# Challenges in design of OSV's in new areas of operation

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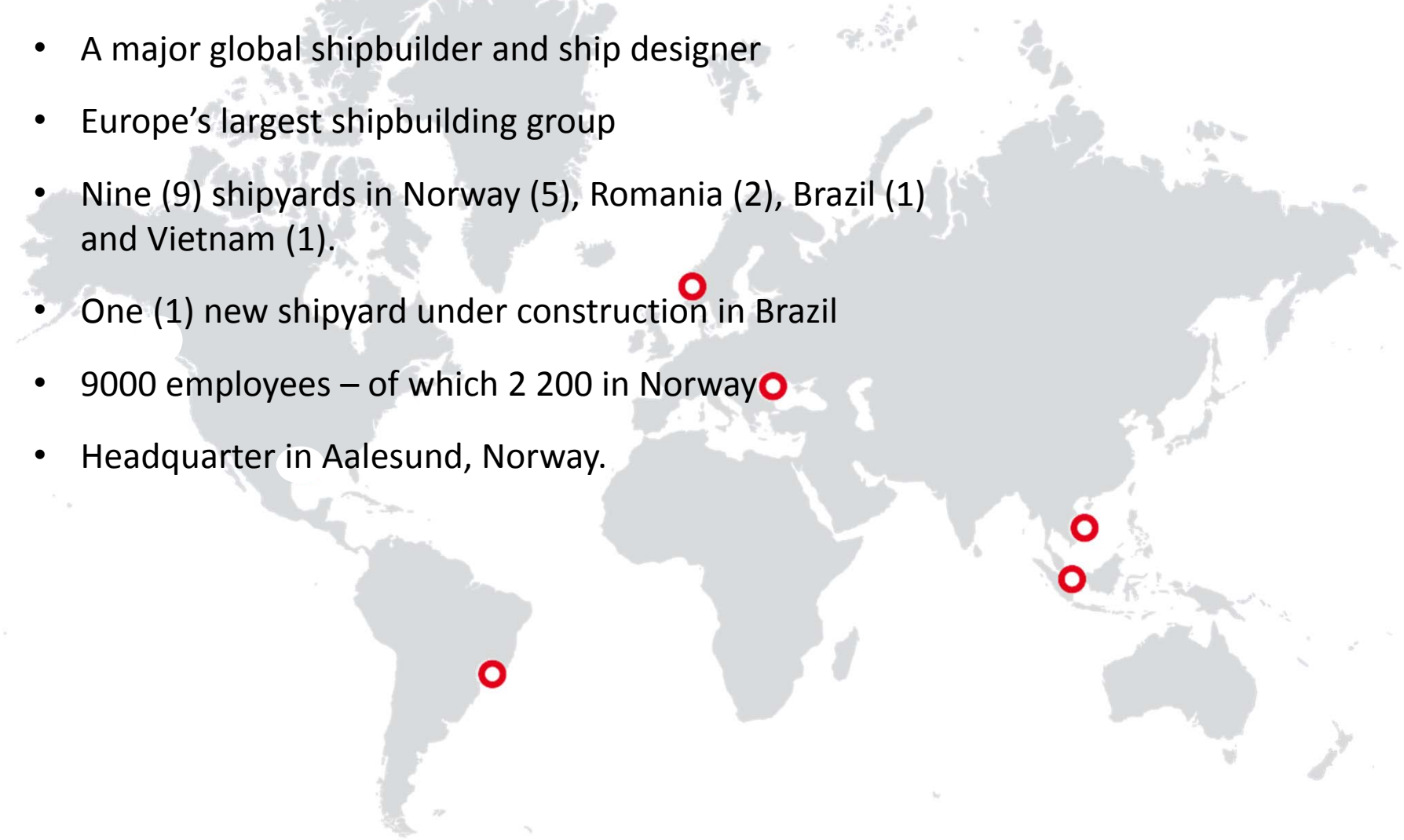
STX OSV Design

# STX OSV at a glance……

- A major global shipbuilder and ship designer
- Europe's largest shipbuilding group
- Nine (9) shipyards in Norway (5), Romania (2), Brazil (1) and Vietnam (1).
- One (1) new shipyard under construction in Brazil
- 9000 employees – of which 2 200 in Norway
- Headquarter in Aalesund, Norway.



