



StimPlan Info

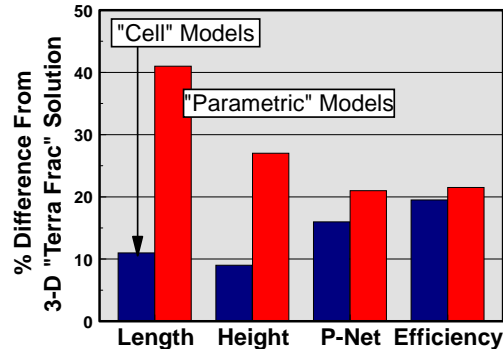
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This information briefly describes NSI's fracture design/ analysis software, StimPlan™. StimPlan is a stable, routine, analysis and design tool with more than 15 years history of development/use. In a comparison of fracture models (Warpinski, N. R., et al, "Comparison Study of Fracture Models", SPE Production & Facilities, Feb 1994) "cell" type PC models such as StimPlan gave much better agreement with the more complex work station model, Terra-Frac (TM of Terra-Tek), than "parametric" (i.e., also termed "lumped") models, with StimPlan giving best overall agreement - as illustrated in the figure. The package runs on PC computers (available on PC compatible & MAC) and is in worldwide use with users in Australia, North & South America, China, and Europe, including company wide use by four major oil companies and two major service companies. "Cell" Vs. "Parametric" Models.

"Cell" Vs. "Parametric" Models



At the SPE Hydraulic Fracturing Plenary Session (2000 Annual Meeting), one presentation presented a list of **"Five Critical Functions"** that fracturing software should perform.

- **Data Handling/Data Analysis** – This should be for pre-treatment fracturing pressure testing/real time analysis, post-treatment analysis & history matching of measured data from a propped fracture treatment, and post-frac production data.
- **Fracture Geometry Model** – This is the classical definition of fracturing software, and of course, this must be provided, but in addition to other critical capabilities. In addition, the geometry modeling should allow use of the solution sophistication required by geologic conditions being attacked.
- **Automatic Economics** – Fracturing is an economic problem, and the geometry model must be coupled with a reservoir

model to allow automatic comparison of treatment designs.

- **Generate Pump Schedule** – No one has time to trial & error their way to the final product of fracture modeling – a treatment pump schedule. Thus, software should generate this!

- **Post-Frac Production Analysis** – The most common information available after a propped fracture treatment for assessing results is production. Therefore, proper analysis tools for this data are critical.

NSI's STIMPLAN is a state-of-the-art PC software package integrating **ALL 5 functions!** It is the **only package providing this complete fracture analysis/design tool kit.** This includes complete data handling & analysis (both "real time" & post-

job), multiple fracture geometry models, 3-D numeric reservoir simulation, and economics. The program generates fracture optimization, design, and stimulation post appraisal reports. I/O is modularized for user-friendly input, and includes a wide range of data handling features. **StimPlan modules include:**

Analysis

The StimPlan **Analysis Module** allows fracture pressure and production post appraisal. Along with the basic StimPlan features, this incorporates a completely integrated package for data handling, data reduction, merging of multiple separate data files, interactive graphical mini-frac analysis, pressure history matching, etc.

The pressure decline analysis function allows the user to interpret mini-frac pressure decline data using cutting edge fracture diagnostics to determine fluid efficiency and leak-off coefficient. It also supports production history matching with a 3-D numerical reservoir simulator to appraise effects of a stimulation and provide insights for future design. Production type curve analysis techniques are also provided for quick user-friendly post appraisal.

Fracture Geometry Model

The Fracture Geometry/Design Module (propped & acid fracturing) includes four fracture simulators.

- **StimPlan** consists of: **QUIK** - an integrated analytical set of equations for instantaneous solution of 2-D fracture geometries. This is used for fracturing pressure analysis, and for developing initial design schedules that are refined by the simulator. **QUIK** is also a screening tool for reviewing treatment designs and/or for sensitivity studies. **3-D SIMULATOR** - The main simulator is a "pseudo 3-D" type model, however, it is a true numerical simulation performing implicit finite difference solutions to basic equations of mass balance, elasticity, height growth, and fluid flow. This is the

Modules Available & Hardware Requirements

<i>StimPlan 5.51</i>	<i>QUIK, Pseudo-3D Frac Model Single Layer Reservoir Model Economic Optimization</i>
<i>+ Analysis StimPlan 5.51A</i>	<i>StimPlan + Complete Data Handling/Analysis</i>
<i>E-StimPlan 5.51</i>	<i>All StimPlan Features + Enhanced Geometry Model, Multi-Layer Reservoir Model, & Acid Fracturing</i>
<i>E-StimPlan 5.51A</i>	<i>E-StimPlan + Analysis</i>
<i>E-StimPlan 3D</i>	<i>E-StimPlan + 3D Geometry Module</i>

PC Compatible (Dual Core chip strongly recommended)
Windows 2000/XP/Vista, 100 MB Hard Disk Space
1 GB RAM (2+ GB Recommended for "Fully 3D")
VGA+ (800x600 or better) graphics monitor

"main model" of StimPlan and is used for finalizing treatment designs and history matching actual net treating pressure data. The model simulates complex geologic environments with frac growth through multiple formations with differing values of stress, strength, modulus, and fluid loss.

- **E-StimPlan** represents a new level of technical sophistication for routine, PC based, fracture design models. This is an enhanced StimPlan, with a rigorous numerical solution for 2-dimensional fluid-flow/proppant-transport. This also includes the only geometry model to correctly handle layered modulus cases using finite element technology.

N-FRACS is part of the E-StimPlan module and uses E-StimPlan technology to consider multiple fracture initiation from separate perforated intervals. This incorporates the wellbore into the solution, and simultaneously solves for fracture growth, geometry, etc. for "N" fractures. This includes rigorous calculations for effects of these fractures joining, or interfering.

- **E-StimPlan 3D** is a full, planar 3-D geometry model for analyzing the effects of complex geologic environments on fracture propagation & final geometry. This tool is particularly valuable for cuttings injection and disposal type analysis where large volumes can create dangerous height growth, and where effects such as filter cake buildup, often ignorable for propped fracture treatment modeling, can become important.

Thus, the proper solution sophistication for the problem at hand is available in one integrated package with uniform I/O for all geometry models.

Reservoir Simulation

Reservoir Simulation is a critical part for any fracturing software, though only indirectly referred to in the "5 Critical Functions" of the SPE presentation. StimPlan includes a 3-D reservoir simulator for predicting (or history matching) production data from fractured (and un-fractured) wells. This includes the ability to simulate such effects as limiting perforated interval length (possibly to allow more favorable fracture geometry growth), non-Darcy flow, etc. For simpler cases, easy-to-use analytical relations allow calculations for "skin", Folds-of-Increase, etc.

Economics/Fracture Optimization

The Fracture Optimization Module integrates fracture geometry simulations with the numerical 3-D reservoir model and an economics package to provide detailed production and economic optimization. This allows maximizing well performance and profitability from a planned fracture treatment.

Thank you for your interest in StimPlan, and, of course, if you have any questions or desire additional information, please give us a call.

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- 4) Bale, Arthur, Owren, Kjell, et al, "Propped Fracturing as a Tool for Sand Control and Reservoir Management," SPE 24992, presented at European Petroleum Conference, Cannes, France, Nov 16-18, 1992.
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