

COURSE OVERVIEW DE0364
Artificial Lift Methods (WSG)

Course Title

Artificial Lift Methods (WSG)

Course Date/Venue

Session 1: January 26-30, 2025/Meeting Plus 8, City Centre Rotana Doha Hotel, Doha, Qatar

Session 2: July 27-31, 2025/Meeting Plus 8, City Centre Rotana Doha Hotel, Doha, Qatar



Course Reference

DE0364



Course Duration/Credits

Five days/3.0 CEUs/30 PDHs

Course Description



This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulator.



Most of the world's oil wells are placed on some kind of artificial lift, the most significant of which are sucker-rod pumping, gas lifting, and electrical submersible pumping. Production engineers are required to design and operate these installations at their peak efficiencies so as to reach a maximum of profit. To achieve this goal, a perfect understanding of the design of the different lift methods, as well as working skills in the ways ensuring optimum production condition is necessary.



This course provides basic knowledge of Artificial Lift. Review of fluid properties, multiphase flow regimes and all lifting methods: rod pumps, progressive cavity pumps (PCP), gas lift and electrical submersible pumps (ESP), discussion of alternate deployments and multi-sensor applications for surveillance and optimization. Strategies and best practices for field production optimization are discussed. The effectiveness for NODAL systems analysis for lifting performance optimization is demonstrated. Workshop format with presentations, discussions and hands-on exercises.



The course first provides an overview of well-performance evaluation leading to determination of well conditions necessitating application of artificial lift. The various types of artificial lift systems along with their selection criteria are then presented. The theoretical and practical aspects of the most important artificial lift methods will be covered, so that at the end of the course the participants will have a sound knowledge of the theory underlying each method as well as an abroad view of the relative advantages, disadvantages, niche of applications and limitations of each artificial lift system.

The course integrates lectures with hands-on exercises. Participants of this course will work with software that allows them to design and analyze artificial lift designs, which will improve performance and results in higher production rates and/or reduced operating costs. Participants will also learn how to design and troubleshoot rod pumping, continuous gas lift and ESP systems.

The course also covers other methods such as PCP, plunger lift, jet pump, hydraulic pump and intermittent gas lift. Participants are expected to gain experience in solving problems by hand and also by using advanced computer programs. Troubleshooting is an important part of artificial lift operations which will be illustrated in the course covering several typical surveillance problems to be solved.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply and gain a basic knowledge on artificial lift methods
- Discuss the basic knowledge of artificial lift, techniques, systems, procedures and processes
- Identify requirements for anticipated artificial assistance to production, maximizing recovery in a cost-effective manner
- Select and design of the proper production methods (natural flow, gas lift, electrical submersible pumps, progressive cavity pumps, rod pumps, hydraulic pumps, among others)
- Make basic PVT properties and inflow performance (IPR) calculations related to artificial lift (PROSPER)
- Explain and apply multiphase tubing and pipe flow principles
- Select the appropriate artificial lift system
- Compare various artificial lift systems and determine which one is most economically feasible
- Specify components and auxiliary equipment needed for each system
- Design system features that allow for gassy production, production with solids, viscous production and for other harsh environment
- Identify what best practices are available to extend the life of equipment and installed lift systems
- Apply basic design and analysis concepts
- Analyze inflow and outflow relationships of reservoir performance

- Determine natural flow, inflow performance, tubing flow performance and well performance
- Carryout artificial lift screening and explain the rod-pumping, gas lift and ESP systems
- Illustrate rod-pump design covering pumping unit, rods, pump, prime movers, gas anchor and pump-off controls
- Apply gas lift technology and identify its limitations
- Describe gas lift design that includes mandrels, valves, injection gas requirements, temperature, chokes, spacing, equilibrium curve and continuous flow design
- Illustrate ESP design comprising of pump performance curves, pump intake curves, typical problems, installation and troubleshooting

