

Advanced simulations within Offshore

Per Bodforss





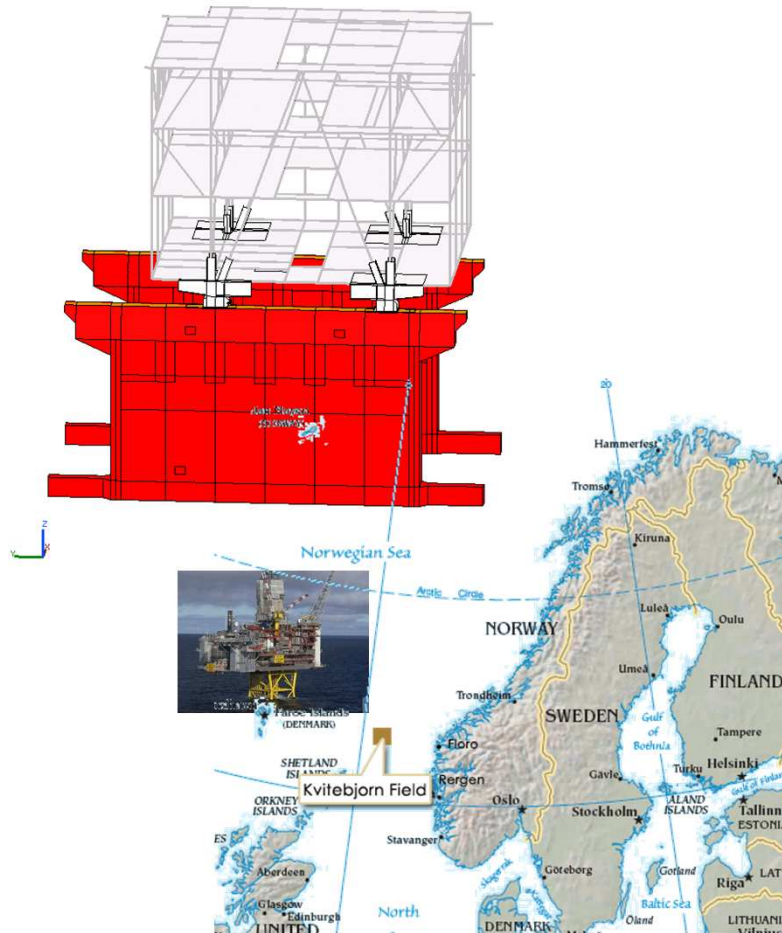
Epsilon

- ▶ 1 500 employees
- ▶ 140 within FEM & CFD simulations
- ▶ 9000 subcontractors
- ▶ 21 cities
- ▶ Privately held
- ▶ Focus on Scandinavia
- ▶ Founded in 1986
- ▶ Main clients within Energy, Vehicles and industry



