

Dynamic Simulations

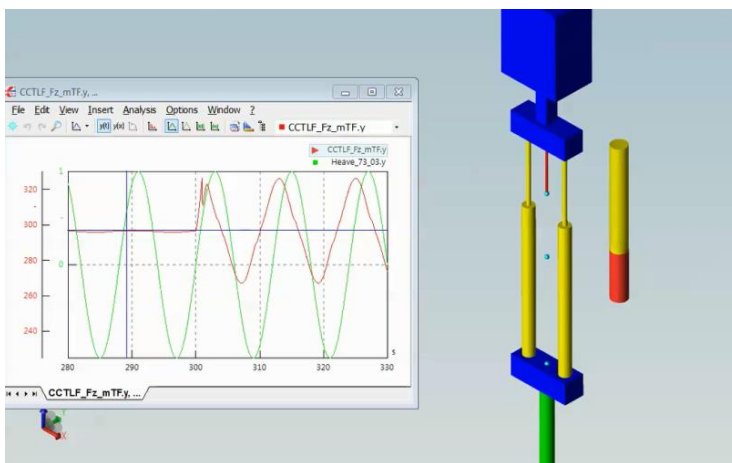
Multidiscipline- and System Simulation.

CDS uses **Simulation X for 3D simulation** of Multidiscipline and Multi-body Dynamic Analysis of individual machines and integrated systems with 6 degrees of freedoms (heave, surge, sway, pitch, roll and yaw).

The dynamic simulations **integrates** mechanical components, pneumatics, electronics, hydraulics as well as control systems to enable **virtual testing** of prototypes and existing systems that accurately accounts for interactions between all subsystems.

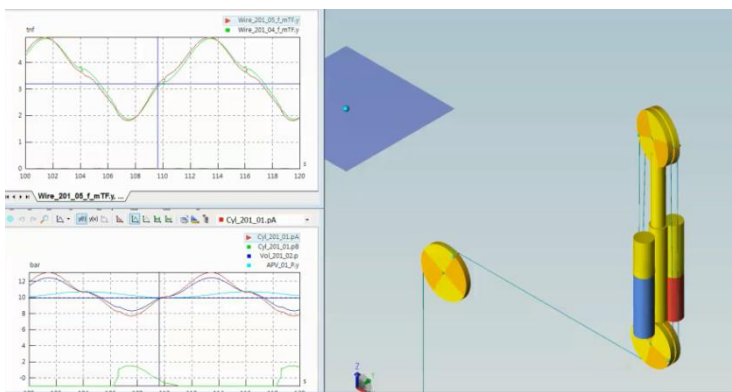
Benefits:

- Improves engineering efficiency, reduce product development cost and enable early system testing.
- Validate systems and sub-systems according to specific requirements during the engineering process.
- CDS modeling expertise: Characteristics of EDS/ anti-recoil, Heave safe systems etc.
- Visualizing system at different operation modes.



Case study of a CCTLF heave safe system where the Active Drawworks stops. Main output is the tension variation on the well head. An increase in the tension variation is expected and also observed, but there will not be a stiff connection to the seabed.

(click on image to start video)



Case study of a wireline tensioner system on a rig with 6 degree of freedoms (heave, surge, sway, pitch, roll and yaw). Main output is the tension variation on the well head.

(click on image to start video)