# Shipyards

STX OSV Aukra | Norway

STX OSV Brattvaag | Norway

STX OSV Brevik | Norway

STX OSV Langsten | Norway

STX OSV Søviknes | Norway

STX OSV Braila | Romania

STX OSV Tulcea | Romania

STX OSV Vung Tau | Vietnam

STX OSV Niteroi | Brazil

# Services

Design & Technology

Electrical Engineering, Installation, Power & Automation

R & D

Green lifecycle focus

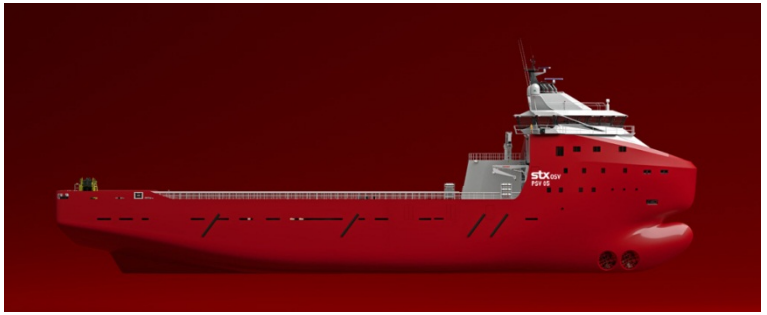
Piping Systems & Installation

Trading

# Core Products

Anchor Handling Tug Supply

Platform Supply Vessels



Offshore Subsea Construction Vessels

Other specialized vessels

# STX OSV Design long term R&D projects

- Calm water optimization study (2006-2008)
- Low speed hull/propeller interaction (2007-2010)
- Low resistance bow development (2007-2009)
- Moonpool pistion motion (2008-2011)
- CIV Arctic project (2008-2011)
- IDEAS (2011-2013)
- EEOSV (2011-2014)

KNOWLEDGE & TOOLS

# What is important entering new areas?

- Metocean and Ice data
- Operational profile
- System thinking, ship & equipment
- Operability limiting criteria
- Analythical tools and simulation models
- Involvement of all diciplines in the maritime cluster in design process

# IDEAS

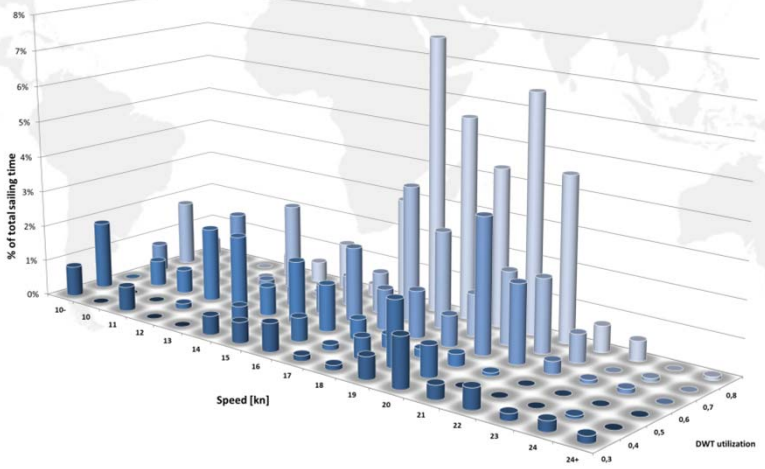
- Initiated Spring 2011, start execution Fall 2011, end summer 2013
- Partners MARINTEK, NTNU, STX, Grieg
- Main focus simulation, secondary focus optimisation
- 8250’ total budget, NFR supported

