



**«Make the invisible, visible»
«Make the impossible, possible»**



Using drilling simulators for entire team training and to support real time operations

Life-cycle drilling simulators



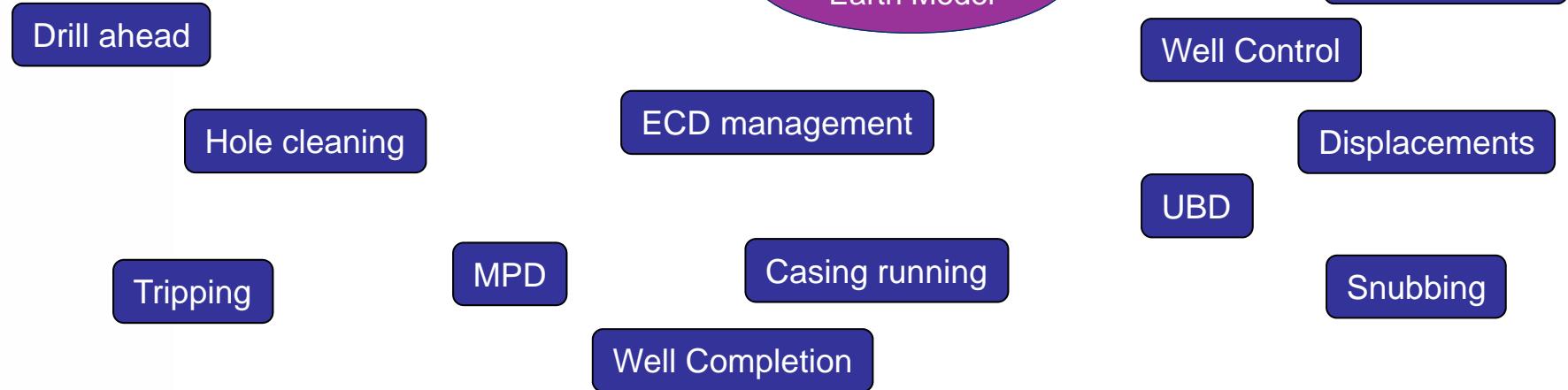
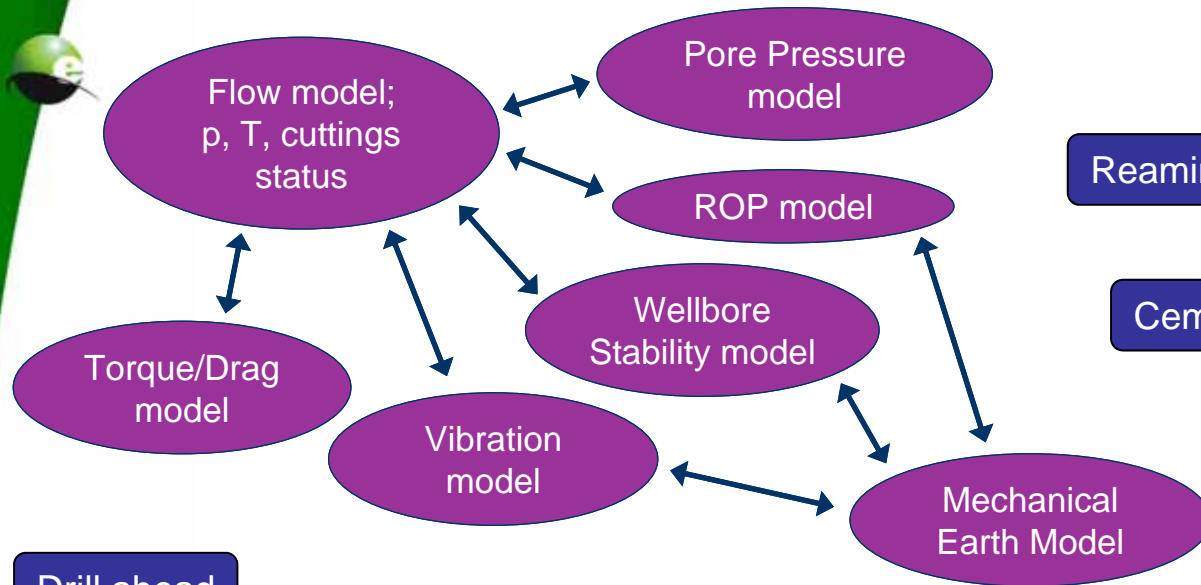
Film



- Vision “Drilling” in 2020 made in 2009



Background



Planning



Training

Dagens næringsliv – 07.09.2010

Simulator skal gi sikrere boring

Realistisk: En ny type bore-simulator skal bidra til å hindre ulykker som BPs Macondo-utblåsing i Mexicogulften i vår. I simulatoren blir det mulig legge inn en tro kopi av BP-brønnen for å trene på hendelsen.