Riser Analysis

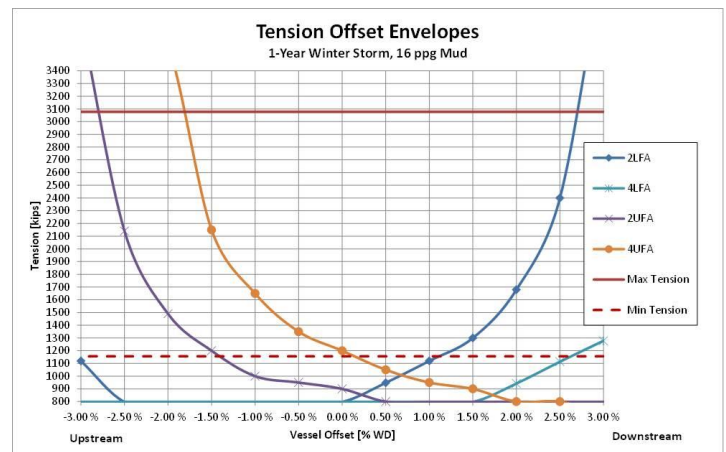
Global Riser Analysis

CDS provides Riser Analysis for better insight into the **dynamics of riser systems** and other load configuration connected to a vessel or rig with 6 degrees of freedoms (heave, surge, sway, pitch, roll and yaw) in an offshore environment.

CDS specializes on analysis requiring combination of a riser system with a **detailed model of top side equipment**, non-standard riser system, detailed model for environmental loads or optimization of riser system configuration for well intervention.

The key objectives:

- **Operating conditions** for a Vessel/Rig based on environmental data for a location
- **Feasibility of critical components** for operations at a location



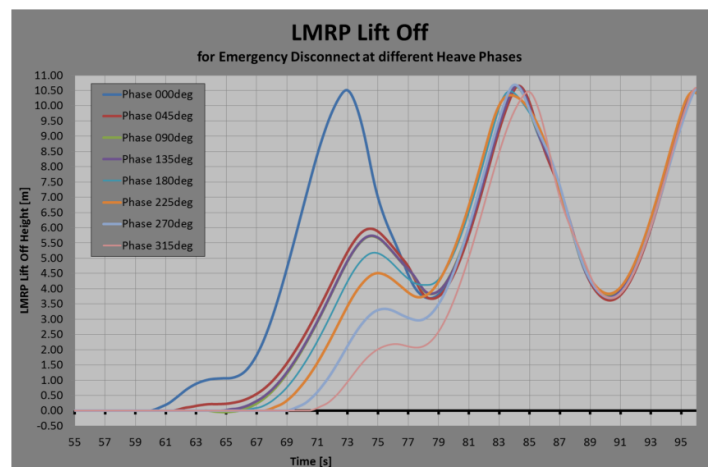
Deployment & Retrieval Analysis

Several Deployment and Retrieval stages are analyzed for riser joint stresses and physical clearances. The riser is analyzed for hangoff in drill floor and the lifting equipment, typical a Top Drive in the Derrick structure.

Riser Disconnect – Riser Analysis

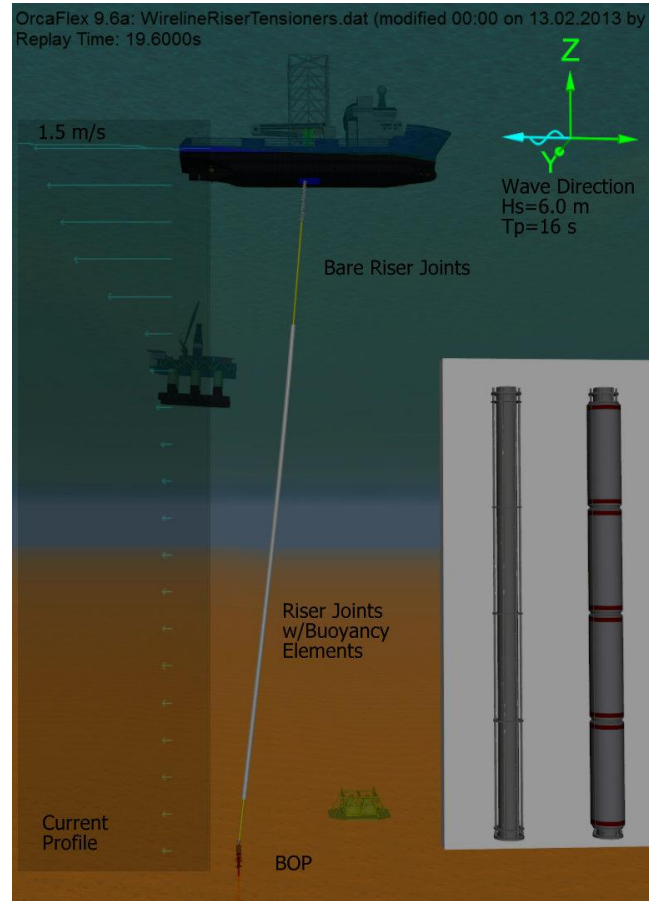
CDS examines the riser tensioning systems capability to lift the Riser Stack and LMRP of the BOP in a **controlled motion during a disconnect sequence**. The setting of a closing curve for the Riser Tensioners valves avoids the LMRP to fall back on the BOP/Wellhead and a jump out of the Tensioner Ring.

