



# PROSPER

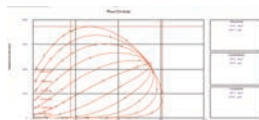


## MULTIPHASE WELL AND PIPELINE NODAL ANALYSIS

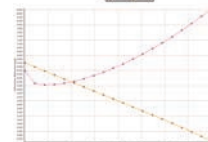
WELL AND PIPELINE MODELS



FULLY COMPOSITIONAL



INFLOW/OUTFLOW RESPONSE

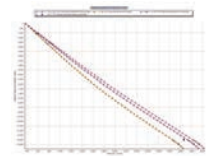


STEAM WELLS

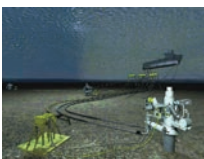


The screenshot displays a complex software interface with multiple panels. On the left, there are lists of parameters and checkboxes for 'Decision Status' (e.g., Surface Equipment, Downhole Equipment). The center contains a large data table with columns for 'Inflow', 'Outflow', and 'IPR'. On the right, there is a graph showing a curve and a 'Prosper (2204) 13.0' label. At the bottom right, contact information for Petex Experts Limited is provided.

OUTFLOW (VLPs) MODELS



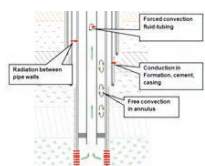
FLOW ASSURANCE



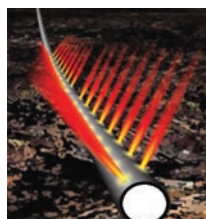
ARTIFICIAL LIFT SYSTEMS



THERMAL MODELLING



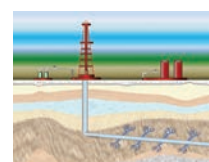
PERFORMANCE DESIGN AND PERFORMANCE

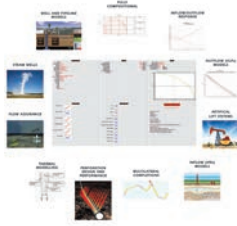


MULTILATERAL COMPLETIONS



INFLOW (IPRs) MODELS





# PROSPER

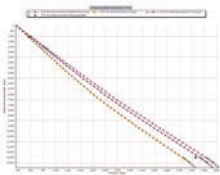
## MULTIPHASE WELL AND PIPELINE NODAL ANALYSIS

### WELL AND PIPELINE MODELS



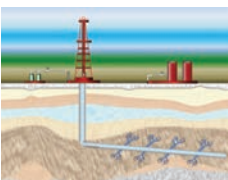
PROSPER was commercialised in the early 90's and has been the subject of ongoing research and development for over two decades. Each year, new models and functionalities are added to the already extensive list of options in the program. There are over three million combinations of options that can be used to describe the vast majority of physical phenomena happening in wells and pipelines. In spite of the large number of situations that can be modelled, the adaptive interface only presents the user with the relevant input fields and menus according to the selections made in the options menu, keeping the model building effort at a minimum. PROSPER has evolved into the industry standard for well and pipeline modelling due to its unrivalled sound technical basis and unique modelling capabilities. The program today forms one of the foundation stones of the Digital Oil Field system, and the calculation engine is utilised by numerous workflows in real time on hundreds of fields world-wide.

### OUTFLOW (VLPs) MODEL



As part of the package of unique features available in PROSPER, research being conducted since Petex was founded has resulted in the creation of a number of proprietary multiphase flow pressure drop models (both empirical and mechanistic). The objective of this research has been to create fundamentally rigorous models that overcome the limitations of traditional models available in the industry. Petex is uniquely placed to have access to data from all over the world and over the years, a comprehensive database of pressure drop measurements has been created, which allows our researchers to compare novel physical models to real world information. Independent comparisons done by industry experts in multiphase flow have proven the reliability and consistency of the Petroleum Experts pressure drop models, to the point where these models are being widely used to quality check measurements obtained in the field. As part of a clearly defined well test quality check workflow, users have the ability to compare and contrast the behaviour of traditional pressure drop models with the ones uniquely available in PROSPER in order to assess suitability and consistency over the life of a well. Should users choose to use third party pressure drop models such as OLGAS or LEDAFLOW, these are also available as plug-ins, provided that the relevant licenses from the third party vendors are put in place.

