



**EMERSON™**

# Sysdrill

Well Planning and  
Drilling Engineering



# Sysdrill

Plan accurately and drill safely,  
on time and on budget.

*The integrated nature of the application, coupled with its ease of use, allows us to efficiently deliver the comprehensive well planning and drilling engineering services that our clients require.*

Clayton Doke, Senior Engineer, Integrated Petroleum Technologies

## An Independent Drilling Solution

Sysdrill™ provides a comprehensive single application for well planning, survey management and drilling engineering analysis. Sysdrill allows operating and drilling service companies to enhance well planning accuracy, reduce drilling risk and uncertainty, quantify wellbore positioning, and improve drilling safety.

## A Unique Architecture for Productivity-Driven Engineering Workflows

The Sysdrill solution is delivered in a single, unified, Microsoft® Windows® application running off a single relational database. This allows unprecedented levels of product integration, interface consistency and productivity gains through highly efficient and flexible engineering workflows. Data is entered once and is instantly available to all areas of the application, ensuring data integrity and avoiding the need for data transfer and re-entry.

Sysdrill is a configurable multi-user system suitable for enterprise-wide deployment. Robust data management



▲ Wellbore dialog and well planning spreadsheet

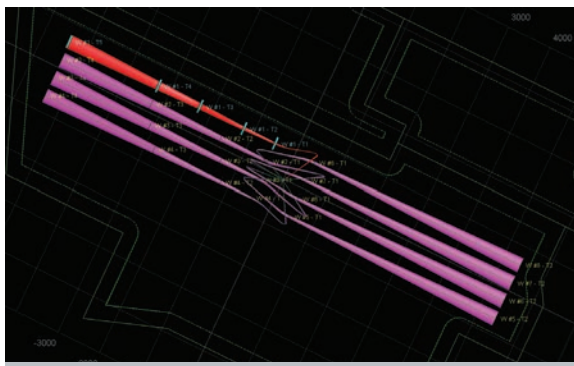
capabilities deliver a high degree of database access control for individual users and user groups. History logs for all objects in the database provide an audit trail of data modifications.

A flexible licensing model provides functional scalability, allowing access to any combination of well planning and/or engineering functions.

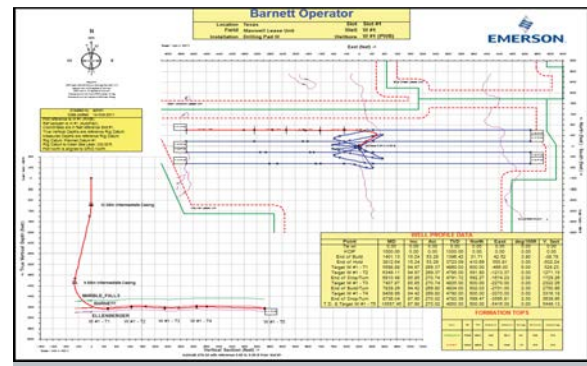
## Sysdrill Director™: Well Planning and Survey Management

### Data management

Sysdrill Director runs off of the Sysdrill database, which serves as a corporate database for wellbore data. Within Sysdrill Director, the global position of fields, rigs and slots can be specified in geographic, UTM or Lambert coordinates from over 1,000 coordinate systems stored in the Sysdrill database.



▲ 3D view showing positional uncertainty and lease lines



▲ Scale plan and section wall plots

Unit definitions, clearance rules and other default settings can be specified on an individual operator basis. RKB elevations and slot permanent datum are stored for each wellbore, allowing wells to be re-entered without having to modify the original data. This ensures the integrity of the database and provides a definitive wellbore history, including RKB elevations, overlapping surveys and error models.

### Well planning

A graphical user interface helps the drilling engineer visualize targets, including shape, dimensions, thickness, rotation, dip and offset. Geological surfaces and faults can be loaded for visualization, and intersections can be computed.