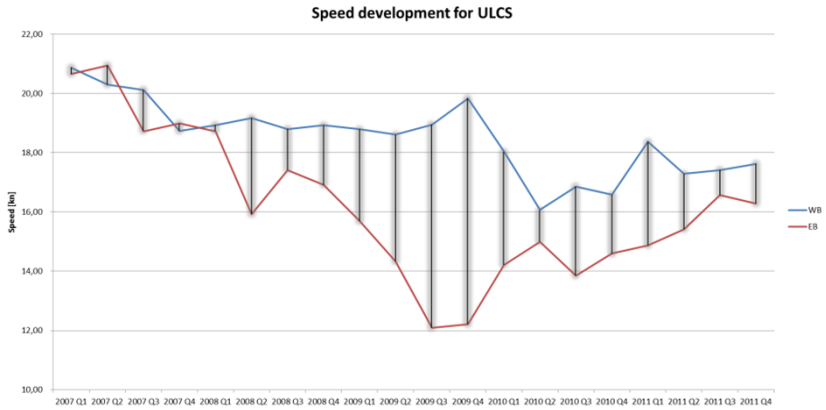
# Main objectives

**Development and testing of methods and tools for ship design in changing and dynamic environments, in a transport system context**

- Offering a more efficient design process
- Optimising the ship to fleet and market demands
- Minimising the risk of introducing sub-optimal links in the transport chain
- Ability to uncover hidden inefficiencies and opportunities

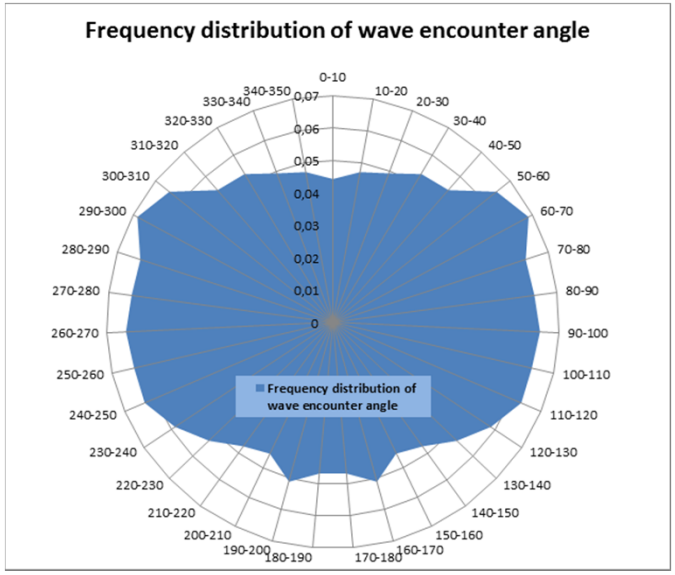
**Primary focus simulation models, simulating ship designs in a transport system/logistics setting**



# STX OSV motivation for participation

- IDEAS provides a framwork for building detailed operational profiles for a specific area of operation based on real metocean data
- Simulation model developed in IDEAS will be used to evaluate and optimize ship designs solutions for specific areas of operation