OLJE
ASGAUT NÆSS
SANDVIS

Skatli har bedt Ståle Petrosjonsforskning i Trondheim og Havsanger og sokkelpost eDrilling Solutions og Oilex Solutions i Sandnes og Bergen om å utvikle en bore- og treningsimulator for større sikkerhet og effektivitet ved boring.

Denne blir den første treningsimulatoren som ivaretar hele boreprosessen fra oppstart av boreloftet og ned til borekronen som brenn ned i brennen.

Verkkelighetstre

Det er viktig å trene på virkelighetstre respons fra brennen og på at det store trykket kan skje, sier Øystein Håland, direktør for undergrunnsforskning i Statoil. I oktober ifjor leste Statoil i markedet etter simulatorløsninger som oppfylte kravene til avansert trening, men fant ingen.

Denne utredning utviklet utvalgte og aktuelle leverandører til å samarbeide for å oppnå løsninger som tilfredsdekkte de

store kravene til realisme i boreoperasjonene.

Håland mener det som skjedde med Macondo-brønnen i Mexicogulften er en ytterligere signal på at trening på det store trykket er nødvendig.

Vi vil simulere reelle hendelser fra indusierne, og hvorvidt våre boretam ville håndtert den aktuelle situasjonen.

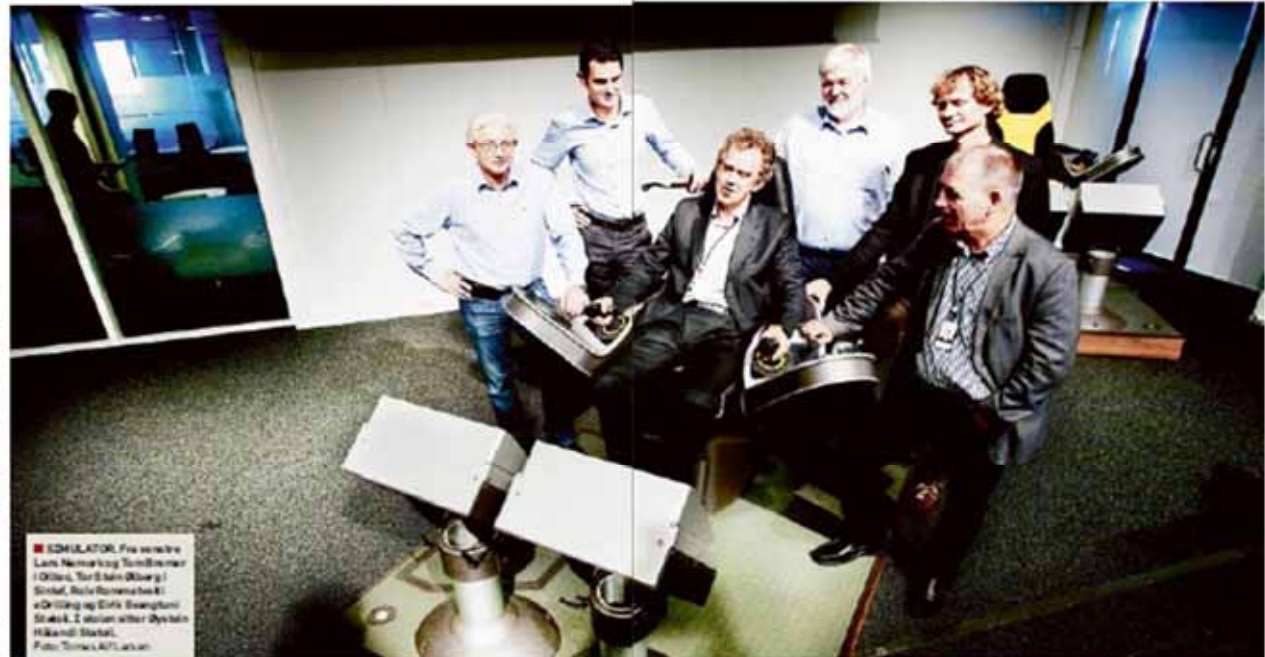
» (...) hvordan våre boreteam ville håndtert den aktuelle situasjonen i Mexicogulften blir et sentral case

Øystein Håland

spesial i Mexicogulften blir et sentral case, sier Håland.