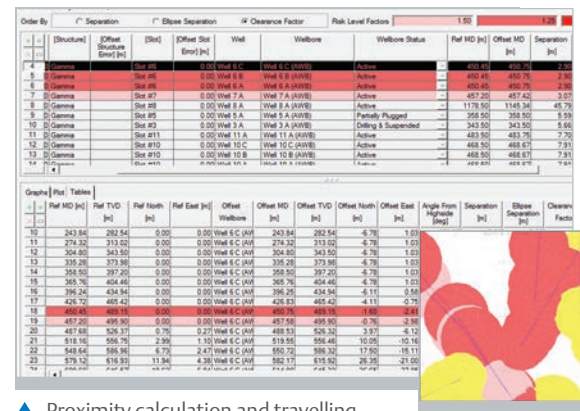
Sysdrill Director can be used to plan sidetrack, multilateral and re-entry wells by tying to existing wellbores stored in the Sysdrill database. Casings, hole sections, comments and survey error tools can be defined. Lease lines can also be entered and visualized, and the offset from well path calculated.

### Positional uncertainty

Sysdrill Director has a full range of modeling techniques for MWD, gyro and inertial, and inclination only downhole survey instruments. These include cones of uncertainty, Wolff and de Wardt, ISCVSA magnetic and gyro models. In addition, it is possible to create user-defined error models based upon tool manufacturers' specifications. WITSML .ipm and OWSG file formats are supported.

### Anti-collision analysis

Anti-collision analysis can be performed against an unlimited number of offset wells stored in the Sysdrill database. Results include wellbore separation, ellipse separation, clearance factor and diverging depths. If positional uncertainty has been specified at surface, it can also be included in the anti-collision analysis.



▲ Proximity calculation and travelling cylinder plots

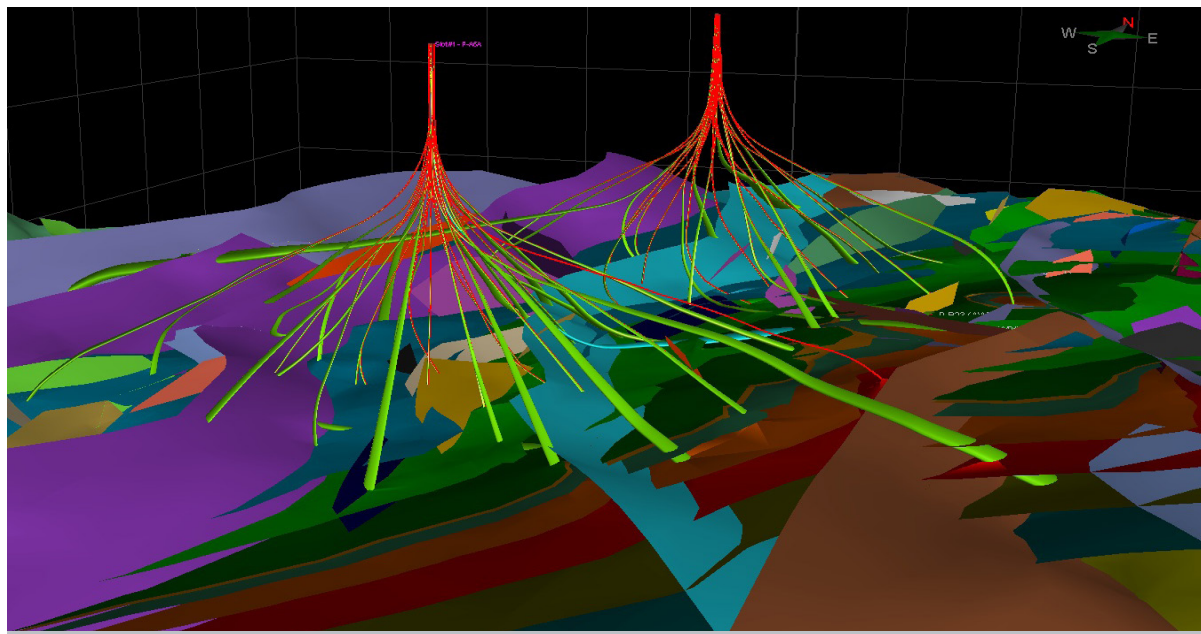
The results are displayed in ladder plot, travelling cylinder and tabular formats. High, medium and low collision risks are highlighted accordingly.