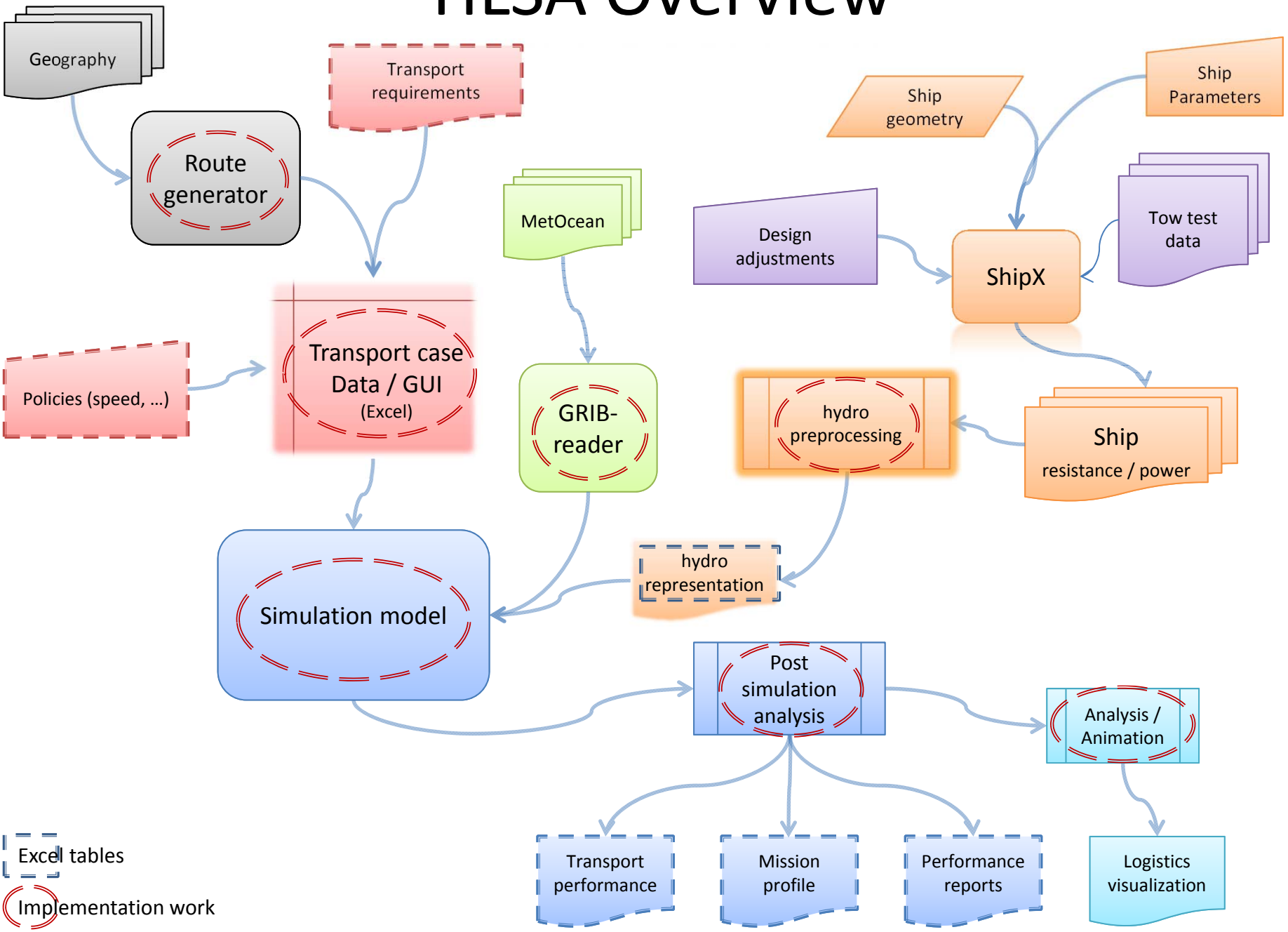

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 4 | 3,05 % | 0,42 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % |
| 5 | 6,62 % | 11,35 % | 0,71 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % |
| 6 | 5,00 % | 14,24 % | 10,05 % | 0,70 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % |
| 7 | 2,11 % | 7,69 % | 8,83 % | 6,00 % | 0,69 % | 0,02 % | 0,00 % | 0,00 % |
| 8 | 0,19 % | 4,23 % | 4,49 % | 2,79 % | 2,04 % | 0,68 % | 0,24 % | 0,01 % |
| 9 | 0,10 % | 1,49 % | 2,14 % | 1,02 % | 0,50 % | 0,53 % | 0,35 % | 0,15 % |
| 10 | 0,02 % | 0,50 % | 0,46 % | 0,56 % | 0,05 % | 0,00 % | 0,00 % | 0,00 % |
| 11 | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % | 0,00 % |

# STX industry case:
# Simulation of offshore vessel operation and performance in the North Sea

- **Methodology and tools for evaluating alternative design options (hull or propulsion), iterating towards an improved solution, in terms of total performance and cost/benefit**
- **Methodology and tools for assessing the degree to which installed performance/functions contribute towards increased availability under true conditions**