Administrerende direktør Tom Bremner i Oilex Solutions forteller at de kan sette inn de samme parametrene når det blir klart hva som skjedde i Mexicogulften.

Da kan vi legge inn en tro kopi av BP-brønnen og gi en svært realistisk respons fra



» SIMULATOR Fra venstre Linn Hennings og Tom Bremner i Oilex, Torbjørn Østevik i Statoil, Rolf Rønnebeck i eDrilling og Erik Swangsten i Statoil. I bakgrunnen Øystein Håland i Statoil. Foto: Torbjørn Østevik

brenningsimulatoren på våre bruk på kontraktbasis, sier Rolf Hennings, administrerende direktør i eDrilling Solutions.

Klar april 2011
Ståle Petrosjonsforskning

leder utviklingsprosjektet lever de mest realistiske modellene kobles sammen med eDrillings system for beredningsprosesser. Simulatoren skal være klar til bruk i april 2011. Simulatoren vil bli fokus vil drives av Oilex.

Den nye simulatoren vil bygges rundt modeller for brenningskontroll, basert på mange års forskningsarbeid.

Det er over år investert langt over 100 millioner kroner i utviklingen som dannet grunn-

laget, sier spesialrådgiver Tor Erik Ulberg ved Ståle Petrosjonsforskning.

Han forteller at enkeltstiler av systemet har vært på markedet i flere år. Det nye er at en meget realistisk nedtall simulator

kobles inn i trening, kombinert med avansert visualisering og datalogg. Når dette settes i system, får boretamene og ledere muligheten for ny forståelse og kontroll av avanserte bore- og treningsoperasjoner.

Statoil har som målsetting å kjøre boretamene i alle sine boretam gjennom simulering og trening i den nye boretamsimulatoren.

.....
asga@edrilling.no

Intellectus hiDRILL



Well specific integrated team training:

- MPD
- Drilling operations
- Stripping operations
- Connections
- Multi fluid operations
- Well control
 - Kick and loss
- TTRD
- HPHT
- ERD
- Dual gradient drilling

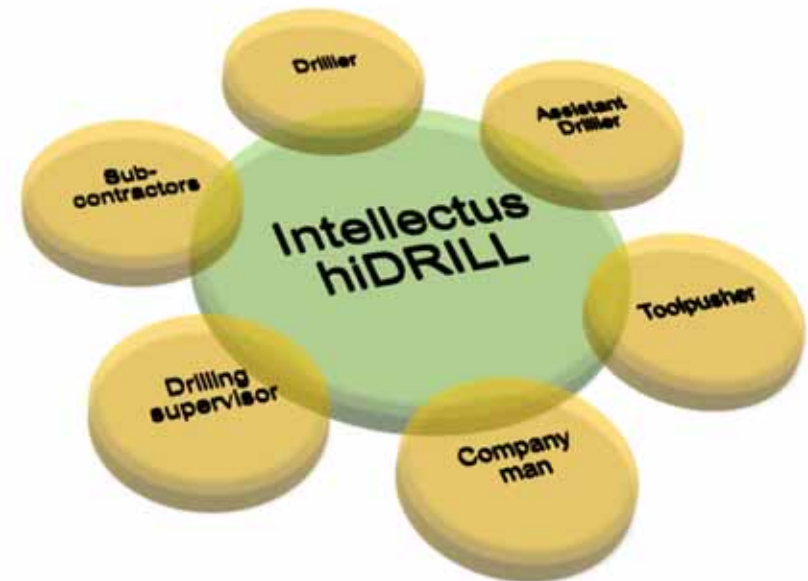


DILTEC
SOLUTIONS

Team training on your well



- Increase operational understanding
- Train on operational procedures
- Improve communication in the team
- Practice operations in a safe environment without affecting the real operation
- Reduce time needed for training offshore
- Test new drilling concepts in a safe environment



Why use a dynamic model?

