



DEEP WATER



MATURE FIELDS



UNCONVENTIONALS



InSite[®] for Well Intervention (IWITM)

Design Software



Design Software for Coiled Tubing and Jointed Pipe

OVERVIEW

Halliburton's InSite® for Well Intervention (IWI™) design software offers a robust modeling tool to create customized solutions for specific intervention challenges. Users may simulate operating scenarios, collaborating with Halliburton subject matter experts and internal resources, to investigate any anticipated working conditions.

This in-depth insight into the job design and collaborative modeling can help align operational expectations and execution strategies between the operator and service provider in order to deliver tailored intervention solutions for coiled tubing and hydraulic workover, improving the reliability of a proposed operation.

Developed and continuously improved over many years, Halliburton's IWI software enables users to accurately model different types of coiled tubing and jointed pipe operations prior to mobilization. Design models may be directly exported to the real-time mode on an operation to ensure continuity of wellbore data, and an entire model file or discreet component files may be saved and exported for seamless transfer to other users for comparison, analysis, or information sharing. Collaborate to build an accurate model and execute with full confidence and seamless integration.

INSITE® FOR WELL INTERVENTION SOFTWARE FEATURES

- » In-depth modeling and design software for well intervention
- » Modes for coiled tubing and jointed pipe
- » Force and limit models
- » Hydraulic models
- » Pipe fatigue models
- » Drag and reach analysis
- » Solids removal analysis
- » Customized string design
- » Depth-based plotting
- » Detailed job analysis and comparative review
- » Shareable models and components
- » Collaborative planning for job optimization

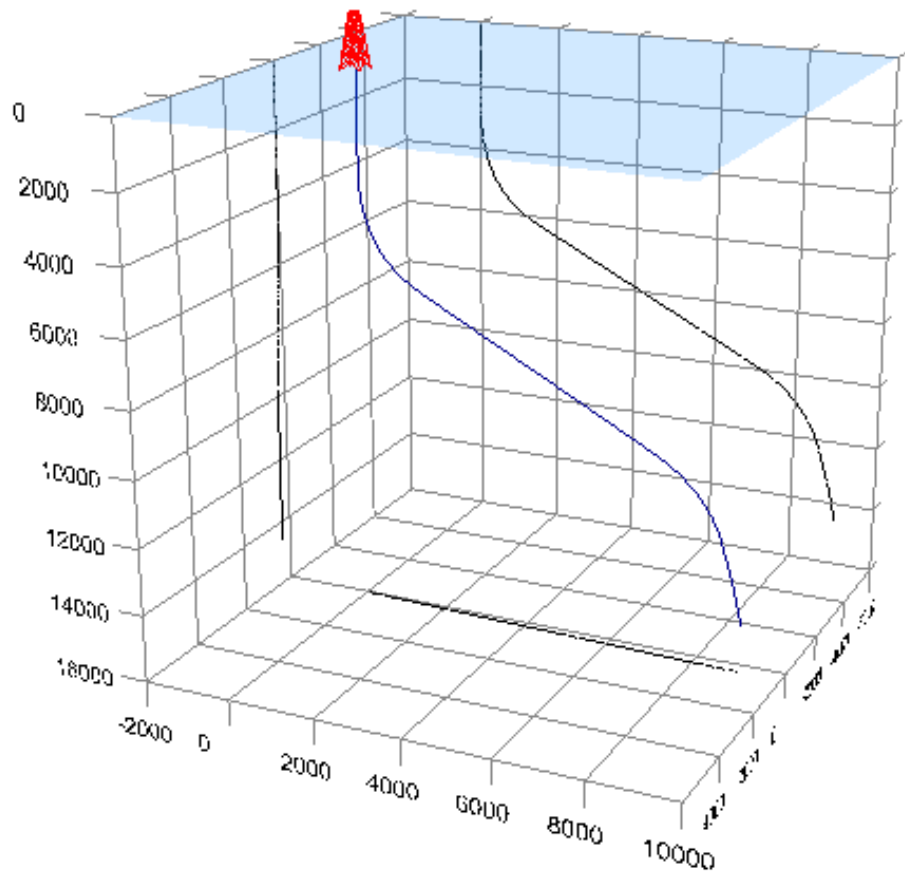
HOW DOES IT WORK?

IWI design software is configured as a web-based application. There are no program files to install on the user's machine and no IT configuration requirements to integrate into internal network systems. Simply log-in to the web module with a license ID and experience the industry's most powerful well intervention modeling tool via a secure network connection.