### INFLOW (IPRs) MODEL

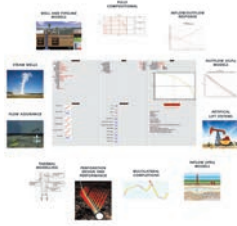


A comprehensive set of inflow models complement the multiphase flow capabilities in PROSPER, enabling Nodal Analysis calculations to be done for virtually any type of well. There are over 20 inflow models that have been developed over the years, that can be applied to horizontal, vertical, deviated, multilayer and multilateral geometries. Furthermore, novel development has seen the realisation of unique inflow models that account for changing PVT conditions in the well drainage area as well as in multiple zones. This allows re-perforation studies, analysis of skin, the application of sand control measures and many other sensitivities to be conducted easily.

### MULTILATERAL COMPLETIONS



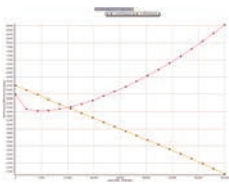
Alongside all of the analytically derived Inflow Performance Relationships available in PROSPER, the Multi-Lateral IPR model is the culmination of extensive research and has been designed specifically for complex well completions that have undulating trajectories across multiple producing zones. This is the most advanced analytical IPR that exists in the industry today and can only be found in PROSPER as another one of the many unique features in the program.



# PROSPER

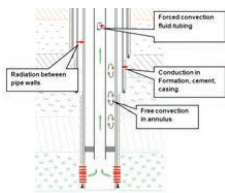
## MULTIPHASE WELL AND PIPELINE NODAL ANALYSIS

### INFLOW/OUTFLOW RESPONSE



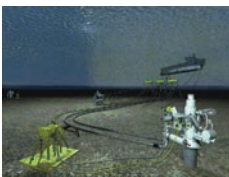
The rigorous multiphase pressure drop models and unique list of inflow performance relationships come together to form system calculations for well and pipeline models. This allows for assessing the productivity of oil, gas and condensate wells to be performed, both for production and injection scenarios, with or without artificial lift. Sensitivities can be conducted through a simple interface that allows the investigation of virtually all parameters that are inputs to the models and the matching workflows allow for comparisons to be done between the results predicted by the models and the measurements obtained for these wells if they are already operational.

### THERMAL MODELLING



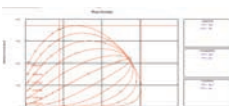
PROSPER is capable of modelling thermal profiles in wellbores using multiple methods, ranging from a constant rate of heat transfer (Rough Approximation) through to a detailed and rigorous full energy balance (Enthalpy Balance) that considers the forced and free convection, conduction and radiation heat transfer mechanisms. The latter considers a detailed materials specification, and to aid with this PROSPER has been furnished with a database of common casing, tubing, cement and mud descriptions with their associated heat transfer properties. Users can also take advantage of a hybrid thermal calculation technique that was developed by Petex (Improved Approximation). This allows for Joules-Thomson effects to be captured in the well, while at the same time enabling multiple heat transfer coefficients with depth to be used.

### FLOW ASSURANCE

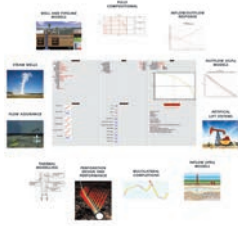


Flow assurance studies are an integral part of any pipeline and well analysis, done both for designing and troubleshooting purposes. In PROSPER many years of research have been dedicated to addressing these issues and users can study either hydraulic flow assurance challenges, or issues related to the thermodynamic behaviour of fluids. Hydraulic investigations can be conducted on flow regimes, erosional velocities, superficial velocities, wellbore stability analysis (liquid loading), slug catcher sizing and many others. Thermodynamic calculations can include studies on hydrate formation, waxing, salt precipitation and others. PROSPER will indicate where in the system these issues might occur and the user has options to consider intervention (e.g. hydrate inhibition, surfactants, etc.) or changing the operational conditions (wellhead pressure).