ABB

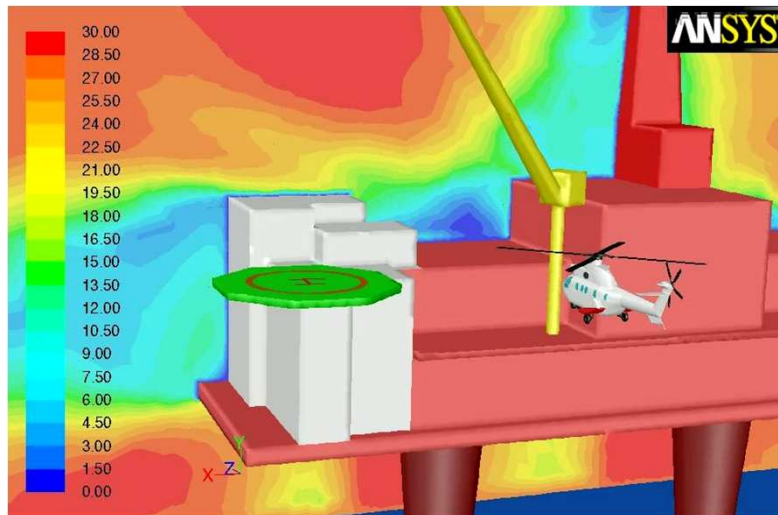
Kvitebjørn



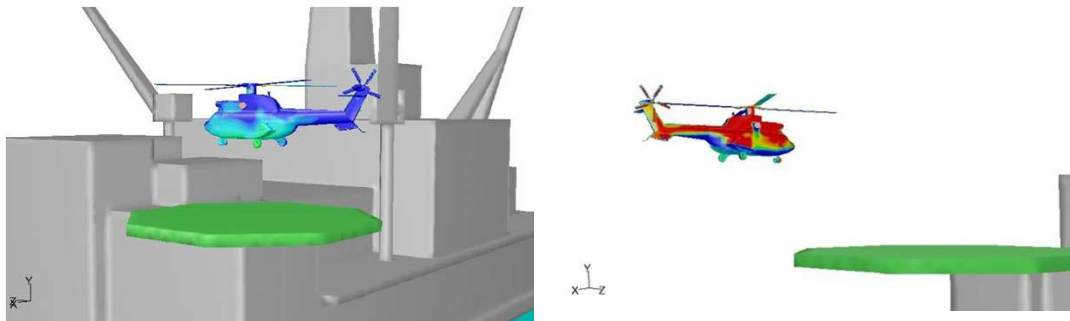
- ▶ **Scope**
The drilling tower on the jacket Kvitebjørn in the north sea is malfunctioning and causes expensive loss in production.
- ▶ **Epsilons & ABB mission**
Identify problem
Solve problem
Propose installation procedure
Verification of solution
Verification of installation procedure
- ▶ **Method**
Modeling, contact simulation (2d & 3D), heat analysis and code check according to DNV