The user may create, edit, and share job design files as needed. These files are compatible with the web-based design program, as well as with the full InSite software program used by Halliburton engineers.

Access to the IWI design software is granted on a license basis.





COILED TUBING JOB DESIGN USING IWI SOFTWARE

With wells becoming deeper, more highly deviated, and more complex overall, the need for accurate coiled tubing design and analysis is becoming more and more critical. Hydraulics and mechanical forces can now be analyzed in greater detail prior to any operation to ensure the likelihood of a successful job or simply to assess overall feasibility.

Forces and Stresses

The IWI Design Forces Module is used to model coiled tubing deployment, with or without tools, into and out of a well using an accurate representation of the wellbore.

The program analyzes the cumulative forces acting at a particular stage of the job and determines whether the target depth can be reached, specified tasks performed, and equipment retrieved to surface. This module can be used to simulate any coiled tubing operation, including HPHT and extended reach applications.

The drag model may be used to estimate parameters such as maximum reach, with and without lubricants and mechanical aids, or “lock-up depth.” This model can also be used to estimate forces such as the available push force on end of tubing at various depths, as well as maximum pull forces for any number of well conditions, relative to the yield limits of the coiled tubing string.

Design outputs can be obtained very quickly to enable analysis of the forces present during a coiled tubing operation.

Top » The IWI design software manager is used to build a detailed wellbore model to be integrated into the other design modules to provide a more accurate analysis

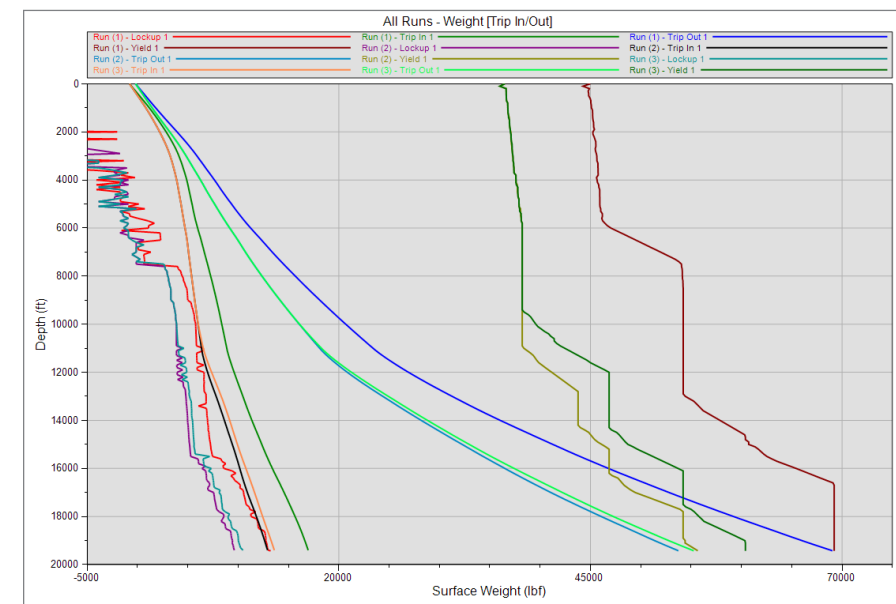
Right » An extensive array of job aspects can be reviewed in the job model, including a thorough selection of force and stress limit parameters



MULTIPLE CASE COMPARISONS

An advanced feature of IWI’s design analysis is the ability to compare several different cases easily during a single design. This can be used to find out which coiled tubing string is most suitable for a particular application. Runs can be compared on a single output graph, allowing decisions to be made quickly and easily. These comparisons can be made based on any input parameter.

