WellFlo® Design and Analysis Software

Simplifying well design, performance modeling, and production optimization
Analyze every phase of the production cycle.

WellFlo® software models naturally flowing or artificially lifted oil and gas wells.

A well is never a static asset. From design to late-stage production, it’s crucial to predict and adjust well output and operating input to get the most from your well. Continual tuning delivers more efficient capital spending through better designed wells and completions, reduced operating expenditures through more effective production diagnostics, and augmented revenues through improved well performance.

WellFlo design and analysis software gives you a powerful and easy-to-use window into performance of your asset throughout its lifetime. This simple and cost-effective platform lets you design, model, optimize, and troubleshoot naturally flowing or artificially lifted oil and gas wells.

With up-to-date modeling and data from WellFlo software, you can accurately predict and model the performance of your wells at any stage of field development. The continuous software monitoring process requires minimal data entry, yet delivers a critical understanding of your well. You gain a simple and visual means of simplifying workflows and optimizing production.

Operating point analysis showing inflow and outflow curves with the current operating point
The WellFlo software package uses nodal analysis techniques to model reservoir inflow and well outflow, which enables optimized design, production, and troubleshooting for individual wells.

Design
Create a well configuration, completion, and artificial-lift plan that maximizes life-of-well performance.

Model
Build well models using a guided, step-by-step well configuration interface. These accurate, rigorous models display the behavior of reservoir inflow and of well completion and surface pipeline flow for any reservoir fluid.

Predict
Generate vertical-lift performance curves for reservoir simulators.

Adjust
Monitor your reservoir, well, and flowline with flowing temperature and pressure measurements. The measurements facilitate design and analysis calculations that enable production optimization.

Troubleshoot
Detect production issues early by using the analysis engine.

Optimize
Continually fine-tune operating parameters for optimal production.

WellFlo software includes subapplications that can function independently from the rest of the system:

Reservoir inflow performance modeling
- Multiple completion and perforation models
- Inflow control device models
- Multiple fractured-zone models
- Detailed skin analysis

Fluid pressure/volume/temperature (PVT) modeling
- Compositional, equation-of-state-based PVT models for all fluid types
- Black oil PVT models for oil and gas
- PVT model tuning using laboratory data
Inflow and completion modeling

Reservoir inflow is a primary measurement for monitoring well performance. The WellFlo system is compatible with sophisticated, real-time, downhole inflow sensors and can model inflow based on sensor data. Alternatively, the productivity index (PI) can be manually entered, or geometry and permeability data can be used to model inflow.

The system also analyzes detailed completion data—including damaged zone, well deviation, partial penetration, perforating specification, gravel-pack information, and fracture geometry—to predict the effect of the planned design on well deliverability.

**Composite systems.** A multilayer model can be used for composite systems. Each layer has its own fluid, completion, and inflow model, which assists in designing new completions and in diagnosing performance problems. Data entered through tables, Corey coefficients, or a sophisticated, constant-mass, flow-rate inflow model can be used to include relative permeability effects. This model provides an accurate performance-forecasting technique for condensate and gas-cap drive reservoirs, especially as reservoir conditions and phase fractions change.

**Fractured wells.** The WellFlo system also models fractured horizontal wells. In low-permeability reservoirs, hydraulic fracturing in multiple zones has been extending the contact between wellbore and reservoirs. Multifracturing horizontal wells results in increased production rates and recoverable reserves for both conventional and unconventional reservoirs. Based on the specified number of fractures, fracture dimensions, and fracture permeability, the system determines the productivity of the reservoir. Further tuning of the reservoir characteristics based on well production data helps you determine the rate of reservoir pressure decline.

**PVT modeling**

Accurate pressure and flow models depend on accurate fluid properties as they vary over the life of a well. The WellFlo package includes a variety of industry-standard black-oil PVT correlation models and several compositional EoS-based (equation-of-state-based) PVT models, including Peng Robinson and Soave Redlick Kwong (SRK).

Each model is tunable using laboratory data, such as constant composition expansion (CCE), differential vaporization (DV), and constant volume depletion (CVD). The tuned correlation or EoS is then used to calculate the fluid properties on which performance predictions and optimization operations are based. The software accurately analyzes mixing fluids from different layers, which enables you to specify gas-oil ratios (GORs) within each layer as well as lift-gas composition.
Flow assurance

The flow-assurance function enables hydrate, wax, and asphaltene analysis. The application uses in-situ fluid composition measurements to compute solid-formation curves. The system then maps the curves along with the pressure and temperature profile to enable a quick flow analysis. In addition, users can proactively mitigate hydrate formation using the WellFlo hydrate-analysis function.

