

## Sysdrill Director™ - Directional Well Planning and Survey Management

Sysdrill Director™ is the industry's most advanced directional well planning and survey management system. It is used by operating companies and drilling service companies to safely and accurately plan, drill, and monitor directional wells.

### Benefits

- Minimize training time by using flexible and easy-to-use well planning spreadsheet incorporating several predefined well trajectories that allow the drilling engineer to quickly plan wells to hit multiple drillers' targets.
- Plan the most accurate and cost-effective directional survey program to ensure wellbore placement within the drillers' targets.
- Reduce drilling risk by minimizing the possibility of collision using wellbore positional uncertainty incorporated into the anti-collision analysis.
- Save time by using directional survey data that can be entered manually, imported from file, or loaded in real time using OpsLink™ WITSML technology.
- Decrease time for decision making by accurately projecting ahead of the bit with comprehensive tools that ensure the wellbore hits the driller's targets

# Well Planning, Drilling Engineering & Real-Time Geosteering

## Well Planning

A graphical user interface helps the drilling engineer visualize the target, including shape, dimensions, thickness, rotation, dip, and offset. Geological surfaces and faults can be loaded for visualization and computing intersections for casing placement. Paradigm 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 also be defined.

## Positional Uncertainty

Sysdrill Director has a full range of modeling techniques for MWD, gyro, and inertial downhole survey instruments. These include cones of uncertainty, Wolff and de Wardt, ISCWSA magnetic, and gyro models. In addition, the drilling engineer can create user-defined error models based upon tool manufacturers' specifications. For re-entry wells, Paradigm Sysdrill Director can model "re-surveying" of the original wellbore with a more accurate survey tool without having to modify the original data, thus ensuring the integrity of the database.

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### Anti-Collision Analysis

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

### 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 the 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 re-entry.

### 3D Visualization

The actual wellbore can be viewed interactively in the HTMLbased 3D viewer and compared against the planned wellbore and other wells on 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.

### Project Ahead

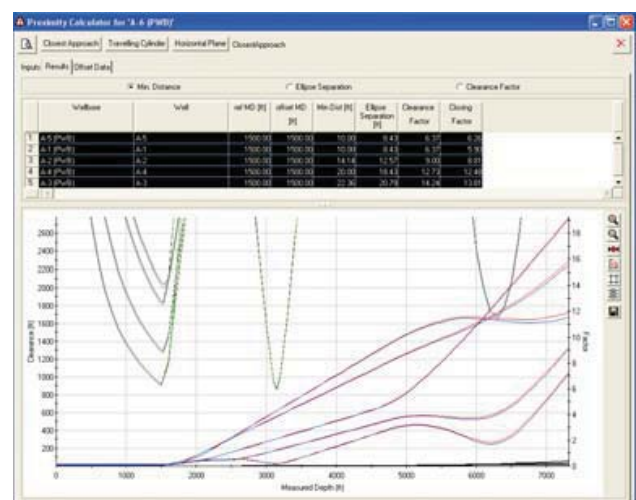
The existing drilling trend can be analyzed to determine whether corrective action is required, and if so, a revised trajectory can be calculated based upon "return to plan" or "project to target" definitions. Projections, including positional uncertainty, are visualized in the 3D Viewer, and can be compared to the drillers' target. Anti-collision analysis can also be performed along the projection to avoid risk of collision. A project-ahead report can be produced and issued to the directional driller.

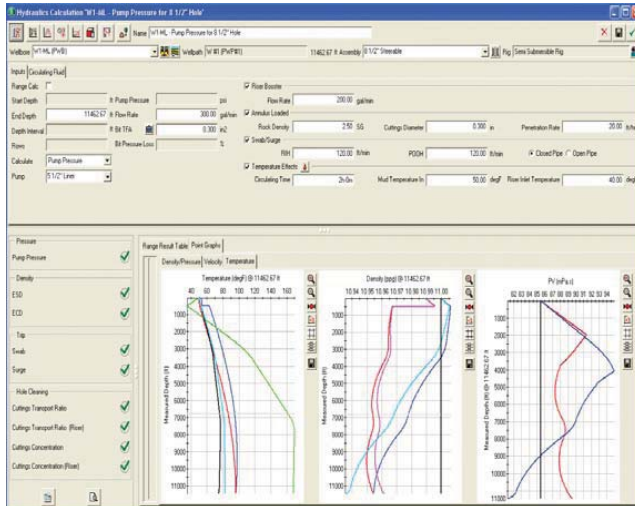
### Field & Data Management

Sysdrill Director has been designed to be used as a corporate database for wellbore data. The global position of fields, rigs, and slots can be specified in geographic, UTM, or Lambert coordinates from over 1,000 coordinate systems included as standard formats. Lease lines and local boundaries can also be entered and visualized. Unit definitions, clearance rules, and other default settings can be specified on an individual operator basis. Individual rig kelly bushing (RKB) elevations and slot permanent datums are stored for each wellbore, allowing wells to be 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. A sophisticated security function using a set of access controls allows permissions and a history log that permits you to restrict and to monitor access to individual users and groups.

