IPM 12

New Features and Software Enhancements

RESOLVE

- **Drivers**
  - *MOVE geological modelling software driver*
    - Suite of Visual Workflow functions developed
- **Enhancement of Existing Application Drivers**
  - *Tokens for Reservoir Simulators*
    - Tokens can be used to run sensitivity studies on variables within a simulation deck
  - *PBS Scheduler with Nexus on Linux*
- **Visual Workflows**
  - *Workflow Exception Point added*
    - Allows exceptions within a workflow to be handled more robustly
  - *Enhancements to the Form Builder*
- **PX Cluster**
  - PXcluster can now see shared directory through network drive mapping
  - Command line entry point to PXcluster through PxSub.exe and PxJob.exe

PROSPER

- **Parallelisation of VLP Generation**
- **New mechanistic multiphase flow model**
  - PE5 (extended)
- **Gaslift**
  - *New Generic valve model ("PETEX")*
    - Captures both orifice and throttling flows
    - Requires only basic valve inputs
    - Allows matching to calibrate valve response
    - Available in Transient Gaslift Simulator, Multipoint Gaslift Method and Valve Performance calculator
  - *New GasLift Method: Multipoint*
    - Determine if there are multiple points of injection and capture the impact on the VLPs
    - Use casing head pressure as boundary condition on casing side and determines total gaslift injection rate as well as the rates through each valve.
    - Additional results reported in System Analysis and VLP windows such as valves' injection rate, tubing and casing pressure, temperature, status, dome pressure and a multipoint flag.

- ▪ Exported TPD lift curves file contains the additional variables mentioned above.
  - o *Transient Gas Lift Simulator: New features/Enhancements*
    - ▪ Additional annulus equilibrium options to define initialisation of unloading process.
    - ▪ Ability to limit unloading to prevent valve damage
    - ▪ Ability to schedule changes during a simulation
    - ▪ Ability to simulate an existing well without unloading
    - ▪ Transfer button for transferring basic input data only or all relevant data (including valves) from New Well Design, Existing Mandrels Design, Single-Point QuickLook or MultiPoint QuickLook windows.
    - ▪ Possibility to transfer basic input data only or all relevant data (including valves) from System Sensitivities Analysis cases when the Gaslift method is MultiPoint.
    - ▪ Integration of the Petex valve model
    - ▪ New interface for valve selection
    - ▪ Improved reporting: opening and closing pressures are displayed in the Playback plot, wellhead rate are reported in detailed results and in plot.
  - o *Valve Performance Calculator: New features/Enhancements*
    - ▪ Opening and closing pressures as well as dome pressure at valve temperature are reported for both casing sensitive and tubing sensitive valves
    - ▪ New interface for valve selection
    - ▪ Integration of the Petex valve model
  - o *Gaslift Design – New and Existing Mandrils*
    - ▪ Static Reservoir gradient line added on the Design Plot
  - o *Gaslift Adjustments*
    - ▪ Transfer button for input data only or for both input data and valves from New Well or Existing Mandrels Design window
    - ▪ Change of nomenclature for some variables to make them consistent with other gaslift interfaces
  - o *Multipoint Quicklook*
    - ▪ Venturi valve type added
  - o *Gaslifted Condensate Wells*
    - ▪ Gas Injection rate not available as injection rate method

- **ESP**

  - o Improvements of the location of the temperature rise generated by an ESP motor: original, conventional and inverted configurations are now available in ESP Input Data, ESP Performance calculator and ESP QuickLook.
  - o *ESP Quicklook*
    - ▪ The *Petex* and *Natural* gas separator methods now available
  - o Additional results reported in system calculations and VLP windows: Motor Power Factor, Motor Load %, Motor Fluid Velocity and Surface kVA.
  - o Exported TPD lift curves file contains additional variables: Motor Power Factor, Motor Load %, Motor Fluid Velocity and Surface kVA.
  - o Other reporting improvements. e.g. the variables "Free Gas in Pump" and "GVF in Pump" have been renamed respectively "Free Gas at Pump Inlet" and "GVF at Pump

Inlet" in System Analysis and VLP windows to highlight that they are calculated at the pump inlet.