Pressure-traverse and temperature calculations

Drastic changes in pressure and temperature can occur between the bottom of the well and the surface. The WellFlo system includes all necessary correlations for pressure-drop analysis. Temperature modeling options include manual definition of temperature at specified depths, calculated and calibrated heat-loss models, or a coupled temperature-pressure model. Heat transfer coefficients can be obtained by system calculation or direct input.

The system simultaneously displays measured data and predictive plots to enable rapid matching. WellFlo software also offers the option to capture data other than pressure and temperature during pressure-traverse calculations. Data options include in-situ phase densities and velocities, flow regime and holdup, or the gravitational, frictional, and acceleration terms of the pressure drop. This alternate data can help determine whether critical velocity limits are exceeded.
Well-model tuning

To obtain a reliable and accurate view of well performance, well models must be continuously updated with current data. With many well-modeling packages, this task can be labor intensive. The WellFlo software tuning mode simplifies the task: Flowing pressure-gradient surveys tune the outflow performance model, and data sets from multiple production-well tests tune the inflow performance model. Using the multiple correlation display function, users can also select the optimal correlation and can tune up to five flow correlations simultaneously.

Data export and import

A data export tool available in DOS or UNIX format enables information transfer between WellFlo software and reservoir simulators.

- Generates performance data files in UNIX and DOS formats for Eclipse™, VIP, CHEARS™, SimBest™ I and II, IMEX™, MoReS™, GCOMP, COM4, and SENSOR® reservoir simulators
- Provides a multiwell batch mode for the Eclipse simulator
- Delivers tab-separated reports for export to word processing and spreadsheet packages
- Enables key-word-encoded file output to other applications
- Enhances report efficiency through cut-and-paste functionality into the Windows® environment
- Generates reports that can be opened directly in programs such as Word® and Excel®
- Supports graphics exports saved in BMP, GIF, JPG, and TIF formats

Importing data into the WellFlo system is also simple. Measured pressure-versus-depth data can be plotted on the same graph as the predictive model, which significantly reduces the time needed to produce a matched-data model. An auto-regression option estimates the optimal flow-correlation tuning factor by a least-squares fit to the measured data.

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Gas-lift design and analysis

Gas-lifted wells often need frequent optimization analysis because of changing well conditions. By taking into account the available injection pressure and rate, WellFlo software lets you design and model gas-lift installations with the optimal number and position of gas-lift valves.

The system lets you use either gas-injection rate or gas-liquid ratio combined with casing-head pressure as input for sensitivity variables. For every rate specified, the program determines which valve is being used for gas injection and provides accurate predictions.

Gas-lift design and diagnosis are key strengths of the WellFlo system. When linked with DynaLift™ dynamic gas-lift simulation software, the WellFlo system offers a unique and powerful tool for complete gas-lift-system modeling and optimization.

**Gas-lift capabilities**

- Model constant viscosity, temperature-effect-based viscosity, and emulsion viscosity
- Design a gas-lift system
  - Valve spacing for continuous and intermittent gas-lift installations
  - Valve sizing
  - Deepest injection point
- Analyze continuous gas-lift performance
- Analyze valve performance with advanced gas-lift valve modeling (AGVM)
Electric submersible pump (ESP) design and analysis

ESPs are complex and costly tools often placed in dynamic well environments. Keeping both the well and the pump operating efficiently is of critical importance. The WellFlo ESP module enables you to design new ESPs and to analyze existing ESP wells. By using the what-if feature of the software, you can virtually try system components before deploying them.

The WellFlo system includes an extensive electric submersible pump and motor database from leading ESP manufacturers to help you choose the best pump and motor for given well conditions. The WellFlo design module designs a complete ESP system—including a pump, motor, and cable—by taking into consideration the well productivity index (PI), total dynamic head (TDH) requirements, maximum allowable number of stages for each pump model, motor efficiency, and maximum recommended voltage drop in the cable.

