

Maximus™

Fully Integrated High Fidelity Production and Flow Assurance Modelling Software



- Fast & Accurate reservoir to facility scenario modelling
- Life-of-field output as key engineering / economic performance criteria
- Optimisation of pre-FEED decision making

BACKGROUND

FEESA-IPM was founded in 2001 with the objective of developing innovative techniques and software for improved decision making during the high value conceptual planning phase of an oil & gas development project.

Fundamental to this process was the development of a suite of modern integrated production modelling software that could quickly and accurately compare any number of engineering scenarios through the life of the field, thus offering the industry a new standard in software to maximise field economics and optimise technical and organisational efficiency.

With its team of world leading consultants, and software engineers armed with the previous experience of developing Schlumberger's PipeSim suite, FEESA-IPM had the expertise to generate a ground breaking product – *Maximus™*.

Traditional integrated production modelling tools are a trade off between accuracy of the model and speed of the simulation. As a result, either the breadth of the study or the accuracy of the results (or both) need to be compromised in order to complete a conceptual study in a reasonable time. *Maximus™*, however, employs novel numerical techniques that give orders of magnitude improvements in speed with even higher degrees of accuracy than possible in other simulators, therefore permitting greater confidence in the chosen concept than ever before.

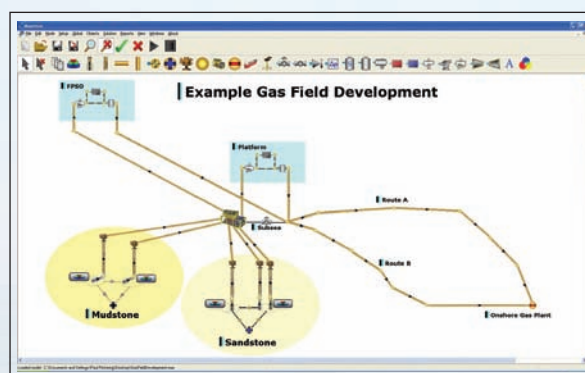
Maximus™ was released during March 2007. It has already been licensed to market leading decision makers including BP, ConocoPhillips and Woodside, and adopted by FEESA-IPM's consultants as an essential part of their tool kit for both conceptual engineering and flow assurance studies.

Innovative improvements in engineering modelling techniques are constantly being developed through FEESA-IPM's internal R&D programme, and these are introduced into the *Maximus™* software once rigorously tested for accuracy and robustness, at no additional cost to our clients. Such developments are presented at annual user group meetings, which establish the development strategy for the year ahead.

Annual software updates, together with a dedicated support team provides FEESA-IPM's customers with the peace of mind they require for such a critical software application.

MAIN FEATURES

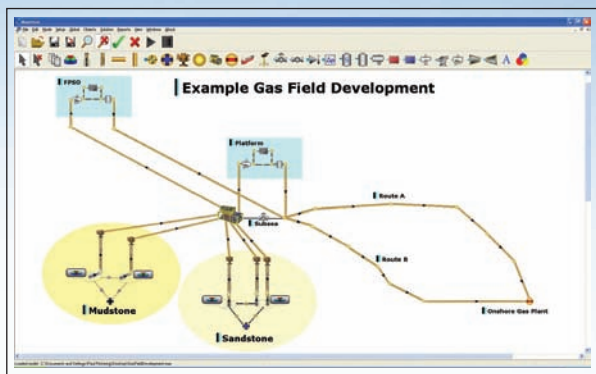
The software allows the simulation of complex general networks, with loops/recycles, mixing/diverging junctions, and with processing equipment incorporated simultaneously. There are no limitations on the way the network is configured provided the resulting model is wellposed.