### Plotting & Reporting

Sysdrill offers an extensive set of pre-defined plot and reports templates for all calculations. User-defined plots and reports can also be designed, saved, and re-used. Customer logos can be imported and will automatically appear by default.





The Sysdrill Hydraulics™ optimization and analysis system is used to model downhole circulating pressures during drilling, tripping, and running casing. There are several modes of optimization to enhance bit hydraulic performance and ensure effective hole cleaning.

A rheology model selector can analyze all types of drilling fluids and automatically select the most suitable mud rheology model based upon actual Fan viscometer readings.

Swab/Surge and equivalent circulating density (ECD) analysis can be performed to reduce the risk of formation breakdown. The maximum running speeds for BHA's and casing strings can be calculated to improve efficiency and reduce rig costs. Individual tool joints are considered in the ECD calculation for modeling narrow mud window.

A sensitivity analysis allows calculation of pressures and ECD's at varying flow rates and indicates minimum and maximum recommended flow rates.

The Volume Calculator can be used to determine mud volumes for a number of circulating scenarios including pill spotting, cement plug, wash out calculation, and reverse circulating.

For deep water operations a riser booster and dual gradient systems are supported.

### Sysdrill BHA String Constructor™

The Sysdrill BHA String Constructor™ allows complex BHA's to be quickly constructed by rapid filtering of extensive catalogs of drilling equipment including bits, collars, pressure loss devices, centralizers, stabilizers, torque reduction subs, and accessories. BHA's that are created can be stored in catalogs for future usage and new catalogs can be added. A customizable graphical view combines mechanical properties and physical dimensions.

### Sysdrill Temperature Modeling™

Sysdrill Temperature Modeling™ provides a quasi steady state temperature model, with an advanced compositional density and HTHP rheology model 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 and ESD (equivalent static density) downhole mud density and rheology under HPHT conditions.



# EASTERN DRILLING SERVICES



## Sysdrill Hydraulics™

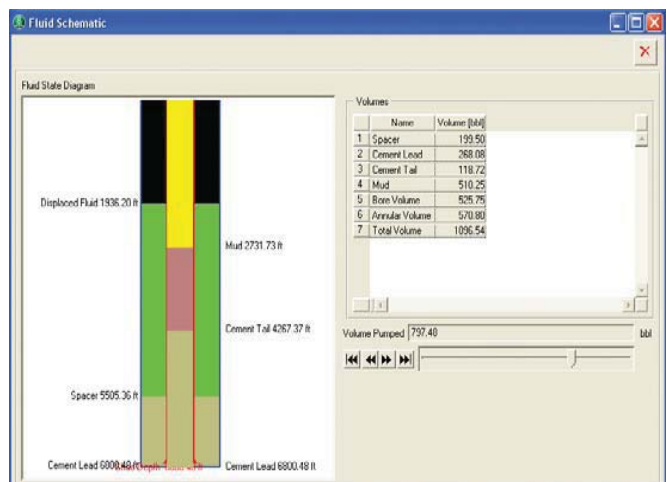
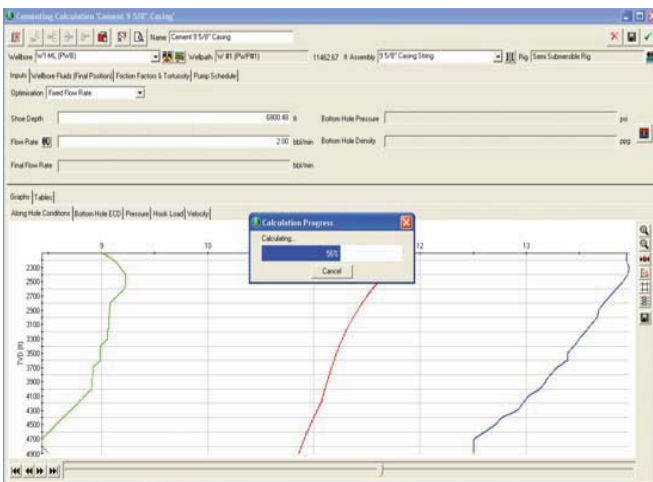
### Sysdrill Well Control™

The Paradigm Sysdrill Well Control™ well kick tolerance calculator is used to ensure that casing shoes are set at safe depths and avoid formation fractures using “Single Bubble Method”. 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™

The Paradigm Sysdrill Cementing™ optimization and analysis system is used for planning cementing operations to ensure the secure and safe installation of casing strings. It is used to optimize pumping operations for variable flow rate pump schedules, fixed flow rate, fixed bottom hole pressure and free fall to manage downhole pressures.

During calculations, an animated wellbore schematic displays fluid flow regimes, bottom hole pressures, ECD's and flow rate as cements are circulated. Bottom hole pressures are plotted against formation breakdown pressure to prevent open hole fractures.





# EASTERN DRILLING SERVICES

## Overview

Reservoir complexity drives the need for optimized well planning and engineering design. Paradigm® Sysdrill® 2009 provides a comprehensive, single application for well planning and drilling that allows engineers to plan wells quickly and accurately with increased confidence and reduced uncertainty.

The application suite includes well planning, survey management, anti-collision, torque and drag, hydraulics, casing design, cementing and well control in a single integrated package.