Graph	Direction	Start Depth	End Depth	Density of Fluid in Annulus	CT Flow Path	Ann Flow Path	CT Pumping Fluid Name	CT Pumping Fluid Density	CT Pumping Pump Rate	WSP	CT Pressure	CT Speed	Comment	Lockup Depth	Max Weight	Max Stress Factor
		ft	ft	lb/gal				lb/gal	gpm	psi	ft/min			ft	lb	
Snapshot	Trip In/Out															
Calc	Calc				Run 1 (1) - Type: "Standard"	Well: "B33"	Friction Profile: "Default Coefficients"	String: "HAL311840000"	Reel: "DID Caspian"							
1-1	RH	0.0	19427.0	8.33	In	Out	Sea Water	8.37	0	0	66.00		No Lockup	16490	Calc	
1-2	None	19427.0	19427.0	8.37	In	Out	Sea Water	8.37	0	0	182	0.00			3.80	Calc
1-3	POOH	19427.0	0.0	8.57	In	Out	Sea Water	8.57	0	0	100.00			68552	Calc	
NEW																
Calc	Calc				Run 2 (2) - Type: "Standard"	Well: "B33"	Friction Profile: "Default Coefficients"	String: "HAL305000000"	Reel: "Default Reel"							
2-1	RH	0.0	19427.0	8.57	In	Out	Sea Water	8.57	0	0	60.00		No Lockup	11973	Calc	
2-2	None	19427.0	19427.0	8.57	In	Out	Sea Water	8.57	0	0	182	0.00				Calc
2-3	POOH	19427.0	0.0	8.57	In	Out	Sea Water	8.57	0	0	100.00			52763	Calc	
NEW																
Calc	Calc				Run 3 (3) - Type: "Standard"	Well: "B33"	Friction Profile: "Default Coefficients"	String: "HAL26831"	Reel: "Default Reel"							
3-1	RH	0.0	19427.0	8.57	In	Out	Sea Water	8.57	0	0	60.00		No Lockup	11680	Calc	
3-2	None	19427.0	19427.0	8.57	In	Out	Sea Water	8.57	0	0	182	0.00				Calc
3-3	POOH	19427.0	0.0	8.57	In	Out	Sea Water	8.57	0	0	100.00			50314	Calc	
NEW																



Top » IWI design software enables multiple job scenarios to be run in a single model to review the impact of minor adjustments or significant changes

Bottom » Analysis of multiple job scenarios may be compared side by side to help optimize a target job design

COILED TUBING AND WELL HYDRAULICS

IWI design software has the capability of accurately modeling fluid hydraulics in the coiled tubing and wellbore. Fluid flow is influenced by several conditions, including string and wellbore geometry, fluid properties, pump rate, measured depth, choke pressure, and reservoir properties. Slight changes may have minimal or dramatic impacts on the potential success of a job.

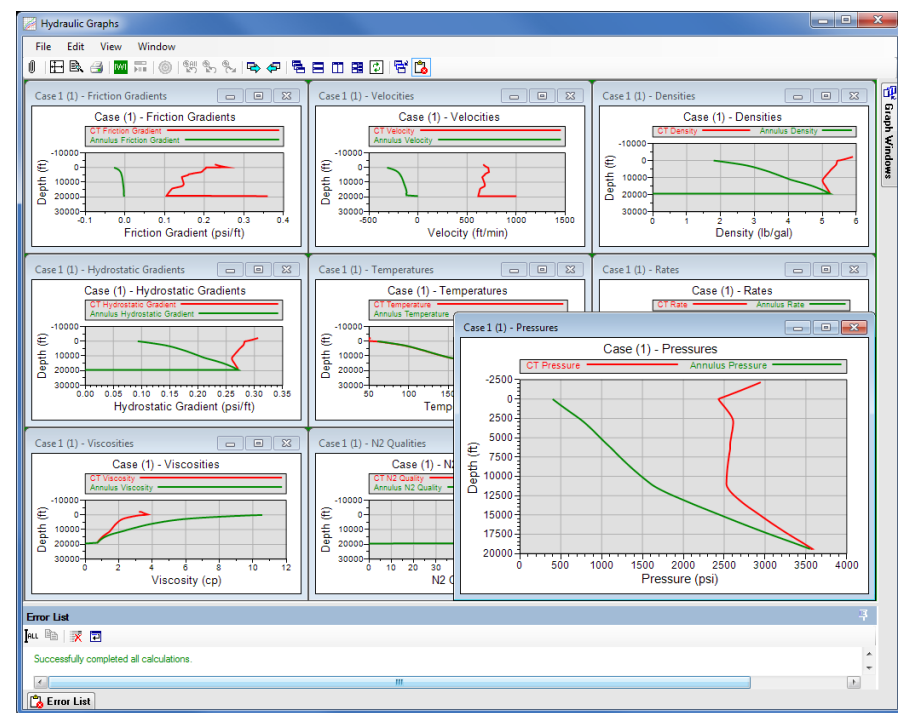
The hydraulics simulations in IWI software are based on empirical data gathered from Halliburton's great wealth of drilling fluids, cementing, stimulation and fracturing experience. Extensive testing using fluids and proppants in coiled tubing have also been performed to complement this experience.