Maximus™ has the full range of functionality:

- Configurable constraints & logic
- Blackoil & compositional physical properties
- Flexible boundary conditions
- Reservoir tank and lookup table models
- Reservoir inflow performance relationships
- Well, flowline & riser multiphase flow models
- Insulation systems & burial heat transfer
- Electrically heated pipelines
- Pumps, compressors, expanders
- Stream tracking from 2 & 3-phase separators
- Heaters, coolers, chokes, valves & NRVs

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THE MAXIMUS™ ADVANTAGE

As a modern purpose-built software suite, **Maximus™** offers the greatest functionality to be offered by any integrated production modelling software, enabling it to set a new industry standard:

- Life of field flow assurance simulations with physically realistic boundary conditions; e.g. reservoir rather than over-conservative wellhead temperatures and pressures.
- Physically realistic integrated production modelling with rigorous component tracking and accurate thermohydraulic well, flowline and riser integrations, rather than look-up tables.
- Numerous features to improve your team's work flow process of model building, analysing results, generating outputs for other disciplines, etc.
- Modern, well written software with no legacy code, and with multicore processing for enhanced simulation speed.
- Realistic outcomes through user definable logic
- Rigorous component tracking and blending during simulation for either black oil or compositional physical properties
- Stream tracking from 2 & 3 phase separators, allowing processing facilities to be modelled
- Ability to integrate converging, diverging and looped networks with multiple hydrate and wax phases
- Advanced Reservoir tank and multidimensional lookup table models
- Pressure/Enthalpy network integrations with rigorous enthalpy balances at nodes for better representation of phase changes and steam injection networks
- Modern well, flowline & riser multiphase flow models
- Models for insulated, electrical heated, fully or partially buried pipelines
- Constrained and unconstrained models for pumps, compressors, expanders, heaters, coolers, chokes, valves & NRVs

BETTER WORK FLOW & EASE OF USE

Maximus™ has been developed as a user-friendly application with standard Windows conventions:

- Based on a multi-document interface where several models may be open simultaneously.
- Models are built using 'drag & drop' with items selected from a toolbox of equipment.
- Models can be QA verified with the 'checkprint' facility producing all data in Excel format.
- Simulation results can be viewed numerically or graphically and are user-configurable.
- Numerical results are produced in Excel format for copying directly to spreadsheets if required.
- Dynamic plotting for producing graphical results as simulation proceeds.
- **Maximus™** charts can be copied as pictures and embedded in Word, Excel or PowerPoint.
- **Maximus™** models and results included in a single file making QA/QC simpler and improving data exchange in project team.

BETTER PHYSICS MEANS BETTER INTEGRATION

FEESA-IPM recognises that many different disciplines require output from a thermo-hydraulic IPM tool.

Economists, reservoir engineers, subsea engineers, flow assurance engineers, facilities engineers, and corrosion engineers are just some of the project-critical disciplines that require a range of different thermal, hydraulic and compositional information.

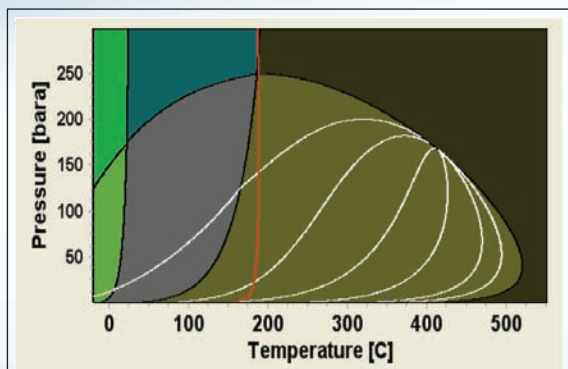
As **Maximus™** takes no shortcuts with the physics, it can generate results for these disciplines at the same time. For example, by deploying Multiflash NRTL mixing rules, **Maximus™** can correctly model the partitioning of carbon dioxide for any point in the network through time, in addition to simulating temperatures, pressures or stock tank flow rates.

Better physics, together with the equation oriented approach used by **Maximus™** also facilitates the fast and efficient generation of models for new equipment.

Whatever production technology innovation is introduced, **Maximus™** will be able to model it. Hence **Maximus™** has been used to model various novel production technologies for clients, such as hydrate slurry loops and helical risers, to assess their thermo-hydraulic performance and their impact on the production profile / income stream.

BETTER PHYSICAL PROPERTIES MODELLING

Physical properties modelling in *Maximus™* is extremely advanced. For compositional calculations, networks can be simulated with phases additional to gas, oil and water, such as hydrate I, hydrate II, hydrate H, ice, wax, salt & secondary oils. This allows complex phase diagrams to be built-up using thermodynamically consistent methods.



Maximus™ is a thermal-hydraulic simulator where components are tracked throughout the network and physical properties calculated rigorously using a thermophysical properties package called Multiflash (although blackoil models are also available).