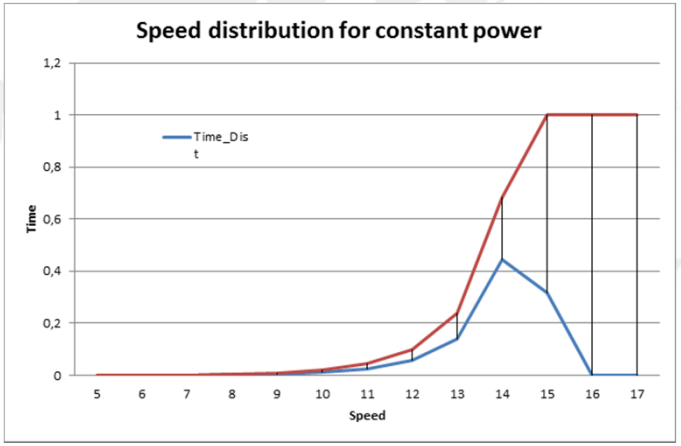

stx OSV

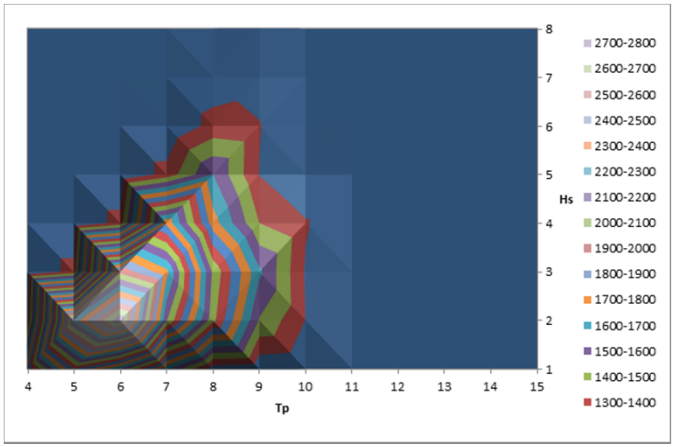
# HLSA Overview



# STX industry case: Simulation of offshore vessel operation and performance in the North Sea

- **Simulate the behaviour and performance of different vessel designs in realistic conditions:**
  - Document and benchmark total performance of vessel designs in realistic scenarios during general product development and design for client
  - Determine the effects of design options (alternative machinery, hull designs, DP) in different/varying operational settings
  - At design-stage, simulate operational behaviour over seasons/years under varying conditions (weather/sea, operational requirements)
  - Assess total performance in terms of fuel efficiency, evaluate robustness and availability, need for power reserve
- **Deliverable**
  - Simulation model for evaluating different PSVs (Platform Supply Vessels) in a real setting
  - Case run: North Sea on real weather data (StormGeo)



# CIV Arctic KMB project

## Project partners

- MARINTEK – Project owner
- Statoil
- STX OSV Design
- CeSOS/NTNU
- VTT – Technical Research Centre of Finland
- Aker Arctic – Aker Arctic Technologies

17.8 mill NOK total budget
3 year duration (2008-2011)

# CIV Arctic project objective

- **The primary objective of the project is to:**
  - Extend the operational season for installation and maintenance of subsea oil and gas field equipment in waters with seasonal ice.

- **To obtain the primary objective the following secondary objectives must be realized:**
  - Development of maintenance philosophy where unplanned intervention takes place in periods with seasonal ice
  - Definition of operational limits/weather windows for intervention tasks
  - Vessel design to optimize operational characteristics in harsh weather
  - Investigate ways of reducing emission footprint for selected operations
  - Design trade-offs to find a vessel with high performance and low environmental impact when operating in Arctic waters

# STX OSV motivation for participation

- Improve our ability to do operational area specific ship designs
- Learn more about metocean and ice conditions in the arctic
- Investigate and find the right design tradeoffs between Ice and open water operation
- Develop hull forms with ice breaking capability that performs well in open water
- Interact with/gain knowlegde from suppliers, owners, sub sea contractors and oil majors

# Vessel operational tasks

- **Intervention and light construction campaigns in arctic region in summer season (open water)**
- **Unplanned intervention tasks in thin to medium first year ice**