Advanced energy balance calculations in the model include frictional heating due to fluid flow, heat transfer between formation and wellbore, heat transfer between

annulus and tubing, and heat transfer within the tubing and annulus along the direction of flow. Fluids are tracked as they move through the system, with pressures and temperature being calculated and displayed throughout the wellbore.

The IWI hydraulics design module combines hydraulic calculations with a powerful graphical interface to allow the user to predict flow rates and pressures at any stage of a coiled tubing job. As with the forces model, comparisons can be made using different parameters, such as different pump rates or coiled tubing strings, in a single job, to allow quick and clear decisions to be made.

Practical applications may include modeling scenarios for fluid displacement, fill removal, and various pumping treatments where parameters such as annular velocity and friction pressures may be of design interest.

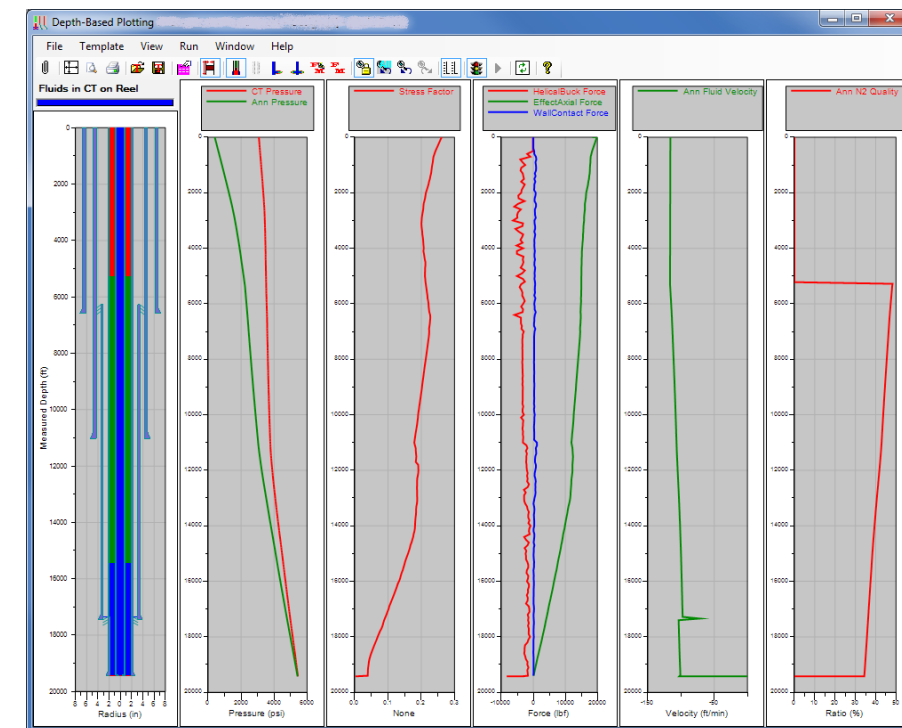
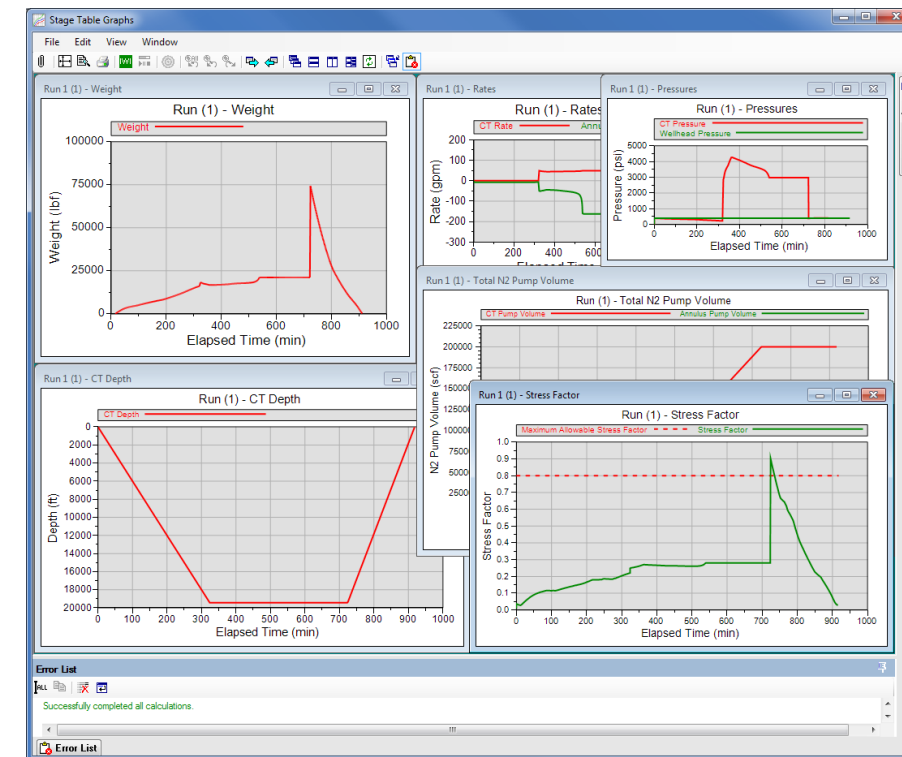