WellFlo software lets you model ESPs for challenging conditions, such as emulsion or high free-gas wells. By modeling emulsion in the PVT module, you can predict the correct TDH and horsepower requirements. The Dunbar correlation, which defines the minimum pump intake pressure before the well reaches gas lock, is available to size and model ESP performance in gassy wells.

Using the WellFlo software ESP analysis mode, you can input measured intake and discharge pressures to analyze existing ESP performance and to validate well test data. You can also adjust sensitivity to well conditions and change frequency or wear to simulate future operating conditions and analyze uplift potentials for production optimization.

ESP capabilities

- Access an extensive downhole- and surface-equipment catalog, with an option to add customized equipment
- Tune pump-performance curves with measured-data calibration

Reciprocating rod lift (RRL) design

The WellFlo design module for reciprocating rod lift provides valuable information to assist in selecting the best surface and downhole equipment for your specific pumping needs. Based on user-entered information about the wellbore, desired pumping unit, and rod type, the software provides predicted fluid production and indicates potential stresses on the entire system. Using this data, you can determine which equipment combination will enable you to achieve your desired production goals most efficiently.

RRL capabilities

- Large catalog of pumping unit, crank, weight, sucker rod, tubing, and casing options
- Selection of multiple test cases to help compare and select the most efficient unit
- Surface and downhole dynamometer cards for each test case
- Gearbox torque plot
- Rod stress plot
Progressing cavity pump (PCP) analysis

The WellFlo PCP module allows users to create a model and run analysis on PCP wells. The module uses nodal-analysis techniques to model reservoir inflow and well outflow performance, which define the equipment operating range and correct sizing.

The WellFlo system includes an extensive PCP equipment database, which enables the best surface and downhole equipment selection for given well conditions. The surface equipment database includes driveheads, electric motors, and variable-speed drives. The downhole equipment database includes casing, tubing, pumps, sucker-rod strings, couplings, and centralizers.

The WellFlo software PCP analysis mode uses pump performance curves to determine operating parameters. The system enables you to calibrate the performance curve based on measured flow and torque data and then to use the new pump performance curve in the well model.

**PCP capabilities**

- Model single and multiphase flow
- Model constant viscosity, temperature-effect-based viscosity, and emulsion viscosity
- Access an extensive downhole- and surface-equipment catalog database, with an option to add customized equipment
- Tune pump-performance curves based on measured data
- Design a sucker-rod system for standard, continuous, and hollow rods along with couplings and centralizers
- Configure wellbore deviation
- Tune IPR and PVT models
- Analyze the operating point based on rate or speed
Jet-pump design and analysis

The WellFlo jet-pump module allows users to design new jet-pump systems and to analyze, optimize, and troubleshoot existing systems. The software identifies all suitable pump combinations and displays the following for each combination:

- Operating range for minimum and maximum injection pressures
- Power-fluid rate and horsepower needed to achieve the target production
- Projected performance curve
- Cavitation regions for both power fluid and production fluid

Using this data, you can select the optimal pump for the well and operating conditions.

Document management

With many software packages, once you complete an analysis or design, there’s no easy way to save your work as a chart or graph. That makes hours of work available to you only as long as it’s on screen.

WellFlo software includes a unique document management system that saves and organizes any chart or report generated in the system. Once the item is saved, it can be recalled and viewed in the document management output section. This lets you display, print, or email analyses from any well model, regardless of which model is active at the time.
Weatherford provides a comprehensive optimization suite for your wells.

WellFlo design and analysis software is part of the Field Office™ suite. Weatherford is the only oilfield services company to offer extensive solutions for full-field optimization tools that include:

- Analysis workbench artificial-lift analysis
- DataMart™ analytical data
- DTSP+™ temperature profiling
- DynaLift dynamic gas-lift optimization
- i-DO® intelligent daily operations software
- LOWIS life-of-well information software
- MatBal reservoir analysis and production forecasting
- PanMesh™ numerical well-test analysis
- PanSystem® well-test analysis
- PVTflex™ fluid property analysis
- ReO® network management optimization
- ReO Forecast™ production forecasting and field planning
- RigPlan™ resource scheduling
- RMS reservoir monitoring system
- WellScribe™ mobile data collection
- WSM well service manager

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Weatherford WellFlo® software simplifies well design, performance modeling, and production optimization. For more information about how it can work for you, contact us at po-info@weatherford.com or call your authorized Weatherford representative.