- Dynamic effects represent the REAL response during drilling.
- **Many safety/risk and technical drilling problems are due to dynamics.**
- To realistically train on problem curing and prevention a dynamic model is required.
- Linking a dynamic model with a realistic G&G / reservoir model will realize the vision “drilling the well in the simulator first”.



Dynamic torque and drag model



- The dynamic torque and drag model calculates stretching of the string, and interaction between the bit and the formation.
- Integrates with topside simulator (Drawwoks and Top Drive)



Possibilities with simulator



Test new drilling concepts or upgrades

- Control system verification and testing
- Test different designs in a safe and effective way
- Practice on tuning and testing with realistic well response
- Training on well behavior with new control systems installed (example next slide)



Example: MPD

- Several days spent offshore prior to MPD operations
 - Drillers to familiarize with well responses due to automatic pressure control
 - Day and night crew
 - Perform simple changes in parameters to understand new behavior
 - Practice on routine operations
 - E.g. connection procedure
 - Practice on well control and emergency procedures
 - Testing and tuning of MPD control system

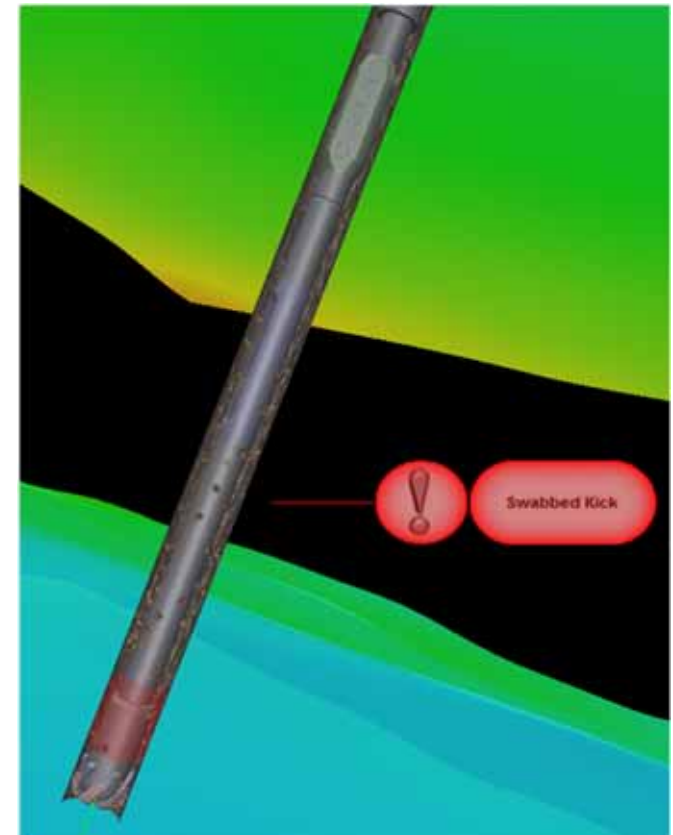
- Easy to do up front in simulator!