Right » IWI design software enables a thorough hydraulics analysis for review of flow and pressure parameters expected during an operation

STAGE TABLE DESIGN

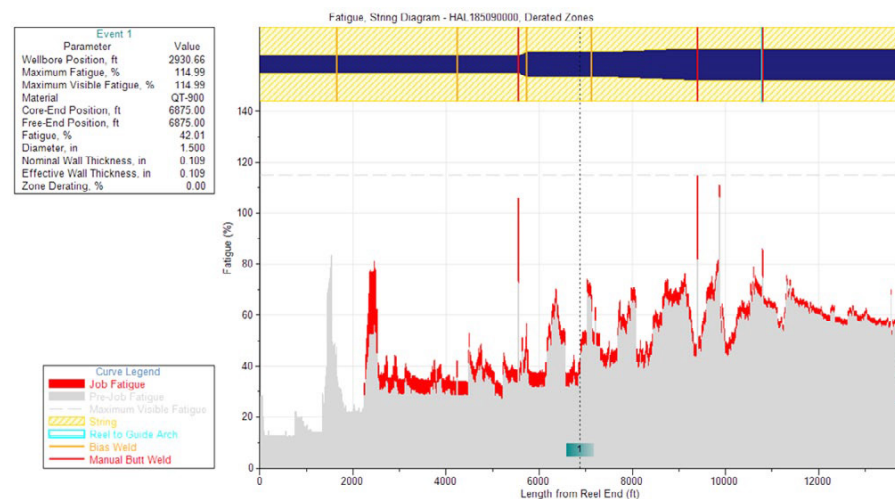
Another advanced feature of the IWI design software is the ability to add the dimension of time. This allows hydraulics and mechanics for a complete job to be calculated simultaneously with any parameter charted against time. By using this we can see maximum coiled tubing stresses, on surface and downhole, during the entire operation. This can be done more accurately as the hydraulics change throughout the job as defined by the user inputs. Pressures can be predicted at any location, such as the choke or well reservoir, throughout the job and input data can be adjusted to optimize the job performance. Volumes and times for different operations are calculated automatically to aid job planning.

Depth-based plotting can be used to graphically represent an entire operation from start to finish, tracking fluid positions, temperature profiles, forces and stresses, across the wellbore throughout the simulated job.



Top » The Stage Table mode enables more complex job designs to be reviewed, with the ability to simulate an operation in step by step detail

Bottom » The Depth-Based plotting feature provides an animated graphic representation of the job model as it moves through the operating sequence and charts selected parameters along the way



Above » Extensive testing and field evaluations have proven the consistency and reliability of Halliburton's fatigue life model which takes into account factors including job exposure type (acid, H₂S, CO₂, etc.), internal and external pressures, ovality, and the number of cycles.

FATIGUE PREDICTION AND MONITORING

Halliburton has developed a comprehensive String Management System. This system incorporates software for fatigue calculations and life prediction.