### FULLY COMPOSITIONAL



As is the case with all the programs developed by Petex, PROSPER uses a powerful thermodynamics engine to complement the traditional black oil models that provide all the thermodynamic properties needed for the pressure drop, flow assurance and inflow calculations. In fully compositional mode, PROSPER allows users to take advantage of advanced hydrate prediction and mitigation calculations, salt deposition, special handling of CO2 for dense and light phases and many other functionalities. In black oil mode, a large number of correlations are available that can be compared and matched to lab data. Special correlations for heavy oils have been implemented and these, coupled with an emulsion model as well as special heavy oil pressure drop models, make PROSPER unique in being able to deal with such fluids and the intricacies of producing them. Another feature that is widely used is the ability to predict the vaporised water that is produced from gas wells. This is based on industry standard calculations that have been modified based on data received from clients to create a uniquely accurate model for analysing this situation.



# PROSPER

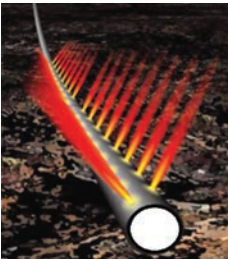
## MULTIPHASE WELL AND PIPELINE NODAL ANALYSIS

### ARTIFICIAL LIFT SYSTEMS



Artificial lift design and troubleshooting has been an area where PROSPER has offered unparalleled modelling capabilities to the user community for many years. Gas Lift, ESPs, HSPs, Coil Tubing Gas Lift, PCPs, Jet Pumps, Sucker Rod Pumps are only a few of the many lift mechanisms that can be evaluated for new and existing installations. With every new release of the program, one or more methods are added and the capability of the existing methods are enhanced. A database of equipment (Pumps, valves, motors etc) is available and is being updated every year as new descriptions become available. Unique features include the Quicklook troubleshooting workflows, minimum energy methodologies for HSP wells, designs that consider the inflow performance and many others. The latest addition to the list is a Fully Transient Gas Lift Simulator, which simulates the unloading phase of gas lifting and allows users to assess the stability of such wells. All the artificial methods available can be made part of a bigger network model (GAP) for full field optimisation as well as the Digital Oilfield systems where they can form the basis of any workflow that users wish to automate (for surveillance, diagnostics and others).

### PERFORATION DESIGN AND PERFORMANCE



As part of the philosophy of sharing knowledge among operators in the industry, Shell has contributed their proprietary perforation optimisation tool (SPOT) which can now be found as part of the standard toolkit of calculations in PROSPER. The objective of this module is to allow engineers to compare the perforation charge performance and assist in selecting the optimum perforation gun. This can be done through the charge properties, rock properties (averages of obtained from logs), fluid properties and by using appropriate drilling mud invasion models. It can handle open hole completions as well as cased hole completions. The implementation in PROSPER allows the output of SPOT to be directly combined with the vertical lift performance models to predict the complete well performance, therefore eliminating the artificial boundary conditions that would need to be put in place if only the inflow part of the well was considered.

### STEAM WELLS



Steam injection wells (SAGD, Huff and Puff, Direct Steam Injection) are becoming more common in the industry and modelling of such systems can be done through a variety of tools in the IPM Suite, primarily REVEAL. PROSPER is also steam enabled and if the wells to be modelled relate to steam injection systems, then lift curves can be generated that can be used to model steam distribution systems (in GAP). In creating integrated steam injection systems models, the efficient designs of the network, analysing the operating envelope limits, evaluating energy management and the economics are now feasible for what have traditionally been a costly operation.