- **ESP Performance Calculator**

    o Transfer button to initialise ESP performance input from system calculation results
    o Additional results reported such as Motor Load %, Motor Fluid Velocity and GVF (as well as GLR) at pump inlet.

- **Tapered ESPs**

    o Pump performance plot in System Analysis window showing operating points for each pump.
    o Reporting of pump head and average rate for each pump of the tapered ESP system
    o QuickLook for tapered ESPs

- **Tubing Correlation Comparison**

    o Ability to enter measured downhole temperature survey and compare the measured data with the calculated temperature profile in the well.

- **BHP from WHP**

    o Two options for overall heat transfer coefficient (OHTC) used for the gradient calculations (matched OHTC for each test or OHTC in downhole equipment).
    o Ability to enter measured downhole gauge pressure and to calculate the pressure at specified gauge depth.
    o Improve plotting where it is possible to assess performance of flow correlation over time.

- **Plotting**

    o The plotting has been updated using a pastel pallet for sensitivities and grouping of sensitivities in terms of colour with different markers for variables.
    o A toolbar has been added allowing to simultaneously read values from multiple curves.

GAP

- **Parallelisation of VLP Generation**
- **Multi-pointing Gaslift VLPs**
    o Capturing valve throttling and multi-pointing behaviour as part of optimisation and field development studies
- **Shared control/constraints for Gas Lifted Wells**
    o Allows for dual-string gas lift optimisation
- **Improved emulsion modelling**
- **Improved choke calculations**
- **Improved steam modelling**
    o Steam enthalpy accounted for across chokes
- **Reporting of hydraulic systems**
    o Interrogate model by hydraulic system via OpenServer or GAP Topology object
- **Improved OpenServer Access**
    o Saving of prediction results
    o Retrieval of VLP correlation and parameters
- **Improved visualisation, validation and warnings**
- **Additional solver results**

- ESP Wells – motor power factor, motor load, motor fluid velocity, surface kVA
- Gaslifted Wells – injection depth, tubing pressure/temperature at valve depth, casing pressure, critical injection rate etc.
- Various including density and kinematic viscosity at separators, unchoked well rates etc.

GAP Transient

- **Addition of new multiphase flow model**
  - *Petroleum Experts 5 (extended)*
    - Developed from learnings and research of transient simulations
- **Improved Time-stepping**
- **Enhanced Plotting and Results**

REVEAL

- **Transient Wellbore Modelling**
  - Allow transient accumulation for all pipes (completions/pipes/multiple connected pipes) s elevated to REVEAL scripts
  - Allow initial fluids to be specified in schedule
- **Visualisation**
  - Allow User Generated 3D plot results
  - Add region labels to initial data view
- **Well Modelling**
  - Petroleum Experts 5 (extended) added to well flow models
  - Improved transient heat transfer model for overburden using detailed wells
  - Rescue file format can import well geometries
- **Reservoir modelling**
  - Creation of NNCs between columns of neighbouring blocks
  - Stress, EPS and initial properties added as Mask variables
  - Allow definition of Imbibition regions
- **Relative Permeability**
  - Improved data entry
  - Improved plotting
  - New hysteresis models
  - Relative permeability correction when block approaches critical region
- **Well Scheduling**
  - Improved control of scheduling for well workovers
  - Allow gas lift casing pressure controlled lift curves
  - Propagate time-step control changes
  - Reset fracture to its initial seed state
  - Import history schedule from ECLIPSE summary file
- **Souring**
  - New nitrate and NRB souring model
  - Allow thermal dependence for maximum SRB/NRB concentrations
  - New asymptotic growth model
- **Initialisation**
  - Transmissibility multiplier added for 'sealed' and 'flowing' for Sealing Barriers
- **Dimensionless Pressure/Time**

