Baker Hughes

JewelSuite Drilling Engineering

Integrated drilling modeling and simulation software

JewelSuite™ Drilling Engineering software provides integrated technical planning, modeling, and simulation workflows for well construction applications. It combines standard and advanced physics models for use in the office as well as in real time for the following applications:

- Bottomhole assembly (BHA) and drillstring design
- Torque and drag analysis
- Drilling and tripping hydraulics
- Advanced fluid properties and displacement modeling
- Finite element statics and vibration simulation

Accurate simulation of the drilling process and of casing or liner runs is critical to reducing risks of nonproductive time (NPT), e.g. due to kicks and losses, stuck pipe, BHA damage, or impaired LWD measurements. It is also key to enabling optimum and repeatable drilling and completion performance.

JewelSuite Drilling Engineering software offers an intuitive working environment for efficient planning, execution, and improvement of directional drilling and completion operations. The highly integrated and flexible workflow is focused on fast, reliable design of engineering solutions and effective scenario analysis.

Powered by a comprehensive catalog of more than 6,600 drill pipes, casings, collars, and BHA components, drill strings and casing assemblies are built quickly while eliminating data entry errors.

Well and log data in many formats are easily integrated into the engineering model.

JewelSuite Drilling Engineering is built on a scalable, modular, extensible platform that can be tailored to the users needs. It is fully real-time enabled and can be used as a key input to advanced well construction monitoring and automation services.

The pre-job models are continuously updated with live data during job execution, replacing planning parameters with real measurements. This provides the most accurate, and always current insights into actual downhole conditions during various stages of the well construction process.

The underlying algorithms are based on more than 30 years of Baker Hughes experience in hydraulics and mechanical drilling process simulation and meet or exceed industry standards. These algorithms are proven through daily use around the globe.

Applications

- Physics-based simulations for well construction
- Horizontal wells
- Extended reach wells
- Complex offshore wells with challenging pressure profiles
- Exploration campaigns

Benefits

- Proactive risk management in job planning and during execution
- Assurance of wellbore integrity
- Optimum well construction performance
- Minimized NPT and invisible lost time (ILT)
- Fast, efficient well engineering through optimized usability
- Evergreen digital twin of well construction with automatic real-time updates of the pre-job model

Specifications

Common features

Software version	JewelSuite 12 Drilling Engineering (2022.3.588)
Platform	Built on the Baker Hughes **JewelEarth™ software development platform** for seamless cross-disciplinary workflow integration
Drillstring catalog	Comprehensive catalog of +6,600 Baker Hughes and API-standard drillstring and casing components with all attributes necessary for deployment planning and simulation
Supported operations	• Jointed pipe and coiled tubing running strings operated in open and cased hole • Tripping in and out of hole, on and off-bottom directional drilling applications • Configurable settings for directional motors, rotary steerable systems, and bypass subs • Support for hole opening operations with fixed-blade and expandable reamers • Fluid displacement and cement placement operations • Scenario modeling to analyze sensitivity of operating parameters

Torque and drag

Drillstring loads	• Equivalent stress, yield and fatigue safety along the drillstring for single depth and entire section • Critical buckling loads and post-buckling behavior (sinusoidal and helical) • Drillstring stretch and twist • Casing wear analysis • Stuck point calculation
Surface loads	• Axial drillstring load and torque at surface and indicated hook load • Friction factor sensitivity analysis (broomstick chart)
Real-time simulations	Continually updated hook load and torque sensitivity analysis
Simulation logic	• Stiff string model, considering drill pipe tool joints and precise wellbore contacts • Analysis for drilling (rotating and sliding), rotating off bottom, pick-up, slack-off, and back reaming • Cased and open hole friction factors, and calibrated borehole tortuosity model

Advanced drillstring mechanics

Detailed statics analysis	• Lateral, torsional, and axial drillstring deformation • Distributed bending loads along string for single depth and depth intervals • Eccentricity, radial clearance, and lateral contact forces • Angular sensor misalignments (e.g., for directional survey corrections) • Steering (build rate) prognosis
Vibration analysis	• Natural vibration – drillstring natural frequencies and resulting deflection shapes • Forced vibration – drillstring deflection shapes and amplitudes in response to excitation, (e.g., through mass imbalance)
Simulation logic	• Proprietary finite element model optimized for drillstring and BHA analysis • Consideration of detailed string and wellbore geometry, steering force, and borehole contacts

Hydraulics

Pressure analysis	• Equivalent circulating and static density (ECD, ESD) calculation, with and without cuttings influence • Pressure drop in surface equipment, drillstring, and annulus; standpipe pressure • On- and off-bottom operations, reverse circulation option • Single and multiple flow rates simulation, including riser booster pumps • Support of riserless mud return, dual gradient applications, and annular backpressure • Split-flow analysis (e.g., bypass subs) • Bit hydraulics - jet impact force, hydraulic horsepower, and optimized nozzle selection • Modeling over-gauge hole
Hole cleaning	• Required flow rate and fluid velocity for effective cuttings transport • Cuttings bed height and distribution along wellbore • ROP sensitivity analysis
Swab and surge	• Trip speed optimization for closed and open pipe, with and without pump flow • Consideration of pore, collapse, and fracture pressure along open hole • Effect of pipe acceleration/deceleration and condition of gels
Compressibility analysis	For circulating/drilling, as well as pressure test (FIT/LOT) and cementing operations
Displacement simulation	• Definition of pumping sequence for multiple fluids in displacement and cementing operations • Effect of ECD/ESD, pump pressures, and other parameters vs. time • Evolution of fluid volumes in string and annulus
Automatic real-time simulations	• Continually updated prediction of hole cleaning and ECD/ESD, calibrated with measured ECD data • Generation and evolution of cutting beds over time • Estimation of borehole cleanup time • Optimum trip-speed profile prediction on every connection, including pipe acceleration effects • Real-time parameter updates for depth, RPM, WOB, temperature, and rheology data
Simulation logic	• Herschel-Bulkley, Robertson-Stiff, Bingham Plastic, Power Law, and Newtonian fluid rheology models • AI-enabled consideration of temperature and pressure effect on density and viscosity • Selectable compositional fluid model or definition by measured PVT • Baker Hughes proprietary pressure drop and cuttings transport models, considering drillstring rotation and eccentricity for laminar and turbulent flow

Directional survey calculations

Sag calculation	Correction of gravity-induced sensor misalignment
Drillstring magnetic interference	• Verification of required non-magnetic spacing • Compliance check with position uncertainty models

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