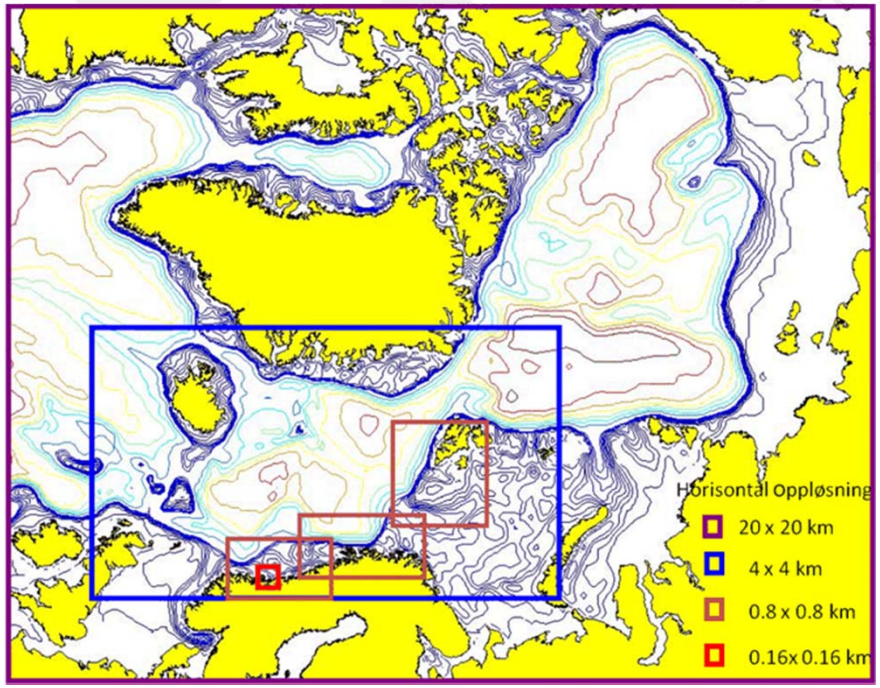
  - **Long sailing distances**
  - **Requirement for excellent open water seakeeping performance**
  - **Ice breaking capabilities required**
  - **Winterization**
  - **Open water DP-capability**
  - **DP in ice**

## Best compromize between ice-breaking capabilities and open water performance sought

# Project outcomes – Metocean and ice data

WP3

- **Preliminary set of metocean and ice data collected by Statoil**
- **Revised set of ice data prepared by met.no**
- **Ice management system specification**
- **Specification of requirements to future metocean and ice forecast tools**
- **Need for more work on validation of forecast tools – request for long term measurement project**

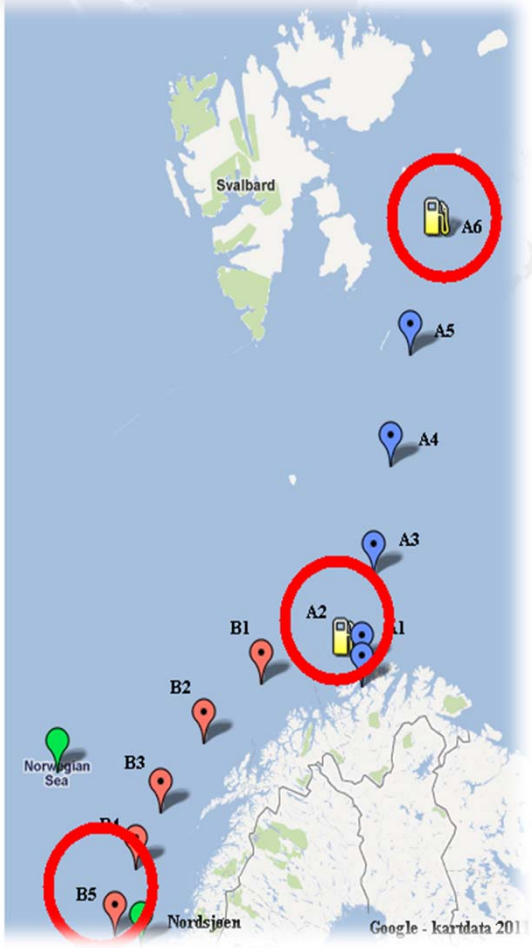


# Project outcomes – Vessel design and operational characteristics

- **Design for open water – modification for ice**
- **Open water model tests**
  - Calm water performance
  - Seakeeping and stationkeeping
- **Ice tank tests**
  - Ice performance
  - Manoeuvring
  - DP force
- **Calculations**
  - Calm water performance
  - Parametric study
  - Operability in Arctic waters