- o Allow PdTd to calculate with simulation with changing rate
- **Parallelisation**
  - o Surfactant calculations parallelised
- **Preferences**
  - o Allow *No File Compression* to speed up saving

PVTp

- **New Improved Interface and Characterisation Workflow**
  - o The new interface is object based interface makes PVT characterisations more transparent and intuitive
- **Characterisation Auditing**
  - o PVTp now allows the process of the characterisation to be completed documented so that it is easier for other users to understand and audit
- **Automatic Lab Data Importer**
  - o New data object allows lab data to be imported in a more automated fashion
- **New Characterisation Wizard**
  - o Guides new users through the characterisation process and shows existing users the new workflow
- **User DDL Extensions**
  - o Users can import their own characterisation or calculation objects via DLLs
- **Multi-Stream Regression Enhancements**
  - o Ability to match multiple samples via the same regression has been improved
- **Pedersen Pseudo Property Correlation**
  - o Pedersen correction added for Tc,Ps and AF from MW and SG
- **Particle Swarm Regression**
  - o Regressions can now be performed using a particle swarm algorithm

MBAL

- **Material Balance**
  - o *Model Auditing*
    - Add comments to each row in the well production tab. These comments can then be seen by hovering the mouse over the point in the well production plot.
    - Add comment to each row in the well production allocation tab.
  - o *Improved Reporting*
    - In History Simulation and Production Prediction for oil tanks, calculation and reporting of free gas and solution gas (at standard conditions).
  - o *Improved Usability*
    - In History Matching plots, if the tank editor is opened and edited, the impact of the changes can be seen by selecting *Apply* rather than *Done*. The inputs will only be saved when the user selects *Done*.
- **Tight Reservoir**
  - o Within a History Simulation, the transient IPR can now be plotted via the Analysis button
  - o When the Analysis button is selected, the data used for the plot is displayed before the plot itself
  - o The transient IPR of each timestep can now be plotted together to see how it changes with time

- **OpenServer**
  - Analytical Method results now accessible via OpenServer
  - Ability to move the position of an icon using OpenServer

DOF IFM & Model Catalogue 6, IVM 9
New Features and Software Enhancements

DOF – General

- **Subroutines**
  - New subroutine feature which allows units of business logic to be shared between visual workflows
  - Managed in Model Catalogue
- **Python**
  - Python logic can now be integrated in the DOF, and Python logic can be executed within Visual Workflows (IPM, IFM & IVM)
  - Managed in Model Catalogue

IVM 9

- **Analytics**
  - New web module which provides the means to analyse and visualise DOF data, and build understanding of field behaviour
- **Security**
  - New IVM security features which provide granular control for graphics, reports, data etc.
- **Charting**
  - New Charting features added:
    - <u>2D Charts</u>: Line, Scatter, Bar, Stacked Bar, Mountain, Stacked Mountain, Pie, Donut, Heatmap, Impulse, Bubble, Band, OHLC, Box Plot, Radar & Error Bar.
    - <u>3D Charts</u>: Point Cloud, Waterfall & Surface Mesh.
    - <u>Data Table</u>: New top-level structure has been added users to create organised views of IVM data
- **Graphics**
  - Graphic control refresh – allows stack panel with associated filter criteria to repopulate/refresh after a graphic is initially opened
- **Data Driver**
  - A new Data Driver has been added for the Cognite Data Platform

IFM 6 & Model Catalogue 6

- **IFM**
  - Field creation and synchronisation is now carried out in IFM service, which is faster to evaluate
- **Model Catalogue**
  - **Security Enhancements**
    - Privilege reduction: The number of privileges have been reduced from 17 to 4 (Read, Write, Security Function and IFM security Function).
    - Grant/Deny calculations are now carried out on IFM Service, which is faster to evaluate
  - **MOVE Provider**
    - A new MOVE provider has been added for processing MOVE files and models