### Survey management

All directional survey data, including overlapping surveys, can be entered. The definitive wellbore is created by specifying to/from depths for each survey section, resulting in a definitive wellbore position and its positional uncertainty. Once the final survey has been loaded, it can be locked as definitive, thus ensuring the integrity of the database for anti-collision analysis or future sidetrack.

### Project ahead

An existing drilling trend can be analyzed to determine whether corrective action is needed. If so, a revised trajectory can be calculated based upon *return to plan*, *nudge/steer* or *project to target* definitions.



▲ Wells and geological formations shown in Sysdrill 3D view

Projections, including positional uncertainty, are visualized in the 3D Viewer and can be compared to the drillers' target or earth model.

Anti-collision analysis can be performed along the projection to avoid collision risk. Projections can be saved for engineering analysis.

**3D visualization**

The actual wellbore can be viewed interactively in the 3D Viewer and compared to the planned wellbore and other wells in the field. Geological surfaces, casings, uncertainty and drillers' targets may also be displayed. The data can be saved and distributed electronically in HTML format, allowing interactive viewing in a standard Web browser.

**Plotting and reporting**

Sysdrill Director offers an extensive set of pre-defined plot and report templates for all calculations. User-defined plots and reports can be designed, saved and re-used. Customizable plan, section, travelling cylinder, 3D and survey comparison plots are supported.

**Sysdrill Drilling Engineering**

**Sysdrill Torque & Drag**

The Sysdrill Torque & Drag optimization and analysis system is used to validate well designs and prevent loss of rig time by eliminating drilling string failure. It can be used by drilling engineers to model all types of BHA's, e.g. drilling assemblies, casing strings, sand screens and completion strings.

*BHA string constructor*

The Sysdrill BHA string constructor enables complex BHA's to be quickly constructed by rapidly filtering extensive catalogs of drilling equipment.

A customizable model allows the addition of new grades and connections. API rotary shouldered and casing connections are modeled, allowing the calculation of connection thread properties.

BHA's that are created can be stored in catalogs for future use, and new catalogs can be added. A customizable graphical view combines mechanical properties and physical dimensions.

*Soft & stiff string analysis*

Soft & stiff string analysis options allow calculation of all the forces acting upon the BHA, including torque, drag, stresses and side forces. The calculated loads are compared to buckling limits, string & connection yields, slip crush and rig operating limits. Results are presented using a "traffic light" approach for quick identification of specific issues.

Multiple user-defined operating modes can be incorporated in a single calculation, allowing the entire drilling process to be modeled for a given hole section.

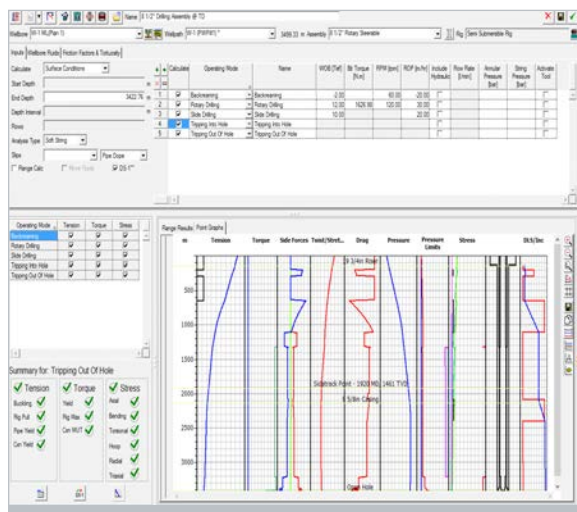
*Friction factor sensitivity*

The friction factor sensitivity module performs analyses at varying depths using different friction factors, and provides a summary of surface results. Hook load and surface torque readings received from the rig site may be entered and displayed, allowing direct comparison of modeled loads with those observed while drilling. Data correction tools and automatic back calculation of friction factors enable the model to be accurately calibrated.