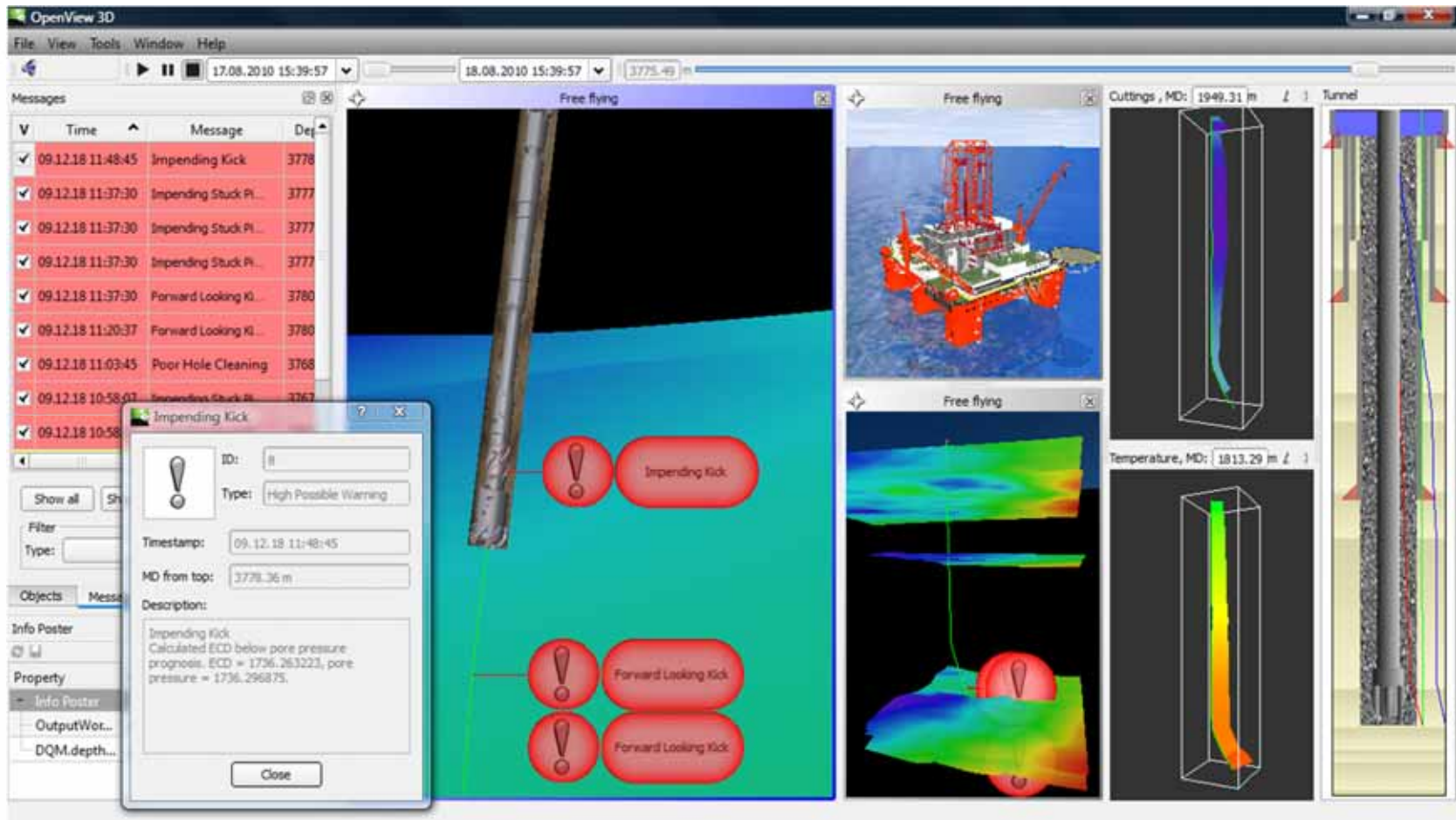
eDrilling capabilities



- eDrilling has demonstrated the following results:
 - Promoting a Pro-active and not reactive approach
 - Automatic supervision of the drilling window
 - Automatic update of pore and well stability during drilling
 - Automatic diagnosis and warnings on
 - Cuttings loading
 - Stuck Pipe
 - Lost circulation
 - Kick/well control
 - Tripping speed
 - High surge & swab pressures
 - Automatic Forward looking of ECD and T/D
 - Virtual PWD capabilities



Operation



The screenshot displays the OpenView 3D software interface. The main window shows a 3D visualization of a wellbore in a blue and green environment. A vertical pipe is shown, with several red warning icons (exclamation marks) placed along its length. A detailed dialog box is open in the foreground, titled "Impending Kick".

Messages Log:

V	Time	Message	Dep
✓	09.12.18 11:48:45	Impending Kick	3778
✓	09.12.18 11:37:30	Impending Stuck Pi...	3777
✓	09.12.18 11:37:30	Impending Stuck Pi...	3777
✓	09.12.18 11:37:30	Impending Stuck Pi...	3777
✓	09.12.18 11:37:30	Impending Stuck Pi...	3777
✓	09.12.18 11:37:30	Forward Looking Ki...	3780
✓	09.12.18 11:20:37	Forward Looking Ki...	3780
✓	09.12.18 11:03:45	Poor Hole Cleaning	3768
✓	09.12.18 10:58:01	Impending Stuck Pi...	3767
✓	09.12.18 10:58:01	Impending Stuck Pi...	3767

Impending Kick Dialog Details:

- ID: 88
- Type: High Possible Warning
- Timestamp: 09.12.18 11:48:45
- MD from top: 3778.36 m
- Description: Impending Kick
Calculated ECD below pore pressure prognosis. ECD = 1736.263223, pore pressure = 1736.296875.