- Rigorous compositional and enthalpy mixing across junctions (e.g. manifolds, in-line tees) means that downstream temperatures and compositions are correctly calculated. This allows more accurate calculation of physical properties, phase behaviour (e.g. GOR or liquid dropout) and therefore more representative multiphase pressure drop calculations.
- Pipeline integrations are pressure/enthalpy rather than pressure/temperature based. This is more physically representative of general systems allowing the simulation of single component systems and properly modelling the effects of latent heat of formation of phases. *Maximus™* has been used by one oil company to model a steam heating network and by another to model a novel 'cold flow' system where additional phases (e.g. hydrates/wax/ice) appear along the pipe.

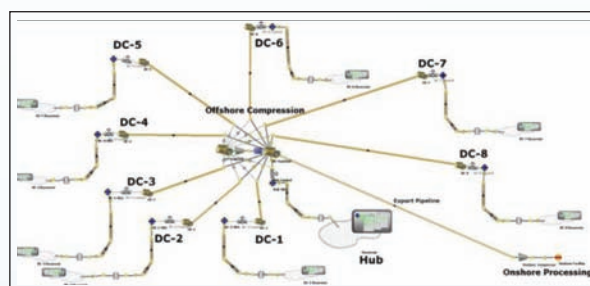
Because the modelling is performed accurately, it is possible to assess various flow assurance phenomena (e.g. hydrates and wax avoidance) during an IPM simulation. This reduces the effort required to investigate the feasibility of networks

ADVANTAGES OF USER DEFINABLE LOGIC

The user-configurable logic is very powerful as it allows users to adapt models to behave realistically:

- Users can add their own equations to models via the GUI's spreadsheet style equation 'parser', which will deal with logical or arithmetic equations.

- Almost any parameter can be made a function of any other, allowing users to add their own IPRs, pump curves, production sharing agreements, or to generate results in terms of economic parameters rather than flow rates, temperatures and pressures.
- Users are able to incorporate complex logic to control the behaviour of their simulation models. For example, to automatically bring on or abandon fields/wells.



THE ADVANTAGES OF MODERN SOFTWARE

Maximus™ has been written entirely from scratch using Microsoft's latest developers' environment 'DotNet', enabling it to quickly provide simulation results, even on PC's:

- Software is based on a modern object oriented design, and it contains no legacy code.
- Hence, *Maximus™* exploits the latest advances in software engineering (e.g. mixed languages, multithreading, multi-processing, grid computing), making it robust, quick to update, and future-proofed.
- *Maximus™* is designed to exploit other future computing trends. It can easily be adapted for Grid Computing, to use the many 'dormant' processors across LANs or WANs, and offers interoperability with other software tools.

MODERN NUMERICS

The numerical solution algorithms are based on the highly efficient Equation Oriented (EO) approach.

- Algorithms are fast, robust and accurate using accelerated globally convergent methods and smart initialisation.
- EO approach is flexible meaning that new models (e.g. processing equipment, inflow performance relationships, multiphase flow relations etc) can be added simply by incorporating the new equations into an appropriate software object. This improves the rate of new software additions.
- Adaptive stepping of tubing/pipeline/riser integration ensures accurate resolution of important phenomena

(e.g. flow regime changes, the appearance of new phases, etc) and increases speed by reducing the number of unnecessary calculations.

'parallelised' and able to run on up to 8 processors, thus benefitting from the emergence of dual-core and quad-core computers.

- Multithreading on multiprocessors has allowed **Maximus™** to be 'speeded up' without reducing the accuracy of calculations. The **Maximus™** simulation engine is
- As computing hardware continues to improve, it is a simple matter for the number of simulation threads to be increased to exploit these advances.

TRAINING COURSES & SUPPORT

FEESA-IPM provides regular two day **Maximus™** training courses at its UK office, and similar courses can be organised at client's offices anywhere in the world. The step-by-step introductory course takes new users to a level where they can confidently build and run their own network simulations.

FEEDBACK AND RESPONSE SHEET

I am interested in receiving more details as follows:

- Call to discuss
- Email literature and case studies
- Send Consulting Proposal for IPM or FA scope
- Issue a **Maximus™** Software 30 day trial
- Send Training Course agenda and costs
- Inhouse IPM FA Workshop for field appraisal

Name:

Dept:

Company:

Address:

Tel:

Email:

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