Additionally, Sysdrill 2009 can be used in combination with Paradigm Geolog® Geosteer™, a commercially-available, contractor independent geosteering solution that supports the fast creation of log-scale geosteering models ahead of drilling, facilitates interactive updates to geosteering models while drilling, and enables re-planning of wells using updated models.

## New Features and Highlights

### Improved Workflow / Ease-of-Use

- QuickWell Wizard for faster well design
- Improved geological surface file handling for rapid import and management of surfaces
- Support of additional geological surface file formats
- Ability to create user defined formations/surfaces
- Formation surface support in the plotting package
- Enhanced 3D viewer provides more flexible display and manipulation options and includes a new query function, measuring tool and mouse wheel support
- Enhanced 2D view with additional labeling
- Project Ahead module now contains a 2D view with formation support to allow visualization of the projection and surfaces in a sectional representation
- Improved plotting package with extended traveling cylinder plot support and isometric plot
- Improved engineering graphs allow display of additional label types and formation tops and provide independent axis scaling
- Improved lease line handling
- Multi-language support
- Improved user interface

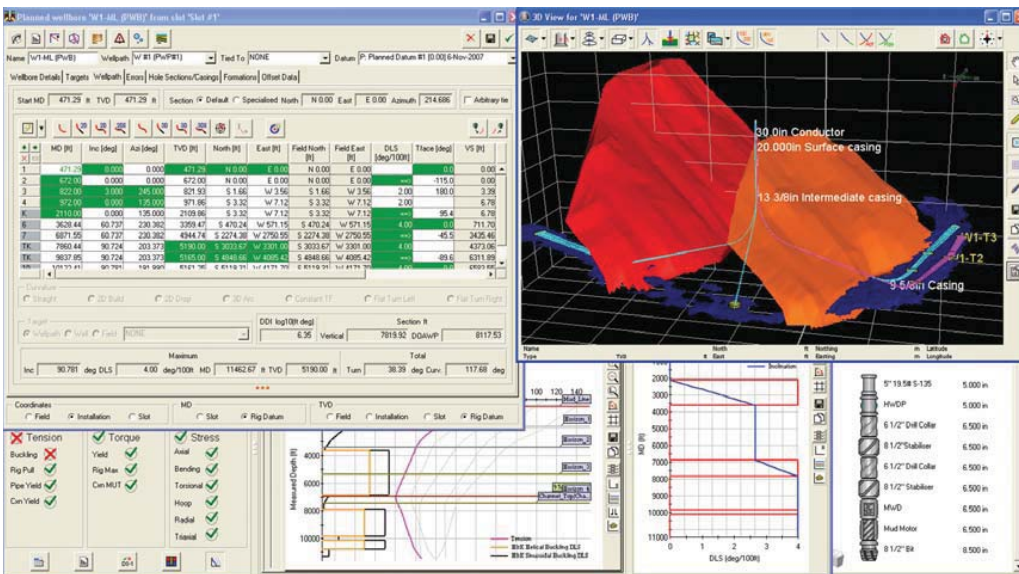


## New Calculations to Improve Engineering Analysis

- Multiple well path support in engineering modules for fast evaluation of multiple proposals
- Flat turn/constant tool face well path profiles
- Directional difficulty index provides a relative measure of drilling difficulty for the well path
- Lockable targets for improved target management
- Planned vs. actual traveling cylinder plot and separation
- Nudge/steer functionality in the Project Ahead module
- Improved clearance calculations, including risk factors and embedded traveling cylinder plot for better understanding of spatial relationships between well paths during drilling
- Torque and drag friction factor sensitivity plot
- New friction factor values for individual assembly components
- Enhanced circulating temperature model
- Improved pump modeling allows identification of appropriate pumps for drilling
- Enhanced casing analysis interface and presentation of results
- API casing connection modeling and catalog for quick casing string creation
- Additional connection design factors for accurate casing design
- Formation squeeze load case support for casing design
- Tubing load case support for tubing design
- Improved casing seat selection with kick tolerance calculation and graphical selection



## Sysdrill 2009



*Integrated well planning, drilling engineering analysis and visualization allows drilling engineers to perform quick and accurate well design by incorporating the geological model.*

### Enhanced Integration

- Improved geosteering support for Paradigm Geolog®
- Reporting output to Microsoft Office Rich Text Format (RTF)
- High resolution hard copy graphical output for improved clarity
- Improved copy and paste throughout application
- Single input/output wizard with ASCII, DEX, WITSML, Epos™, Microsoft Clipboard and Excel support
- Extended DEX and WITSML support
- Ability to copy pressure and temperature profiles between wells
- Overburden gradient support for load case analysis
- New engineering catalogs for fast re-use of key datasets

### The Sysdrill® 2009 suite includes the following modules:

- Sysdrill Director®
- Sysdrill DirectorGeo™
- Sysdrill Torque & Drag™
- Sysdrill Hydraulics
- Sysdrill Casing Design
- Sysdrill Casing Wear
- Sysdrill Cementing
- Sysdrill Well Control
- Sysdrill Fluid Temperature Modeling