**CIV Arctic**

- A1 (71.06,23.64)
- A2 (71.23,22.21)
  A2 is close to the Goliat field
- A3 (72.79,24.41)
- A4 (74.65,25.55)
- A5 (76.36,26.87)
- A6 (77.92,28.40)
  A6 is close to the Olga field
- Hammerfest
  Norway
- Halten Bank
- Norskehavet
- B1 (70.73N,16.91E)
- B2 (69.50N,13.02E)
- B3 (67.99N,10.12E)
- B4 (66.65N,08.46E)
- B5 (65.01N,07.00E)
- Nordsjøen

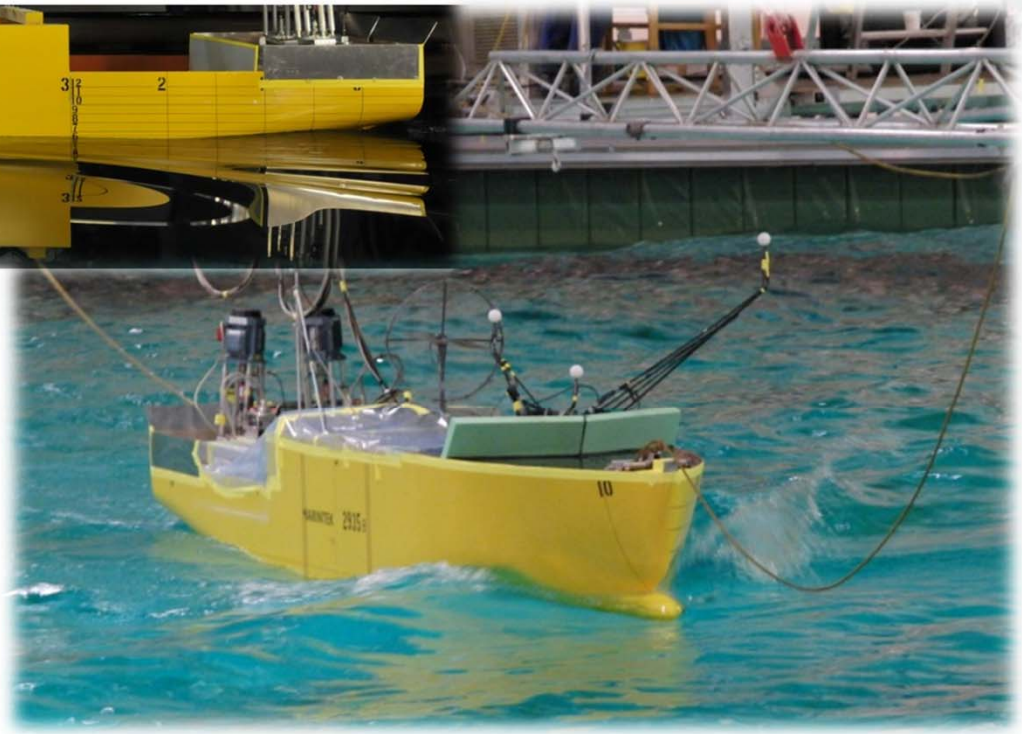


# Open water model tests in MARINTEK



Open water model tests

- Calm water performance
- Seakeeping
- Stationkeeping



## Calculations

Calm water performance
Parametric study
Operability in Arctic waters

# Ice model tests in Aker Arctic ice tank

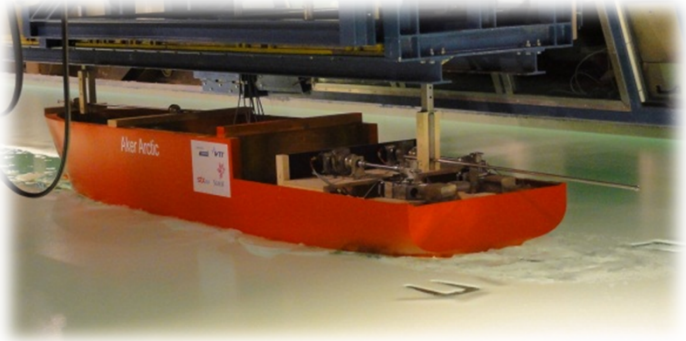
| Ice performance | Manoeuvring | DP force requirement |
|---|---|---|

