Virtuoso®/EOR (Enhanced Oil Recovery) SAGD & Other Thermal Processes

wood.

Wood provides robust, real-time online and offline digital tools for the efficient management of oil and gas operations. Virtuoso® is a field proven suite of software tools, with more than 20 years' successful track record of performance in the field.

Wood technology supports engineering studies, operator training and simulation of wells, pipelines and processing facility operations both onshore and offshore.

Wood's software products provide essential operational and commercial functionalities based on the unique challenges specific to each customer's project. We address the most complex single and multiphase gathering, production, transportation and processing issues with our technology solutions.

Today, Virtuoso is used to help manage some of the world's key gas resources, supporting 30% of the global LNG production.

The Virtuoso software suite is offered in both offline and online packages, which are geared for Asset Performance Monitoring (APM). They provide monitoring and advisory functions and are focused on ensuring operational integrity, production operations management & optimisation, performance assessment, planning & forecasting, data analysis and visualisation.

Virtuoso®/EOR

For Enhanced Oil Recovery (EOR) operations, Wood offers Virtuoso®/EOR that is built-for-purpose for managing thermal oil recovery processes. The benefits of such a system includes the following:

- optimization of steam consumption and allocation
- improved well surveillance and testing
- improved temperature prediction & process thermal performance assessment
- optimization of ESP/gas lift operations
- improved diluent usage and blending

For EOR, specific capabilities have been incorporated to model the details with respect to the reserviour, associated properties and production performance.

Key features of the SAGD VMS Steam Allocation module include the following:

- heel vs toe real-time steam rates
- distribution of steam along the reservoir

- detection of short circuit and recommend setting of steam control device
- distribution of steam along the reservoir
- steam injection points configured
- P/T in steam chamber
- heat loss to surroundings
- location of steam / liquid interface
- well and reservoir sub-cool values
- well temperature profile predictions
- determines optimum steam temperature

Value propositions

Steam allocation	Steam flowrate to each well is not measured nor the impact to production fully understood	Virtuoso can allocate steam flowrate and quality to each well, predict heat loss, and total flowrate / P&T leaving the steam generation unit
Improved well testing	Well testing done infrequently; ΔP error >2 or 3 bar @ normal production => allocation factors can have +/- 30% errors	Virtuoso can improve allocations significantly, and improve reservoir modelling leading to better planning on additional wells to be drilled
ESP / Gas lift optimization	Up to 20% variability in daily well production => up to 5 operators watching / optimizing wells	Virtuoso can model this behavior and predict which control actions will increase oil production and optimize lifting costs, while minimizing short-circuiting
Diluent blending	Diluent required to reduce the viscosity of the bitumen for its transport is not injected in optimal amounts	By modeling / monitoring the export pipeline, the bitumen and diluent properties, diluent requirement can be optimized
Temperature prediction	Expensive fiber optics are used for temperature measurements and have experienced high failure rates	Better temperature predictions can reduce need for expensive transducers and optimum setting for flow control device using better flowrate predictions
Operator training	Facility uptime and production can differ based on the operators on shift	An operator training system could facilitate a more standardized approach to facility operations
Control system check out	Control system upgrades or new additions often include bugs or issues that could compromise production and are costly to fix	An offline method to independently check logic or updates, could confirm & verify updates prior to implementation
Real-time monitoring	Transport lines can have flow assurance and integrity issues	An online monitoring system could alert operations earlier, reducing the potential impacts of an issue
Well integrity / corrosion	Improperly managed corrosion issues can lead to loss of production	By coupling real-time modeling and corrosions models, problem wells can be identified early
Well design	Well design can be optimized to save on CAPEX, such as analyzing the use of VITs	The integrated model will allow for offline analysis to better optimize the requirements for the well design

Key components of the Virtuoso/EOR include the following:

Virtual Metering for Oil/Water Production

The Virtual Metering System® (VMS) for SAGD Oil/Water Production module provides accurate, real-time estimates of three-phase (oil/gas/water) flowrates from individual wells. To provide robust and accurate calculations of well flowrates, the module uses multiple methods combining measured pressures, temperatures, valve statuses, and ESP speed. Each method incorporates a calculation of the method uncertainty, which is used to produce a weighted average of the methods to provide a best-estimated well flowrate.

Key features of the SAGD VMS Oil/Water Production module include the following:

- real-time per well oil production rates at operating conditions and comparison with field metering
- real-time per well total fluid rates
- retrieves well-test info in real-time
- validate the "virtual" metered well rates vs. well tests
- reduces overall errors and uncertainty in well-test and allocation reports (meter factors closer to 1)
- provide calibrated well rates monthly reporting

Virtual Metering for Steam

The Virtual Metering System® (VMS) for SAGD Steam Allocation module provides accurate, real-time estimates of the steam flowrate into each well. It uses multiple methods combining measured pressures, temperatures and valve statuses. This produces a weighted average of the methods to provide a best-estimated steam flowrate. Additionally, the module uses the measured flowrate of the steam from the generation point to correct any errors by determining an allocation factor. The model improves the knowledge of steam allocation, allowing operators to better determine optimum future steam allocation and ultimately leading to reduced steam use (i.e., minimised steam-oil ratio / SOR).

ESP Optimization Module

For SAGD wells, the oil/water mixture drains down to an ESP to pump the oil/water mixture to the surface. Typically, if the ESP is not running, there is no production. The purpose of this module is to provide real-time status of the ESP: Is the ESP working properly, does it need maintenance, is the current setpoint correct, what is the optimum setpoint? Key features of the ESP Optimization Module include the following:

- monitors real-time performance and compares vs design and historical performance
- based on steam/oil interface, recommends best lift settings to minimise short-circuit
- alert system to identify possible performance issues
- look-ahead advice of additional production from future changes
- machine learning (ML) algorithms can be applied to auto-learn for predictive maintenance

For more info, please visit us at
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Other available modules:

- Flowline Monitoring Module for
  - real-time surveillance of transport lines
  - leak detection
  - real-time restriction detection or build-up
  - real-time calculation of oil/water emulsion viscosity as a function of temperature and diluent
  - recommendation of optimum diluent usage
- Corrosion Monitoring Module for
  - real time calculation of corrosion rates on all fluid/wall interfaces
  - utilises Wood's ECE corrosion model to calculate corrosion
  - utilises current measured and calculated data
  - Life of Field cumulative can be tracked and reported
  - alert/traffic light system to highlight problematic wells

Wood. Powered by possible

The need for change has never been greater. In our industries, in the way we treat our planet, and in how we live.

To challenge the status quo we must be brave – it's having the courage to forge new answers. We're 40,000 inquisitive minds, on a quest to unlock solutions to the world's most critical challenges, across all of energy and the built environment.

United by our mission to create a sustainable future as the world evolves to a cleaner planet. Our bold spirit drives us to lead the charge, our actions transform challenges into solutions, and our curiosity keeps us pushing, innovating, making the impossible… possible.

Because we understand the time for talk is over. Because the world needs new answers to old challenges. Because at Wood, we are future ready, now.

For further information please go to:

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