The interface also includes a "Messages" panel on the left, a "Free flying" view of the wellbore, a "Cuttings, MD: 1949.31 m" view, and a "Temperature, MD: 1813.29 m" view.

Life cycle simulations



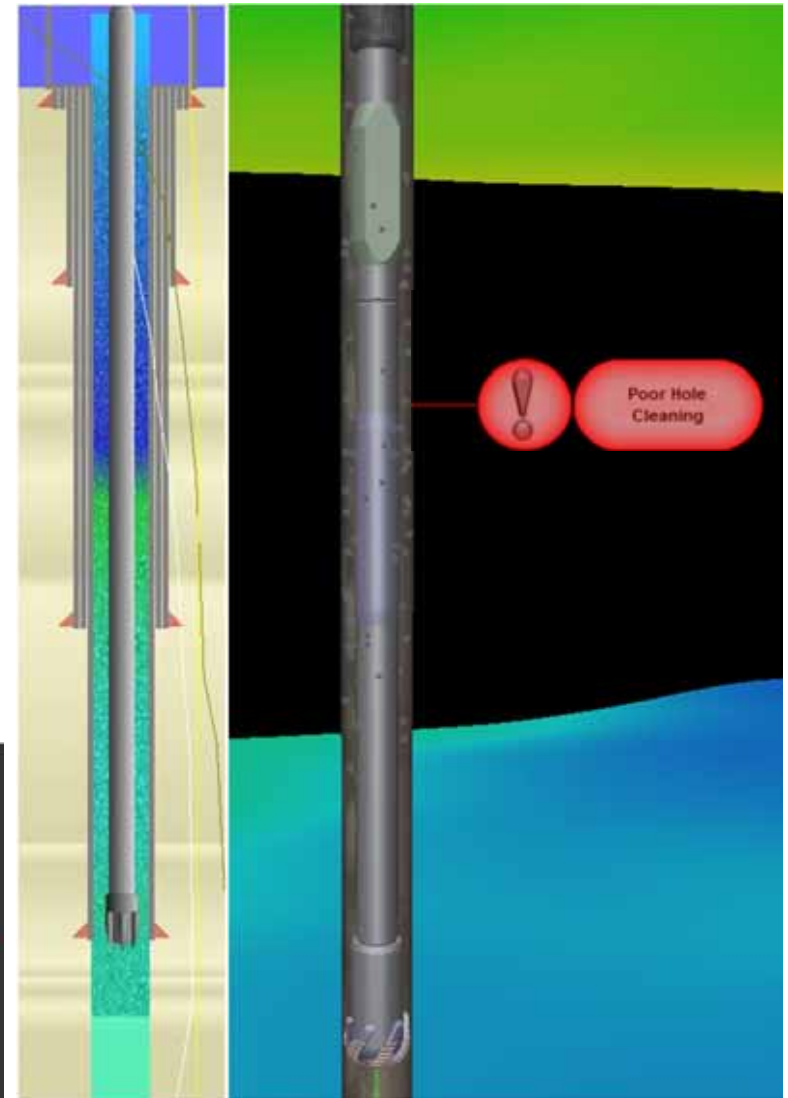
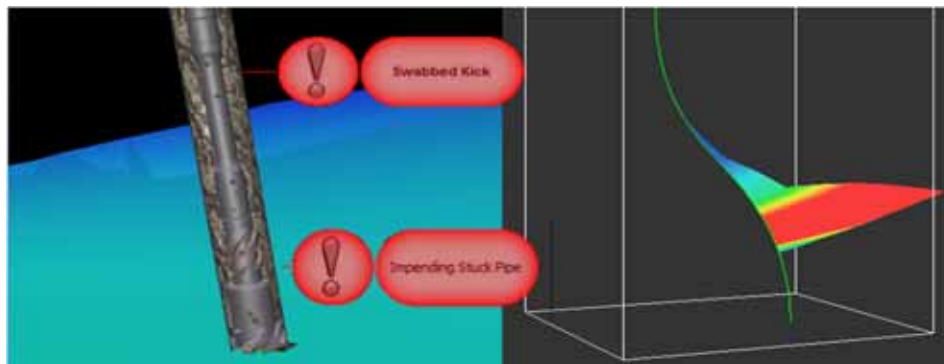
- Drilled sections:
 - Pre-study on pore, frac, collapse. Coupling to company overburden database
 - What-if scenarios in Intellectus for scenario evaluation & verification
 - Training in Intellectus hiDRILL for scenario awareness
 - Run eDrilling in Real Time, with Forward Looking and RT updating of ECD, PP, frac and collapse pressure with use of PWD and LWD data
- Cementing liner
 - Pre-simulation in Intellectus; planning & verify critical procedures
 - Near Real Time cementing simulation with actual data
 - Real Time with eDrilling -> fracture detection and mitigation