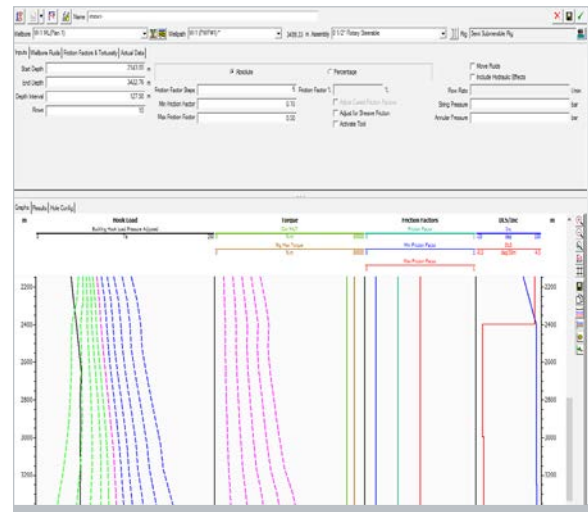
*Torque reduction*

Axial and torsional friction factor reduction can be incorporated to model the latest torque-reducing drilling tools. Tractors, swivel/clutch and traction drilling tools are also modeled. An integrated hydraulics model analyzes additional viscous forces and pressure induced stresses for a number of drilling circulating conditions including MPD scenarios. A packer calculation enables modeling of casing liner/hanger setting conditions, including rotating liners, and provides the maximum available set down weight.

The entry of complex fluid states allows the simulation of buoyancy assisted casing running.



▲ Torque & Drag dialog with inputs and results



▲ Friction factor sensitivity analysis

**Stuck pipe calculator**

The stuck pipe calculator is used to accurately predict the stuck point depth while drilling, based on measured surface torque and twist or surface over pull and stretch, considering hole inclination.

**Critical rotary speed analysis**

Sysdrill critical rotary speed analysis is used to predict the rotational speeds at which resonant frequencies may develop. The analysis considers axial, lateral and torsional vibration modes, and highlights rotary speeds to avoid while drilling, to prevent excessive string damage.

**Sysdrill Jar Placement**

The Sysdrill Jar Placement module analyzes drilling and fishing strings using the torque and drag model, and determines the optimal location for Jars based on their operating parameters and hole conditions. The module updates the assembly design accordingly and produces a detailed report.

**Sysdrill Hydraulics**

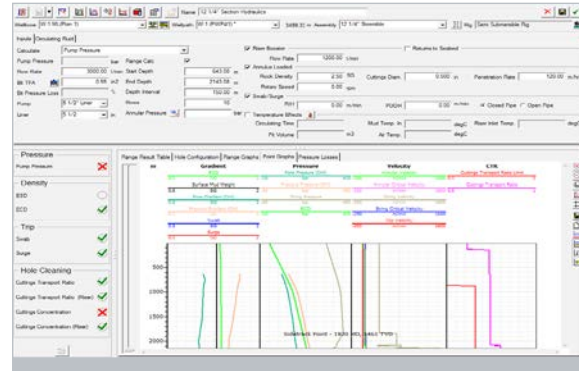
The Sysdrill Hydraulics optimization and analysis system is used to model downhole circulating pressures during drilling, tripping and running casing. Several modes of optimization are available to enhance bit hydraulic performance and ensure effective hole cleaning. For deep water operations, riser booster and dual gradient systems are supported. The hydraulics calculation includes applied annular pressure to support MPD operations. Split flow components such as jet subs, bypass subs and under-reamers can be defined, and the resulting flow rates determined.

**Rheology model selector**

The fluid builder allows accurate definition of fluid properties for use in all engineering calculations. Fluids can be stored in catalogs for re-use in other analyses.

A rheology model selector can analyze drilling fluids and automatically select the most suitable rheology model based upon viscometer readings. Power Law, Bingham Plastic, Herschel Bulkley & Robertson Stiff models are supported.