Exclusive Smart Training Kit - H-STK®



*Participants of this course will receive the exclusive “Haward Smart Training Kit” (H-STK®). The H-STK® consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

This course provides a basic overview of all significant aspects and considerations of artificial lift methods for AL-engineers/foremen. Petroleum engineers, production engineers, reservoir engineers and field supervisors will definitely benefit from this course.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

- 30% Lectures
- 20% Practical Workshops & Work Presentations
- 30% Hands-on Practical Exercises & Case Studies
- 20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

US\$ 8,500 per Delegate. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Accommodation


Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

Certificate Accreditations


Certificates are accredited by the following international accreditation organizations:-

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The International Accreditors for Continuing Education and Training (IACET - USA)

Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units (CEUs)** in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

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British Accreditation Council (BAC)

Haward Technology is accredited by the **British Accreditation Council for Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:



Dr. Chris Kapetan, PhD, MSc, BSc, is a **Senior Drilling & Process Engineer** with over **40 years** of international experience within the **onshore and offshore oil and gas** industry. His wide experience covers **Asset Operational Integrity** for Operations, **Process Plant** Operations, Control & Troubleshooting, **Plant Shutdown System & Flare Systems**, **Heat Exchangers & Fired Heaters** Operation & Troubleshooting, **Gas Conditioning**, Treatment & Processing Technology, **Production Operations** in the Oil & Gas Fields & **Surface Facilities**, **LNG Process**, **Applied Process** Engineering Elements, **Production Control** Systems, Well Commissioning & Crude Oil Specifications, **Hydrogenation & Gasification** Technology, **Physical & Chemical** Solvents, Sulfide Stress Cracking (**SSC**), Hydrogen Induced Cracking (**HIC**), **Corrosion**, Steels & Alloys, **Fertilizer Manufacturing** Process Technology, **Fertilizer Storage** Management (Ammonia & Urea), **Process Calculation Methods**, **Directional Planning**, **Completion Design**, **Directional Surveying**, **Drilling Fluids**, **Matrix Acidizing**, **Hydraulic Fracturing**, **Well Completion Design & Operation**, **Cased Hole Formation Evaluation**, **Cased Hole Logs**, **Production Management**, **Drilling Operations**, **Directional Drilling**, **Gas Lift** Operations, **Petroleum Business**, **Petroleum Economics**, **Gas Lift Valve** Changing & Installation, **Horizontal & Multilateral Wells**, **Well Stimulation & Control** and **Workover Planning**, **Completions & Workover**, **Rig Sizing**, **Hole Cleaning & Logging**, **Well Completion**, **Servicing & Work-Over** Operations, **Practical Reservoir Engineering**, **X-mas Tree & Wellhead** Operations, Maintenance & Testing, **Advanced Petrophysics/Interpretation of Well Composite**, **Construction Integrity & Completion**, **Coiled Tubing Technology**, **Corrosion Control**, **Wireline & Coil Tubing**, **Pipeline Pigging**, **Corrosion Monitoring**, **Cathodic Protection**, **Root Cause Analysis (RCA)**, **Root Cause Failure Analysis (RCFA)**, **Production Safety** and **Delusion of Asphalt**. Currently, he is the **Operations Manager** at **GEOTECH** and an independent **Drilling Operations Consultant** of various engineering services providers to the international clients as he offers his expertise in many areas of the **drilling discipline** and is well **recognized & respected** for his process and procedural expertise as well as ongoing participation, interest and experience in continuing to promote technology to producers around the world. Currently, he is the **Operations Consultant & the Technical Advisor** at **GEOTECH** and an independent **Drilling Operations Consultant** of various engineering services providers to the international clients as he offers his expertise in many areas of the **drilling & petroleum** discipline and is well **recognized & respected** for his process and procedural expertise as well as ongoing participation, interest and experience continuing to promote technology to producers around the world.

