go into infinite loop if invalid perf depth entered.

## Pumping Schedule

- Added traps for preventing renaming of Stage or Design while engine is running. Does not prevent renaming of batch runs.
- Fixed a bug that caused problems when more than 255 stages were created.
- In the pumping schedule setting the rate to 0 now sets the volume to 0.
- CSXP (Sand Exponent) is now a functioning input on the Pumping Schedule Run Parameters
- Changed data entry of foam pumping schedule to keep bottom hole volume constant
  - Added default value for bottom hole volume
- A couple fixes on the new data entry methods for the Pumping Schedule
- Now allow Pumping Schedule w/o creating Grid. Allows for viewing schedule for during real time.
- Pumping Schedule Time Plot may now be undocked.
- Save column settings to project file now for pumping schedule.
- Changed Pumping Schedule Design to allow for entering bottomhole or surface values.
  - The data entry mode changes automatically as the user enters a field. I.e. enter slurry it calculates based on slurry rate. Enter quality it calculates on surface or BH quality.

## Production

- Added the saving of visibility of Production curves
  - Fixed bug where colors of unstimulated and stimulated were being loaded the same
- Allow user to enter Perm and Porosity on Production
- Changed source of SW to be from values entered on Treatment instead of from Engine Results
- Renamed EUR to OOIP and divided by 1000 on Production Outputs
- Fixed a problem where new proppant/fluids were not being loaded into Production.
- Added final FCD and KfWf to production output.
- Corrected order of Est Flowing Frac Length and Inf Conductivity in table. Widened column.
- Changed the default reservoir phase to GAS for production.
- Added columns to the Engine Output Viewer Report for lateral fracs

Transverse Fracture	Proppant Cutoff Length	Est Flowing Frac Length	Est Inf Conductivity Length	Fracture Height	Average Proppant Conc
1	360.000	9.985	18.575	50.000	0.121
2	120.000	8.479	14.596	75.000	0.113
3	280.000	8.658	16.784	75.000	0.0999
4	280.000	8.975	17.046	70.000	0.106
5	320.000	9.911	18.182	50.000	0.122



### **Engine Output Viewer**

- Fixed issue where wrong time units could be used on the Engine Output Viewer. Pumping schedule input curves were always assumed to be in minutes.

### **Reports**

- Fixed Avg Prop concentration display on Design Summary and report.

### **Real Time**

- Added support for space delimited Real-Time input
- Added support for time in hh:mm:ss
- Added option to save raw data.
- Raw Data now displayed at bottom of real time screen
- Pumping Schedule Time Plot may now be undocked.

### **Fluid Database**

- Fixed a data entry scaling issue for Fluid Editor when entering leakoff/viscosity data in metric units.
- Added ability to convert K' column to either oilfield or metric units in the Fluid Editor Viscosity Data tab.

### **Miscellaneous**

- Added Width Exponent on the Design
- Moved Reservoir parameters from grid to treatment and design
- Added Batch Processing
  - When starting Engine there is a check box for batch job.
  - The queued jobs show on the Treatment Configurations Page
  - The queue is started from the Treatment Configurations Page
  - The batch job is run as a Windows Batch File external to GOHFER.
  - The status of each run is displayed.
  - After the job is complete a double click on it in Treatment Configurations will bring it up.
  - Cannot add jobs while a batch job is running.
- Added Foam Viscosity to CALCMU
- Added error trap for bad path name in saving design.
- Added specific error trap for being unable to write to file because it is locked by another program (usually MS Excel)
- Fixed units issues with Meters/Oil Field projects on Design Summary
  - The Engine Output Viewer must be opened and re-saved for the correct units on old projects.