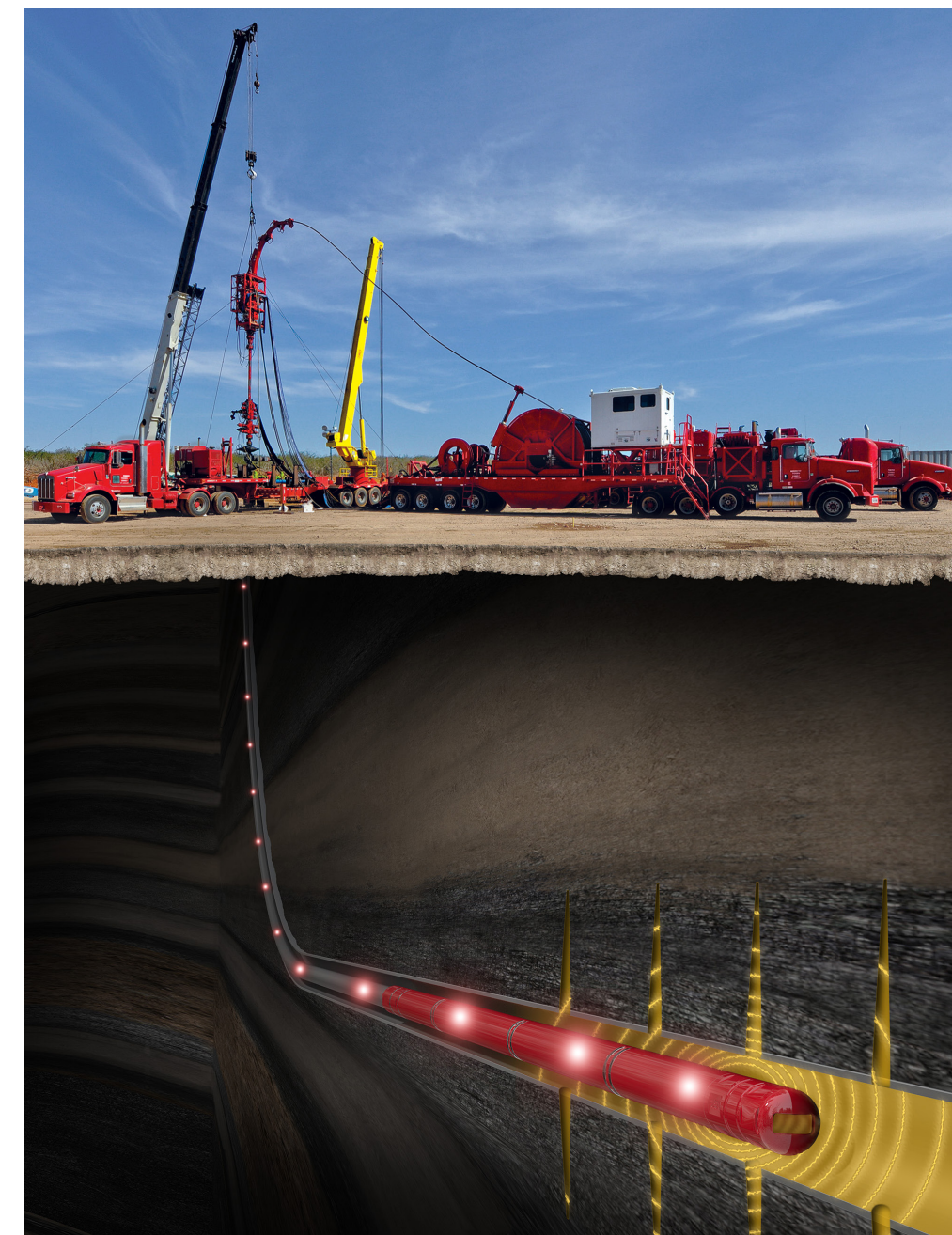
IWI design uses Halliburton's proprietary fatigue model to predict fatigue for coiled tubing string design. The simulator features an analyzer to compare multiple cases and optimize the material, diameter, and wall thickness(es) of the string.

Wellsite geometry and dimensions of surface equipment may be adjusted in the model to reflect the anticipated wellsite set-up to more accurately predict the potential fatigue expected on the job.

The IWI Fatigue Viewer displays estimated fatigue accumulated during the current run model, clearly visible against the previous fatigue. The display also gives a graphical interpretation of the string itself, indicating wall taper design and weld locations.

BHA DESIGN

IWI's bottomhole assembly (BHA) module can be used to build out various downhole tool assemblies to better simulate the planned operation. This aspect can be used to model factors such as maximum rigid length for evaluation of tool string length versus well trajectory and dogleg severity (DLS). It can also simulate the expected pressure drop across the BHA for various fluids and pump rates, and the resultant impact on surface pressures and potential pipe fatigue.



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