Statfjord B

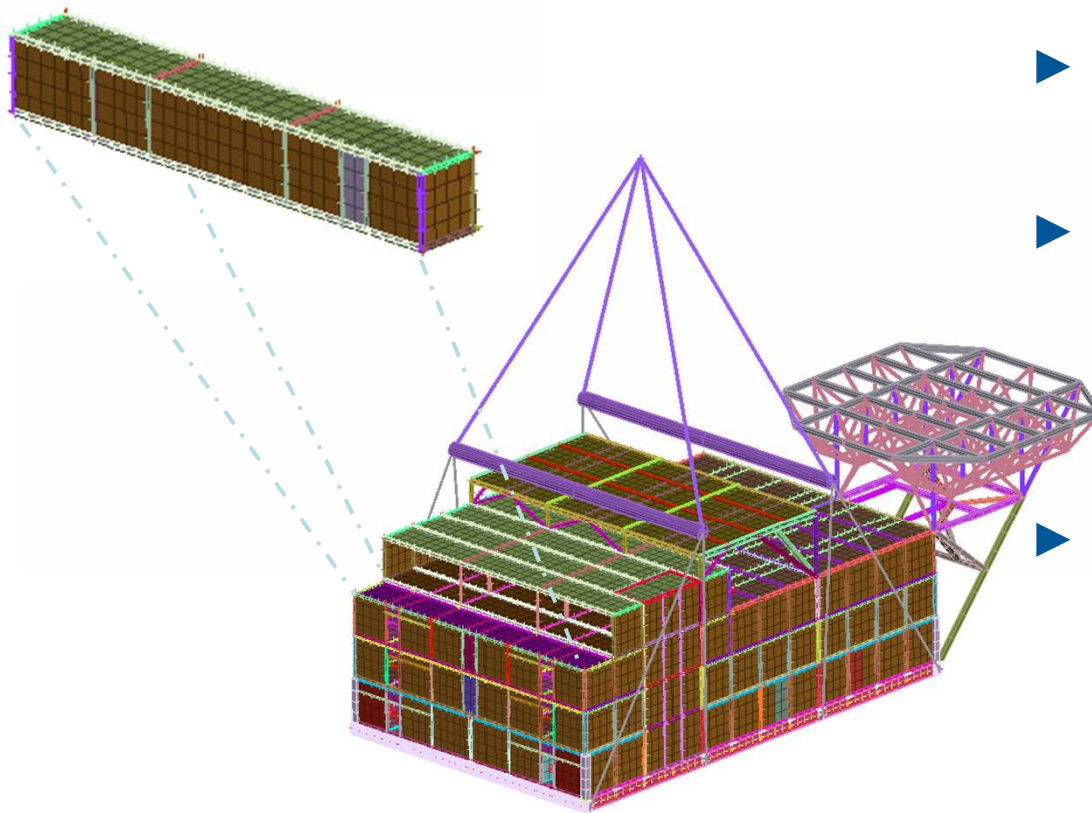


Contours of Velocity Magnitude (m/s) (Time=1.2000e-01) Mar 26, 2010
ANSYS FLUENT 12.1 (3d, dp, pbns, dynamesh, sstkw, transient)

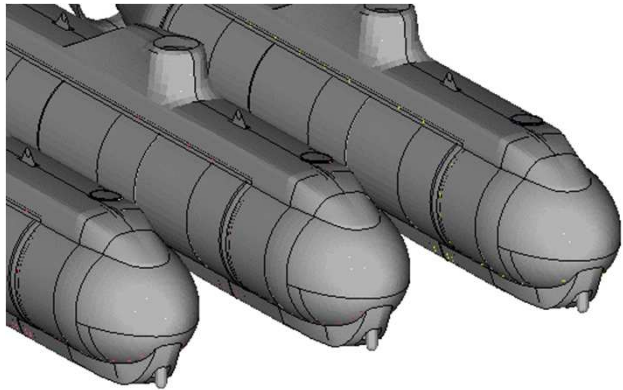
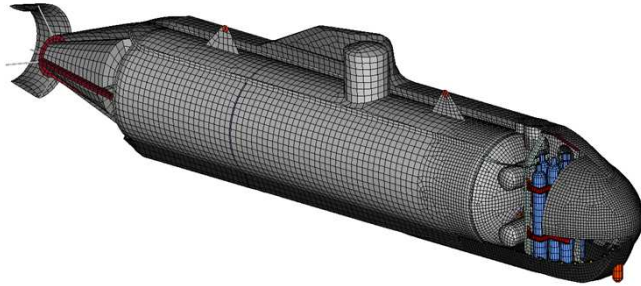


- ▶ **Scope**
Simulation of flight operations with a Super Puma Helicopter on the Statfjord B in stormy conditions, 25 m/s
- ▶ **Method**
Transient CFD simulations using Fluent for multiple inflight and wind directions
- ▶ **Results**
 - Velocity
 - Turbulence
 - Pressure
 - Search & Rescue

Living quarters



- ▶ **Scope**
Sizing and structural strength evaluation of offshore living quarter
- ▶ **Method**
Structural strength are evaluated for:
 - In place loads
 - Sea transport loads (Noble Denton)
 - Global lift
 - Handling of modules before assembly
- ▶ **Results**
Structural strength of the living quarter are performed according to AISC 2005. The living quarter modulus are designed and built in Sweden by Apply Emtunga and shipped to Asia for assembly. The complete living quarter is shipped (barge) offshore and lifted into place with a single crane.



Time: 0 ms



HM Ub Spiggen

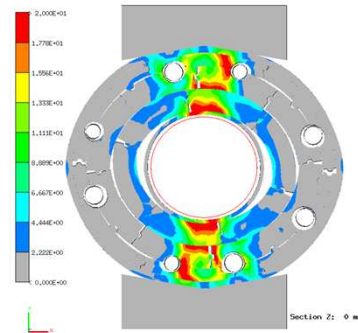
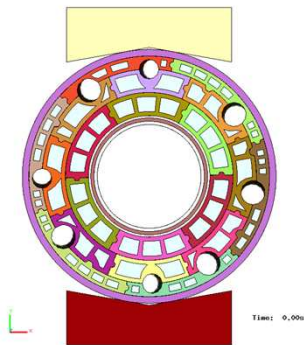
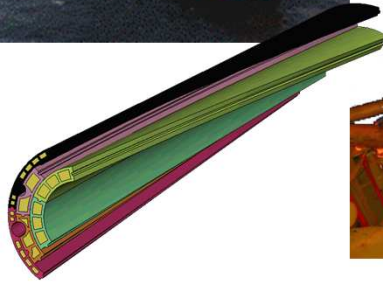
- ▶ **Scope**
Modification of the hull and rudders on a target submarine
- ▶ **Method**
Explicit FE simulations for different cover materials (LS-Dyna)
CFD simulations on different rudder configurations and drag at different speeds (Fluent)
- ▶ **Results**
 - Verification of crashworthiness and hull integrity
 - Improved maneuverability and handling