Drilling

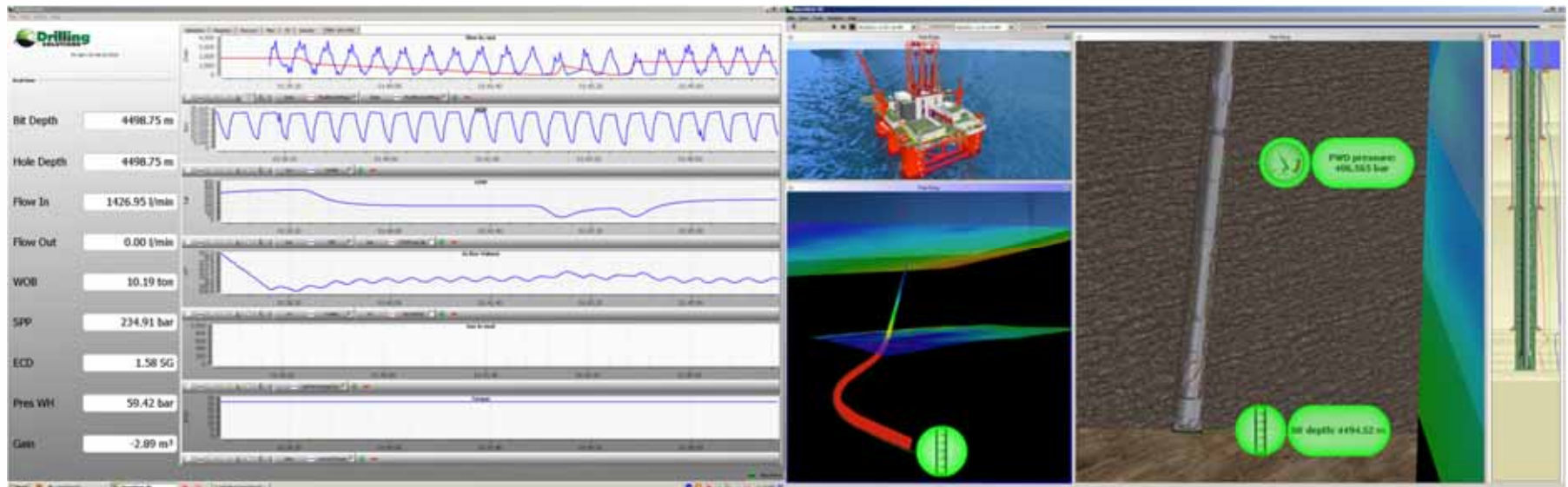
Focus on hole cleaning, well stability and ECD Management through:

- Real Time pressure & ECD monitoring with forward looking
- Real Time hole cleaning calculation with automatic alarm system
- Real Time well stability model with integrated collapse and fracture update
- RT pore pressure updates based on MWD/LWD data?



