FracCADE

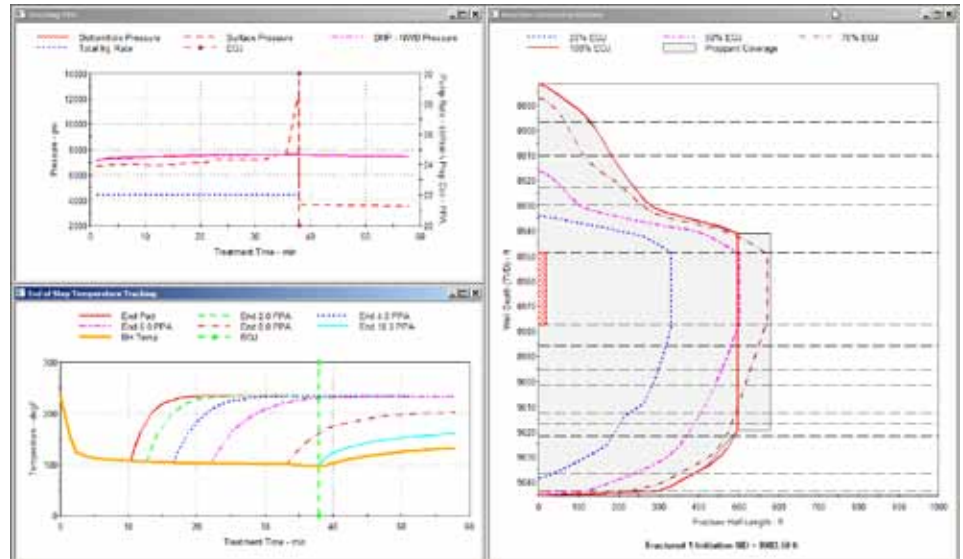## Fracturing design and evaluation software

APPLICATIONS
- Proppant fracturing and acid fracturing operations
- Vertical, deviated, or horizontal wells
- Open and cased holes

BENEFITS
- Identify candidates for fracture stimulation
- Characterize fracture geometry (KGD, PKN, radial, MLF-P3D)
- Optimize treating fluids and proppants, pumping schedules, production forecast, and economic evaluation
- Receive accurate stimulations and predictions
- Get fully integrated real-time monitoring
- Comprehensive post-treatment analysis and interpretation

FEATURES
- 15 complementary modules
- Economic optimization
- Proppant schedule generation
- Single and multiple fracture growth modeling
- Updated StimLab proppant correlations to the 2009 release from StimLab
- Acid fracturing stimulation

FracCADE software contains a variety of modules specially designed to improve production at your wellsite. Tracking temperature and characterizing fracture geometry are among its functions, as shown above.

FracCADE* fracturing design and evaluation software is a field-validated fracturing simulator developed on proven physical principles of hydraulic fracturing for an optimized treatment. The system incorporates a range of complexities, from 2D models to extensive laterally coupled three-dimensional simulators. The FracCADE software includes fully integrated real-time monitoring, pressure matching, and redesign capabilities. The software also has data handling, merging, and filtering capabilities, as well as customer reports and graphics.

The FracCADE software's various modules add tremendous value:

Optimization (NPV) module
This module uses information about the well, the reservoir, the fluids, and the proppant in conjunction with operational constraints, fixed costs, and production constraints to calculate an economically optimum fracture design based on net present value. The goal of a fracturing treatment is to maximize the economic return on a well, achieving the most cost-effective treatment yielding the highest potential return on the client's investment. The Optimization (NPV) module plots enable engineers to study the economic effects of varied propped fracture length ranges with selected fluids, proppants, and propped concentrations. Various geometry models can be selected. Transient inflow performance relationship (IPR) curves are used to forecast production.

PropFRAC Placement
The PropFRAC Placement module is a numerical hydraulic fracture simulator that uses a different fracture geometry model. It provides the capability to model fracture growth into layers above and below the pay zone along with fracture extension and rock mechanics that allow screenouts and slurry dehydration to be stimulated. The stimulation can continue even after proppant bridging or slurry dehydration occurs.

Scenario Manager
Scenario Manager is a new module in FracCADE that allows Schlumberger engineers to create and manage multiple fracturing designs or scenarios at once. It allows on-site best

matches against a real-time case and performs real-time visualization of critical parameters, comparing them to presimulated calculations.