HPHT fluids can be defined using multiple HPHT viscometer readings.



▲ Hydraulics dialog with inputs and results

**ECD & swab/surge analysis**

Swab/surge and equivalent circulating density (ECD) analysis can be performed to reduce the risk of formation breakdown or swab induced influxes.

Individual tool joints and cuttings concentration are considered in the ECD calculation for modeling narrow mud window. Cuttings transport ratio and annular and critical velocities are also displayed.

**Maximum running speeds**

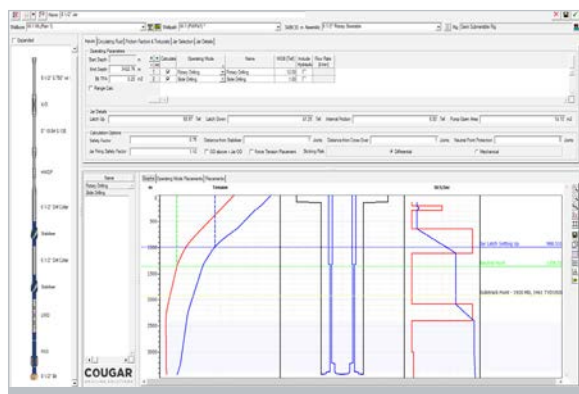
The maximum running speeds for BHA's and casing strings (both open and closed pipe) can be calculated to improve efficiency and safely reduce rig costs. A run speed sensitivity analysis shows anticipated swab/surge values at the last casing shoe and open hole TD.

**Optimizations**

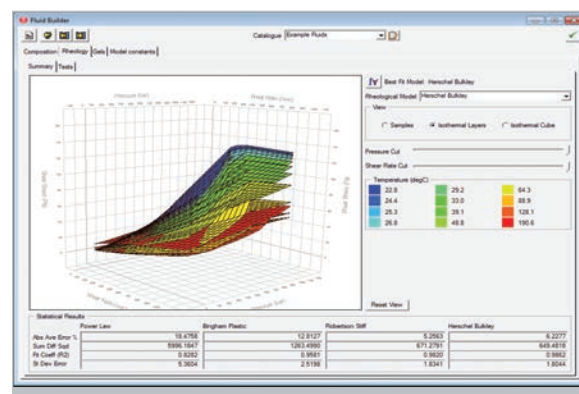
Sysdrill Hydraulics include several modes of optimization, including pump pressure, flow rate, % bit pressure loss and bit TFA calculations. BHHP & JIF curves can be generated, quickly showing hydraulic power and impact force with varying flow rate and bit TFA. Nozzle configuration and TFA can be calculated based on flow rate and surface pressure.

**Sensitivity analysis**

A sensitivity analysis allows calculation of pressures and ECD's at varying flow rates, and indicates min/max rates. Liner pressure profiles for the selected rig pump can be compared to aid in pump liner selection.



▲ Jar placement module determines optimal location for Jars



▲ Fluid builder showing HPHT rheology

*Fluid temperature modeling*

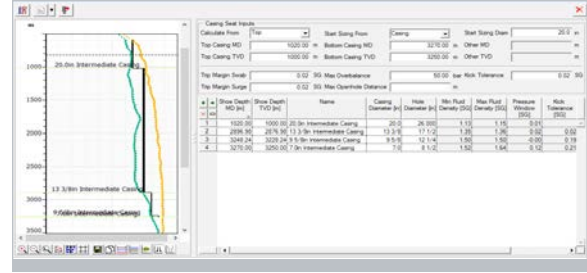
Sysdrill temperature modeling provides a quasi-steady state temperature model, with an advanced compositional density and HTHP rheology modeling, to simulate a number of drilling scenarios, including complex geothermal gradients, horizontal wells, riser booster and dual gradient systems. This allows accurate prediction of ECD, ESD and downhole mud density and rheology under HPHT conditions.