Technip

KVÆRNER

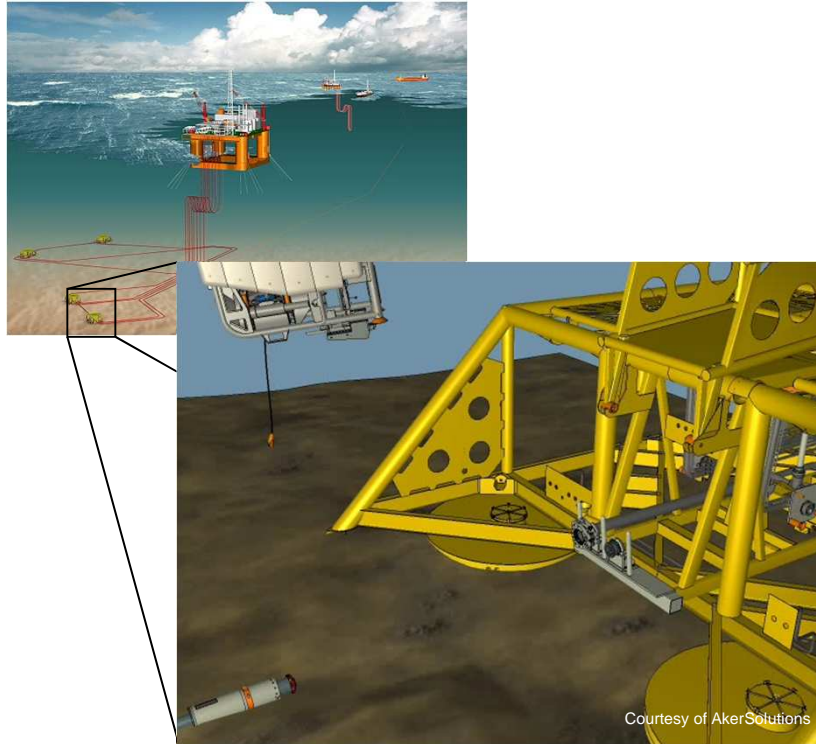
Bodycote
METAL TECHNOLOGY



Bonga deep water project

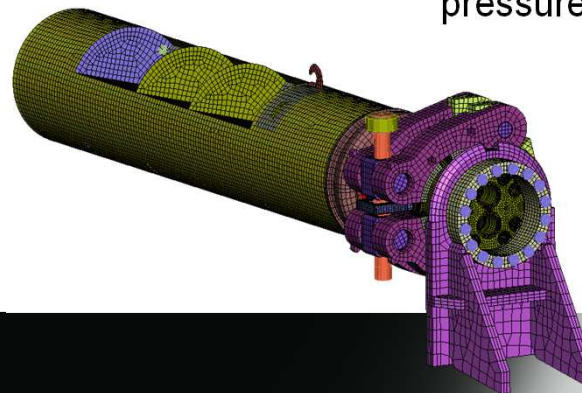
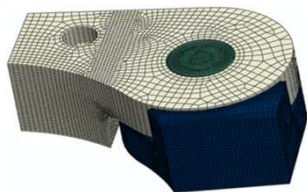
- ▶ **Scope**
When reeling a GLR off the coast of Nigeria at the Bonga field problems arise during crash-stop, with sliding between different internal parts of the riser. - Why?
- ▶ **Epsilons mission**
Identify problem
Verification of proposed solutions
- ▶ **Metod**
3D transient contact simulations with material models including relaxation data from tests