AcidFRAC

The AcidFRAC module enables you to create a comprehensive simulation, taking into consideration the various mechanisms involved in an acid fracturing treatment. The AcidFRAC module simulates the effects of classical gel-pad-flush treatments, gelled acid systems, LCA systems, and retarded systems. The Placement simulator used in proppant fracturing is also used in acid fracturing. AcidFRAC module calculations are based on a plugged flow along the fracture. The cross-section etch area is based on averaged rock properties along the fracture height.

MultiFRAC Placement

The MultiFRAC Placement (MLF) module simulates simultaneous initiation and extension of multiple hydraulic fractures. MLF supports only PKN fracture geometry.

MLF models screenout due to proppant bridging or dehydration. Cross-flow is calculated after pumping stops, but viscosity is ignored so the value could be magnified. Perforation friction is calculated for each layer.

- Improvement on contour plots, linked the axes for all subplot for ACL Contour plots and the design plots.
- Real-time related changes.
- Added new parameters to Dynamic Digital Display Window.

BHP

The Bottomhole Pressure module converts:

- Surface treatment conditions to bottomhole conditions by taking a pumping schedule, containing pressures and rates at surface conditions, and calculating the bottomhole values
- Bottomhole conditions to surface treatment conditions by taking a pumping schedule containing bottomhole data and calculating the corresponding surface conditions
- Added new parameters (cement wall thickness and thermal conductivity) and implemented new heat transfer coefficient equation
- Added an option of including viscous heating in bottomhole temperature calculation

DataFRAC

This module analyzes the fracture data generated by the treatment, which can be used to design a propped fracture treatment.

DataFRAC information helps to determine fracturing parameters so future treatment design can maximize production. Fracturing parameters determined:

- Fracture Closure Pressure
- The Appropriate 2D Model
- DataFRAC Fluid Efficiency
- Leakoff Coefficient

The DataFRAC module determines characteristics and parameters specific to the particular well and formation that should be considered when designing a propped fracture treatment. These are graphically illustrated on interactive plots. Interactive plots are used during the analysis to narrow the boundaries and arrive at a reasonable solution.

OPAL

The OPAL module provides easy integration with Optimized Pressure Analysis (OPAL) so that results can be imported into FracCADE for further analysis. OPAL is a pressure-analysis application for obtaining reservoir closure pressure, fracture fluid efficiency, and fracture height growth or confinement data based on real-time or treatment history data.

Auto Pressure Match

The Auto Pressure Match module presents a technique for consistent analysis of pressure records during both injection and decline, including changes due to rate and fluid viscosity variations. It is also used to match simulated and measured fracturing procedures within specified limits.

The procedure can be applied to both calibration test and propped fracture treatments.

The module repeatedly executes the PropFRAC Placement module using the prescribed treatment parameters (slurry injection rates, proppant concentration, etc.) to predict fracturing pressures for a given set of fracture parameters (stresses, fluid leakoff, etc.)

Additives and Foams

The Additives and Foam Calculations module evaluates the rate of N_2 and CO_2 at different conditions of pressure and temperature in order to facilitate the design of a foam job. The Additives and Foam Calculations Module performs volumetric calculation of liquid, solid, CO_2, and N_2 at different temperatures and pressures.

The Additives & Foam Calculations module also provides the ability to

- Design a CO_2 and N_2 commingle foam schedule
- Inject additives at two different points—in the high-pressure line or at the discharge of the blender
- Compensate the quality due to the introduction of proppant.

Log Analysis

The Log Analysis module provides you access to electronic log data, either processed, full-wave sonic logs, or unprocessed Triple-Combo logs through the standalone application LGZones.

It allows the import of zones from LGZones or the export of FracCADE true vertical depth and width profile to LGZones. Once the electronic log data is imported from LGZones, you can view them from the zones spreadsheet.

Sensitivity Analysis

The Sensitivity Analysis (FGS) module can be executed using two different procedures:

FracCADE

- Fracture length is determined based on the amount of injection volume specified.
- The fracture length needs to be specified; the injected fluid required to attain the specified fracture length is then determined.

Because computations in the FGS module are analytical and can be quickly executed, the FGS module is useful for sensitivity studies.