**Sysdrill Casing and Tubing Analysis**

Sysdrill casing design allows the drilling engineer to design the minimum number of casing strings required to safely complete a well, thereby reducing well capital costs. Fully customizable design load cases can be specified according to company policy and stored in catalogs.

*Casing seat selection*

Casing setting depths can be automatically calculated based upon pressure data and user-defined constraints, such as trip margin, kick tolerance and maximum open hole distance. Pressure data, formation tops, and hole and



▲ Casing seat calculator

casing sections can be co-visualized to allow interactive picking of casing shoes.

*Casing analysis*

The analysis offers uni-axial, half biaxial, full biaxial and tri-axial stress checks for axial, burst and collapse load cases for all stages of the well life cycle. Graphical plots, tabular data and a traffic light pass/fail indication allow rapid identification of problematic loading conditions.

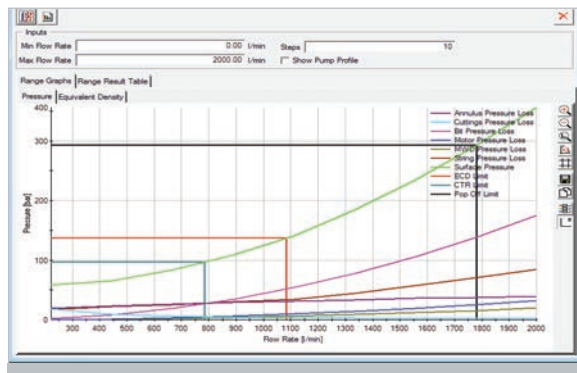
Individual or multiple load cases can be viewed, and load case pressure profiles can be visualized with the resulting load condition.

*Casing wear*

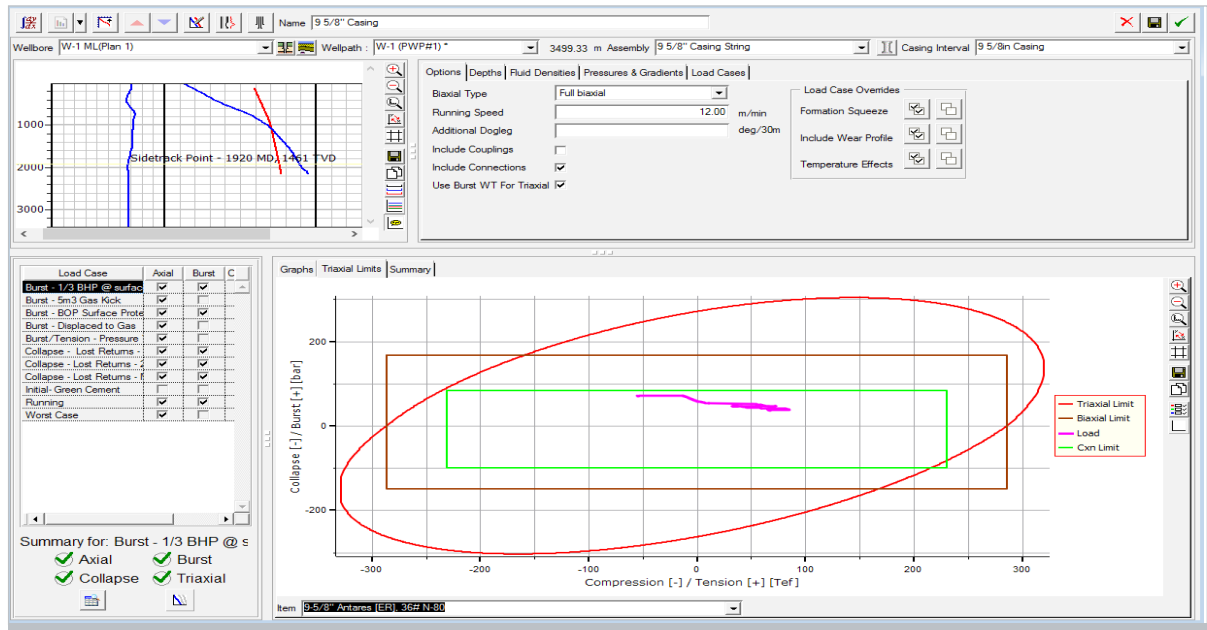
Sysdrill casing wear can be used to predict internal casing wear for a number of drilling operations and derate casing thickness for burst and collapse calculations. Alternatively, a caliper log can be imported as percentage wear and used in the calculation.