The analysis combines full freedom for the vessel and riser joints, and a detailed **hydraulic model of the tensioning system**.



Short list of typical simulation and analysis work:

- **WOB** variation for passive and active drill string compensators.
- **Forces on well head** from the riser system and tensioning system (wireline or direct acting).
- Global Riser Analysis .
- Emergency Quick Disconnect (**EQD**) analysis for the LMRP.
- **Anti-recoil** valve control settings.
- Drive-off or Drift-off.
- **Landing** and retrieval of BOP.
- Deployment and Retrieval operations for riser.
- Accuracy of **Active Heave Compensation** (AHC) systems.
- **Tension variation** for inline compensators at a well testing.
- **'What-if'** analysis of systems.



CONNECTED OPERATIONS		CALCULATIONS FOR RISER ANALYSIS		
Riser Stack-Up				
Name	No. of Joints	Length [ft]	Dry Weight [kips]	Wet Weight [kips]
Outer Barrel	1	77	3892.0	846.9
Riser Joint 1 bare	4	437	3848.0	806.9
Riser Joint 1 2000 ft Bouy	16	1877	3700.0	670.9
Riser Joint 1 4000 ft Bouy	22	3857	2724.0	710.6
Riser Joint 1 6000 ft Bouy	8	4577	1316.0	722.9
Riser Joint 1 bare	5	5027	780.0	689.0
Lower Flex Joint	1	5030	595.0	519.0
LMRP	1	5039	585.0	510.0
BOP	1	5061	385.0	336.0
DEPLOYMENT & RETRIEVAL OPERATIONS				
Riser Stack-Up				
Name	No. of Joints	Length [ft]	Dry Weight [kips]	Wet Weight [kips]
Telescopic Joint	1	82	3923.0	877.9
Riser Joint 1 bare	4	442	3848.0	806.9
Riser Joint 1 2000 ft Bouy	16	1882	3700.0	670.9
Riser Joint 1 4000 ft Bouy	22	3862	2724.0	710.6
Riser Joint 1 6000 ft Bouy	8	4582	1316.0	722.9
Riser Joint 1 bare	5	5032	780.0	689.0
Lower Flex Joint	1	5035	595.0	519.0
LMRP	1	5044	585.0	510.0
BOP	1	5066	385.0	336.0
HANG-OFF OPERATIONS				
Riser Stack-Up				
Name	No. of Joints	Length [ft]	Dry Weight [kips]	Wet Weight [kips]
Riser Joint 1 bare	1	90	3352.0	368.9
Riser Joint 1 2000 ft Bouy	16	1530	3315.0	334.9
Riser Joint 1 4000 ft Bouy	22	3510	2339.0	374.6
Riser Joint 1 6000 ft Bouy	8	4230	931.0	386.9
Riser Joint 1 bare	5	4680	395.0	353.0
Lower Flex Joint	1	4683	210.0	183.0
LMRP	1	4692	200.0	174.0