Tubing Movement
The Tubing Movement module is designed to calculate and provide a profile of force effects on tubing and packers. The module simulates the effect of four forces: applied, pressure-induced, frictional, and thermally induced. Calculations take into consideration tubing to packer motion, well completion type, current well conditions, and changes which occur with treatment application.

BRACKETFRAC
The BRACKETFRAC module is used to control upper fracture migration, lower fracture migration, or both simultaneously. The BRACKETFRAC module is based on the need for placement of diverting particles at the vertical limits of a fracture prior to undesirable height growth.

The BRACKETFRAC module allows the option to design a treatment using any of the following three fracture services:

- INVERTAFRAC*— Prevents upward fracture propagation by placing a layer of particles at the top of a vertical fracture.
- DIVERTAFRAC— Contains downward fracturing by placing the diverting material at the bottom of a fracture.
- BRACKETFRAC— Combines the two treatments in the same application.

HiWAY module
- Added HiWAY module that enables the generation of HiWAY pumping schedule.
- The HiWAY module can be accessed from the PropFRAC Placement module.
- The link to the HiWAY module is visible only to the members of HiWAY FracCADE LDAP group.
- Users will be granted access to HiWAY module only after training. Training will be provided as a part of the rollout.

HiWAY is based on a very novel approach to hydraulic fracturing. The HiWAY service is a new, revolutionary type of hydraulic fracturing treatment. HiWAY removes the dependence of the fracture performance on the proppant characteristics. This is done by creating open channels inside the fracture, which imposes substantially higher hydraulic conductivity and a much more conductive way for reservoir fluids compared to a conventional fracturing treatment. In a HiWAY fracture, proppant is placed heterogeneously in the form of proppant pillars surrounded by open channels. The HiWAY module of FracCADE 6.2 generates the HiWAY pumping schedule based on the conventional treatment. The HiWAY module can be accessed from the PropFRAC Placement module.
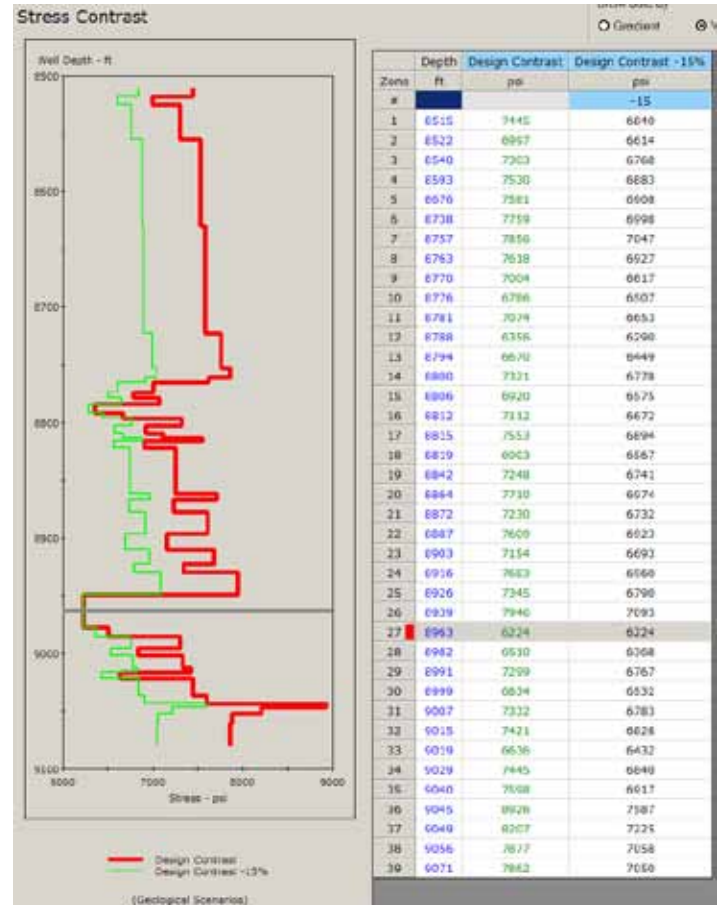
Measuring stress contrast is one of the functions performed by FracCADE software. Its modules also can be used to control fracture migration, as well as calculate and provide a profile of force effects on tubing and packers.

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