**Sysdrill Well Control**

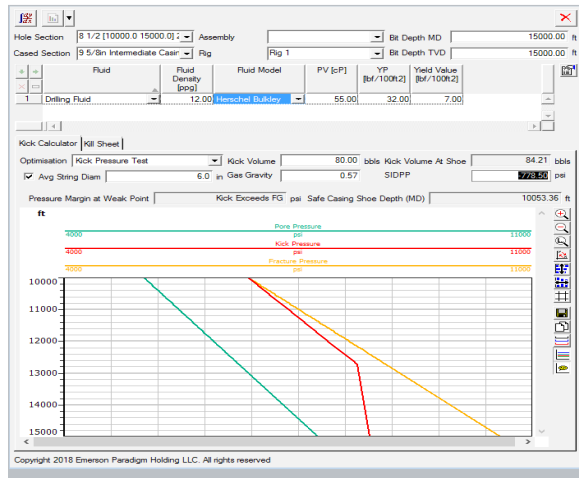
The well kick tolerance calculator is used to ensure that casing shoes are set at safe depths, and to avoid formation fractures using the “Single Bubble Method”. A kick of a given



▲ Flow rate sensitivity analysis with pressures and min/max flow rates



▲ Casing and tubing analysis dialog with inputs and results



▲ Well control dialog with EMW plot showing kick pressure against fracture gradient

size can be compared to the chosen casing shoe depth or the maximum allowable influx for a hole section calculated. A Kill Sheet can be quickly produced, including dynamic MAASP, volumes, strokes, and a pressure step down chart required to control the well.

**Sysdrill Cementing**

Sysdrill Cementing simulation is used to plan cementing operations to ensure the secure and safe installation of casing strings. It is used to optimize pumping operations for fixed flow rate, fixed bottom hole pressure, and free fall cementing to manage downhole pressures.

*Cementing analysis*

During calculations, an animated wellbore schematic displays fluid flow regimes, bottom hole pressures, ECD's

and flow rate as cements are circulated into position. Bottom hole pressures are plotted against formation breakdown pressure to prevent fracture. Expected pump, annular and hydrostatic pressures and pressure losses are also calculated.

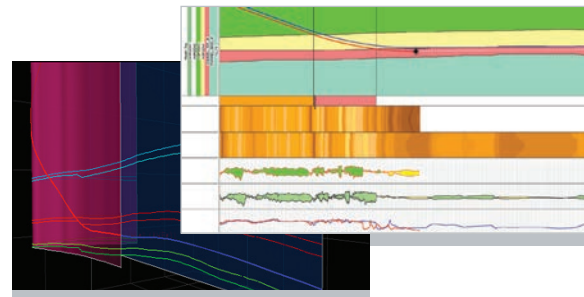
*Volume calculator*

The volume calculator, available from the cementing and hydraulics modules, provides solutions to many common well site volumetric problems, including pill spotting and balanced cement plugs.