$$Ff_{tot} = \sum_{i=1}^n F_i \cdot \eta_i \cdot \mu_i$$

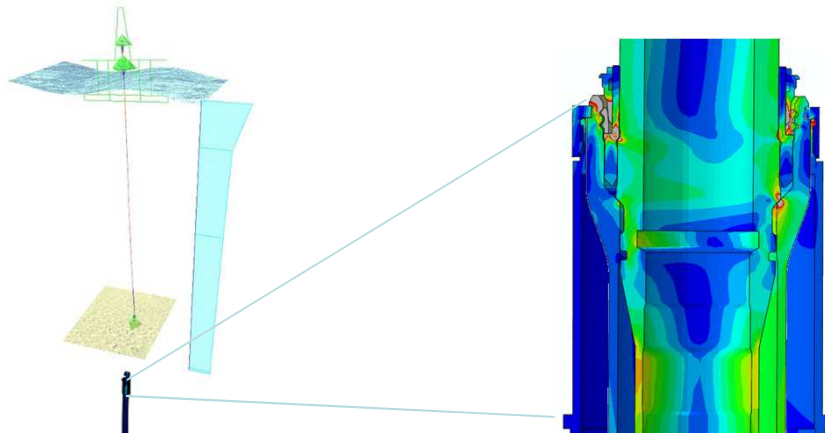


Kristin

- ▶ **Scope**
Verification of a multi-bore subsea tie-in connection
- ▶ **Method**
Simulations in Abaqus using non-linear material data and contacts. Typical loads are:
 - Make-up (pre-tension), installation loads
 - Global loads
 - Pressure and temperature
- ▶ **Results**
Structural verification according to ISO and ASME. Function verified in terms of deformation, seal integrity and contact pressure.



Wellhead system



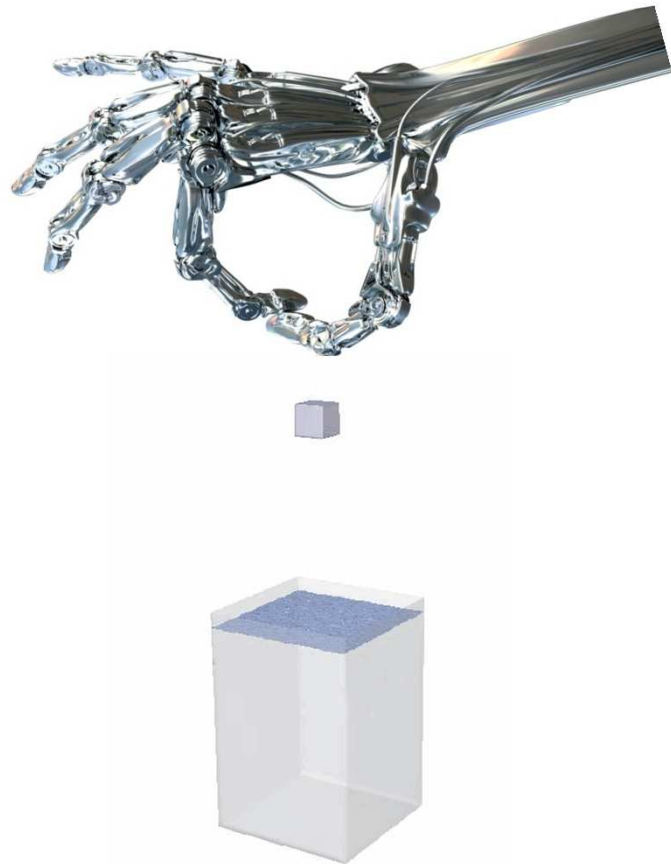
Courtesy of FMC Technologies

- ▶ **Scope**
Determination of the fatigue life of wellheads

- ▶ **Method**
The sea state for each location is used to determine the loading history using a global model.

A detailed model of the wellhead including soil/cement stiffness and contacts is then established and used to determine the fatigue life that can be used in different marine operations.

FMC has developed in-house programs based on Abaqus to perform these kinds of simulations



It is your own
imagination that
sets the limitations
for numerical
simulations...