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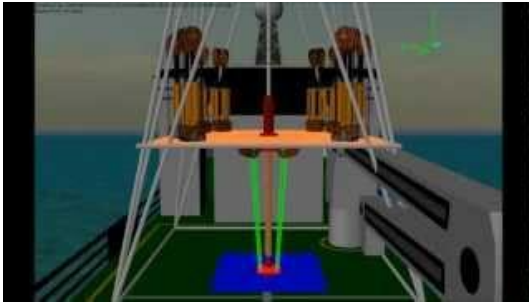
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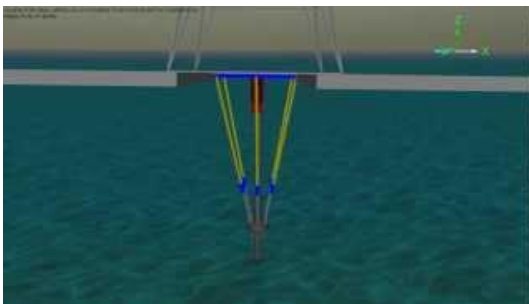
YouTube videos by Castor Drilling Solution:

<http://www.youtube.com/user/oha2001/videos>



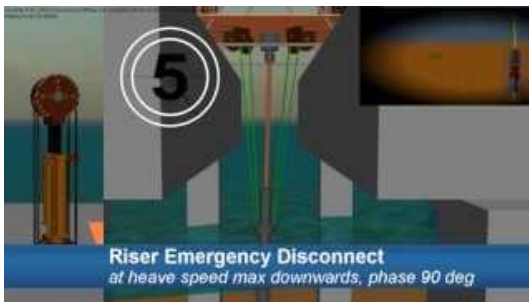
CDS – Riser Analysis and Wireline Tensoning System

Global riser analysis for a wireline tensoning system on a well intervention vessel.



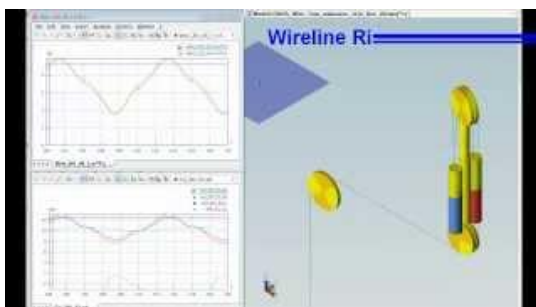
CDS – Riser Tensioner Performance and Tribology Analysis

A video illustrating the rod deflection for Direct Acting Tensioners. The deflection affects the coating, stuffing box, fatigue of rod and the tribology.



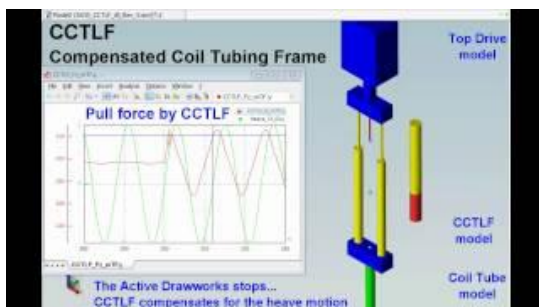
CDS – Riser Emergency Disconnect

Analysis of riser emergency disconnect with a Wireline Riser Tensoning system is shown for 8 different heave phase. In Anti-Recoil Mode a control loop for the Olmsted valve opening is modeled. Detailed hydraulic model of the valve, pipes and high pressure air system is built in SimulationX.



CDS – SimulationX model for Wireline Riser Tensioner

3D multi-body mechanical simulation of rig motion in combination with a detailed hydraulic model which includes the pressure losses in pipes and valves, and the air compression in APV.



CDS – SimulationX model for compensated CCTLF

Describes a model of CCTLF as a heave safe system in a case where the Active Drawworks stops. An increase in the tension variation is expected and also observed, but there will not be a stiff connection to the seabed.

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