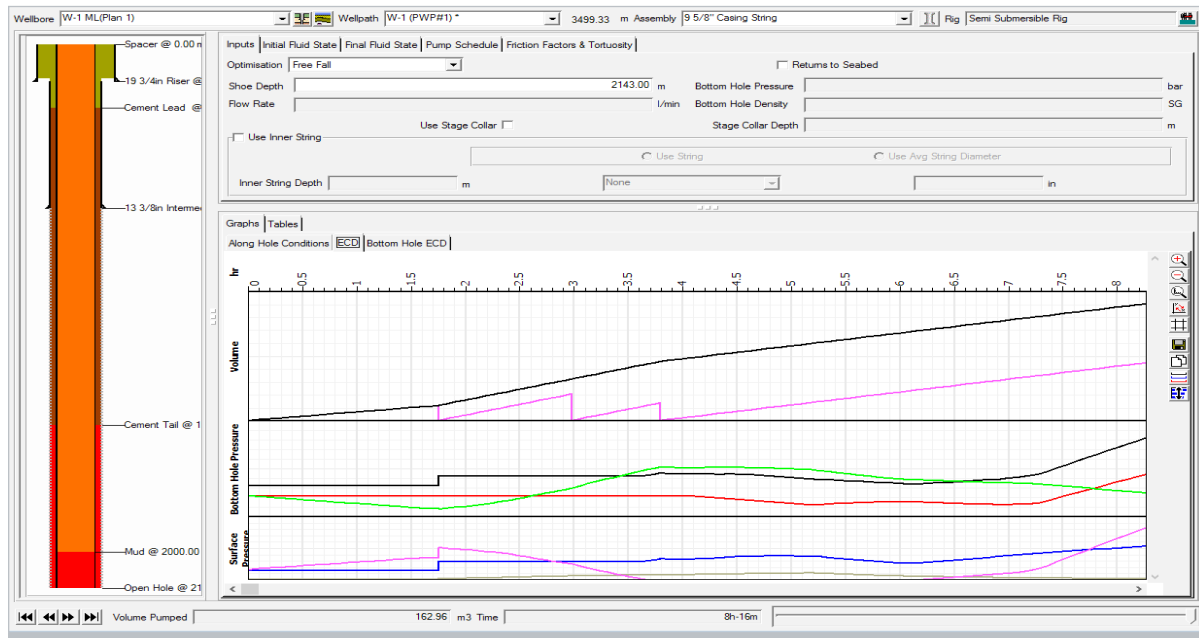
**Integrated Workflows Deliver Multi-Disciplinary Solutions**

Sysdrill has tight integration with Emerson E&P software applications running on the Epos™ data management and interoperability infrastructure, providing a common environment for multi-disciplinary teams of geoscientists and drilling engineers to plan and monitor wells to ensure optimal wellbore design and positioning.

Integration includes links to the Epos Well Database for combined well planning, engineering and geosteering workflows using Geolog™ Geosteer™.



▲ 2D correlation in Geolog Geosteer; equivalent section in 3D in Sysdrill



▲ Cementing dialog with fluid schematic and associated ECD plot



## Features

- Minimum curvature and constant toolface profiles
- Wolf & DeWardt, Cone and ISCWSA magnetic and gyro error models
- IGRF, BGGM, HDGM, EMM and WMM magnetic models for declination calculation
- 3D closest approach, traveling cylinder and horizontal plane proximity calculations
- 3D viewer with free plug-in, enabling third parties to view Sysdrill data
- Soft and stiff string Torque & Drag with buckling calculations, support for friction factor reduction
- Jar Placement to analyze drilling and fishing strings using the torque and drag model
- Hydraulics, including four rheological models, managed pressure, split flow calculations and HPHT modeling
- Casing analysis, API 5C3 modeling, including tri-axial and bi-axial calculations
- Cementing simulation to ensure the secure and safe installation of casing strings
- Reports to Microsoft Word and Microsoft Excel
- Easy to use import/export functionality supporting Epos, WITSML file and server, ASCII, LAS and copy/paste

## System specifications

- Microsoft® Windows® 7, 8.1 and 10 (64 bit)

## The Emerson E&P Software Advantage

- Sysdrill's single application and multi-user database architecture offer seamless interaction between well planning and drilling engineering, ensuring efficient and productive workflows.
- A result-driven analysis approach supports rapid identification and understanding of drilling problems.
- An advanced data input/output interface allows convenient loading of third-party data and rapid output to a variety of external repositories and file formats.
- Loading of real-time data from WITSML provides the latest information for accurate decision-making.
- Comprehensive database access control for all data, restricted to specific areas of the database, can accommodate 'tight hole' scenarios.
- Incorporation of geological data in industry-standard formats improves visualization and optimizes wellbore placement.

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