Throughout his long career life, Dr. Chris has worked for many international companies and has spent several years **managing** technically **complex wellbore interventions** in both **drilling & servicing**. He is a **well-regarded** for his **process** and **procedural expertise**. Further, he was the **Operations Manager** at **ETP Crude Oil Pipeline Services** where he was fully responsible for optimum operations of crude oil pipeline, **workover** and **directional drilling**, **drilling rigs** and equipment, drilling of various geothermal deep wells and **exploration wells**. Dr. Chris was the **Drilling & Workover Manager & Superintendent** for **Kavala Oil** wherein he was responsible for supervision of **drilling** operations and **offshore exploration**, quality control of performance of **rigs**, **coiled tubing**, **crude oil** transportation via pipeline and abandonment of **well** as per the API requirements. He had occupied various key positions as the **Drilling Operations Consultant**, **Site Manager**, **Branch Manager**, **Senior Drilling & Workover Manager & Engineer**, **Drilling & Workover Engineer**, **Process Engineer**, **Operations Consultant** and **Technical Advisor** in several petroleum companies responsible mainly on an **offshore** sour oil field (under water flood and gas lift) and a gas field. Further, Dr. Chris has been a **Professor** of the **Oil Technology College**.

Dr. Chris has **PhD** in **Reservoir Engineering** and a **Master's** degree in **Drilling & Production Engineering** from the **Petrol-Gaze Din Ploiesti University**. Further, he is a **Certified Surfaced BOP Stack Supervisor** of **IWCF**, a **Certified Instructor/Trainer**, a **Certified Trainer/Assessor/Internal Verifier** by the **Institute of Leadership & Management (ILM)** and has conducted numerous short courses, seminars and workshops and has published several technical books on **Production Logging**, **Safety Drilling Rigs** and **Oil Reservoir**.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	<i>Registration & Coffee</i>
0800 – 0815	<i>Welcome & Introduction</i>
0815 – 0830	PRE-TEST
0830 - 0930	<i>Overview of Artificial Lift Technology</i>
0930 – 0945	<i>Break</i>
0945 - 1030	<i>Introduction for IPR & Artificial Lift Types</i>
1030 – 1130	<i>Criteria for Selection of Artificial Lift System</i>
1130 – 1230	<i>Reservoir Performance: Inflow & Outflow Relationships</i>
1230 - 1245	<i>Break</i>
1245 – 1420	<i>Natural Flow</i>
1420 – 1430	Recap
1430	<i>Lunch & End of Day One</i>

Day 2

0730 - 0930	<i>Inflow Performance</i>
0930 – 0945	<i>Break</i>
0945 – 1100	<i>Tubing Flow Performance</i>
1100 – 1230	<i>Well Performance</i>
1230 – 1245	<i>Break</i>
1245 – 1420	<i>Artificial Lift Screening</i>
1420 – 1430	Recap
1430	<i>Lunch & End of Day Two</i>

Day 3

0730 - 0930	<i>Introduction for PCP, SRP & ESP Equipments & Design Data & Process</i>
0930 – 0945	<i>Break</i>
0945 – 1100	<i>Rod-Pump Design: Pumping Unit, Rods, Pump, Prime Movers, Gas Anchor, Pump-off Controls</i>
1100 – 1230	<i>Rod-Pump Design: Pumping Unit, Rods, Pump, Prime Movers, Gas Anchor, Pump-off Controls (cont'd)</i>
1230 – 1245	<i>Break</i>
1245 – 1420	<i>Application of Gas Lift Technology & its Limitations</i>
1420 – 1430	Recap
1430	<i>Lunch & End of Day Three</i>