Cement liner

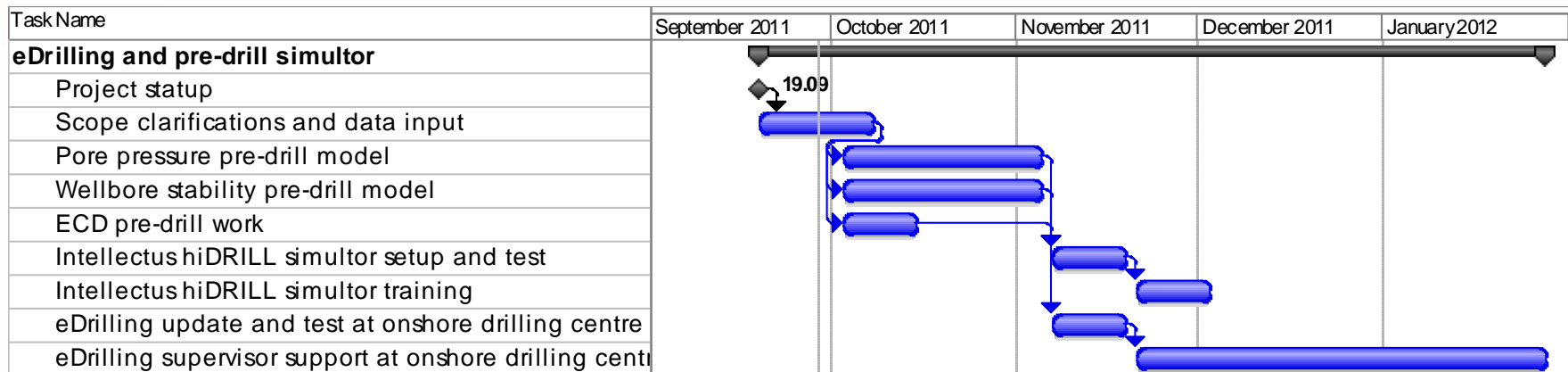
- Real Time pressure monitoring & control
- Pre-simulation in Intellectus; planning & verify critical procedures
- Near Real Time cementing simulation with actual data
- Real Time with eDrilling -> fracture detection and mitigation



Typical plan

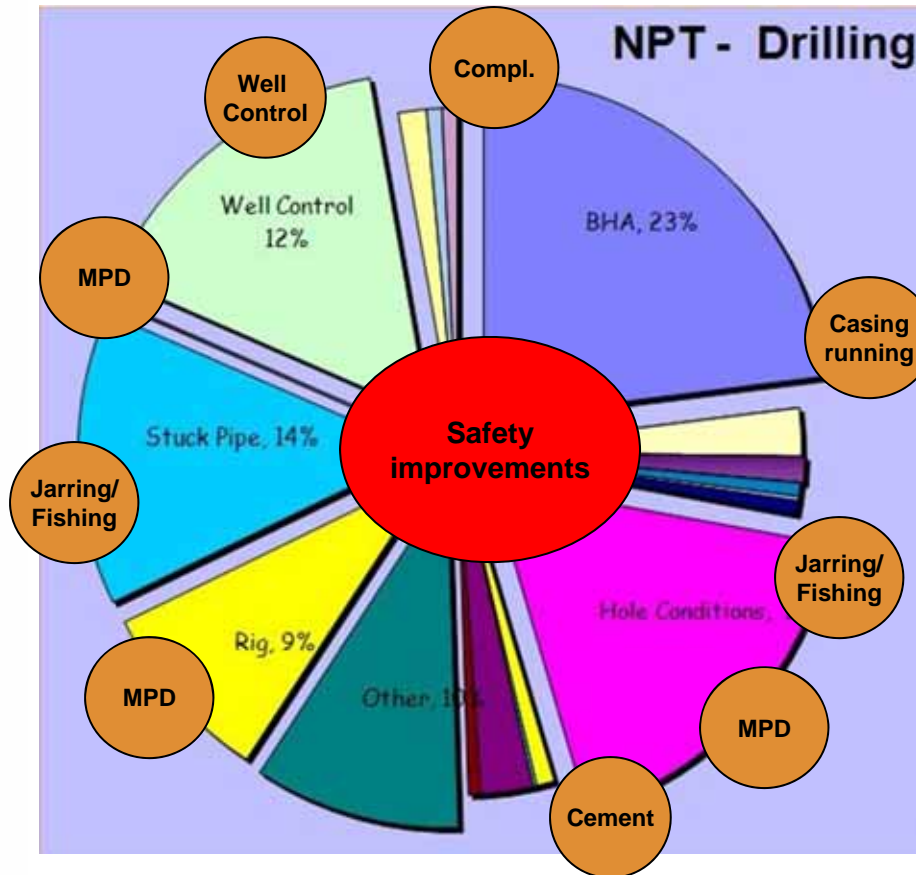


- Kick-off 19/9-2011
- Pre-simulations – October 2011
- Training – November 2011
- RealTime followup – December/January



Added value

NPT accounts for 20-40% of total drilling costs.....



Goal (reduce NPT) with Team training	
Well Control	-25%
Stuck pipe	-20%
Hole conditions	-15%
Cement	-15%
Casing/liner	-15%
Completions	-15%

In addition:

- Drilling Opt
- HSE improvements
- Increased recovery