Day 4


0730 - 0930	<i>Gas Lift Design: Mandrels, Valves, Injection Gas Requirements, Temperature, Chokes, Spacing, Equilibrium Curve, Continuous Flow Design</i>
0930 - 0945	<i>Break</i>
0945 - 1100	<i>Gas Lift Design: Mandrels, Valves, Injection Gas Requirements, Temperature, Chokes, Spacing, Equilibrium Curve, Continuous Flow Design (cont'd)</i>
1100 - 1230	<i>Gas Lift Design: Mandrels, Valves, Injection Gas Requirements, Temperature, Chokes, Spacing, Equilibrium Curve, Continuous Flow Design (cont'd)</i>
1230 - 1245	<i>Break</i>
1245 - 1420	<i>ESP Design: Pump Performance Curves, Pump Intake Curves, Typical Problems, Installation, Troubleshooting</i>
1420 - 1430	<i>Recap</i>
1430	<i>Lunch & End of Day Four</i>

Day 5


0730 - 0830	<i>ESP Design: Pump Performance Curves, Pump Intake Curves, Typical Problems, Installation, Troubleshooting (cont'd)</i>
0830 - 0930	<i>ESP Design: Pump Performance Curves, Pump Intake Curves, Typical Problems, Installation, Troubleshooting (cont'd)</i>
0930 - 0945	<i>Break</i>
0945 - 1230	<i>Optimization Methods for PCP, SRP & ESP Using Nodal Analysis Software</i>
1230 - 1245	<i>Break</i>
1245 - 1330	<i>Optimization Methods for PCP, SRP & ESP Using Nodal Analysis Software (cont'd)</i>
1330 - 1400	<i>Course Conclusion</i>
1400 - 1415	<i>POST-TEST</i>
1415 - 1430	<i>Presentation of Course Certificates</i>
1430	<i>Lunch & End of Course</i>

Simulators (Hands-on Practical Sessions)

Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art “PROSPER” software.




PROSPER




MULTIPHASE WELL AND PIPELINE NODAL ANALYSIS

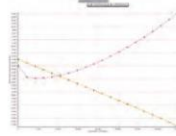
WELL AND PIPELINE MODELS




FULLY COMPOSITIONAL




INFLOW/OUTFLOW RESPONSE

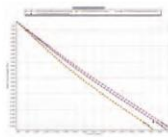


STEAM WELLS






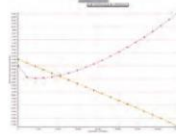
OUTFLOW (VLPs) MODELS



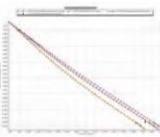
FLOW ASSURANCE




ARTIFICIAL LIFT SYSTEMS



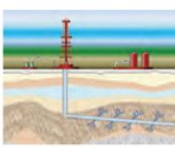
THERMAL MODELLING




PERFORATION DESIGN AND PERFORMANCE



MULTILATERAL COMPLETIONS



INFLOW (IPRs) MODELS





PROSPER

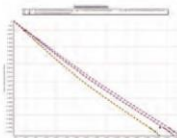
MULTIPHASE WELL AND PIPELINE NODAL ANALYSIS

WELL AND PIPELINE MODELS



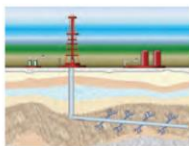
PROSPER was commercialised in the early 90's and has been the subject of ongoing research and development for over two decades. Each year, new models and functionalities are added to the already extensive list of options in the program. There are over three million combinations of options that can be 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



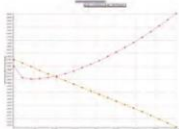
Alongside all of the analytically derived Inflow Performance Relationships available in PROSPER, the Multi-Lateral IPR model is the culmination of extensive research and has been designed specifically for complex well completions that have undulating trajectories across multiple producing zones. This 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

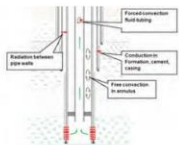
MULTIPHASE WELL AND PIPELINE NODAL ANALYSIS

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

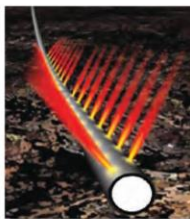
MULTIPHASE WELL AND PIPELINE NODAL ANALYSIS

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.

Course Coordinator

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