**Level ice**


**Floe ice**

**Ice ridges**

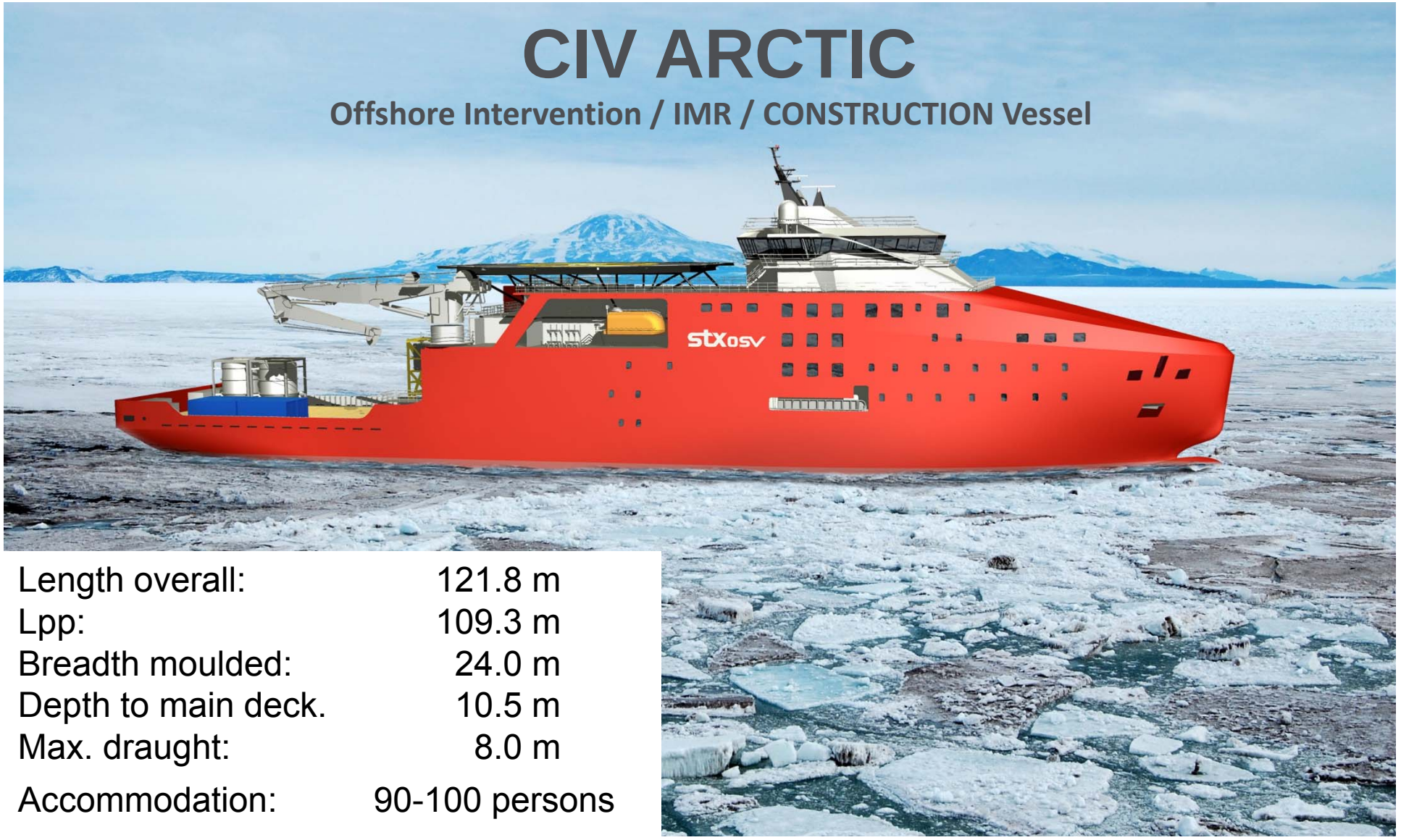

**Stern first**




**Ice flowing along hull / icing in moonpool**

# CIV ARCTIC

## Offshore Intervention / IMR / CONSTRUCTION Vessel



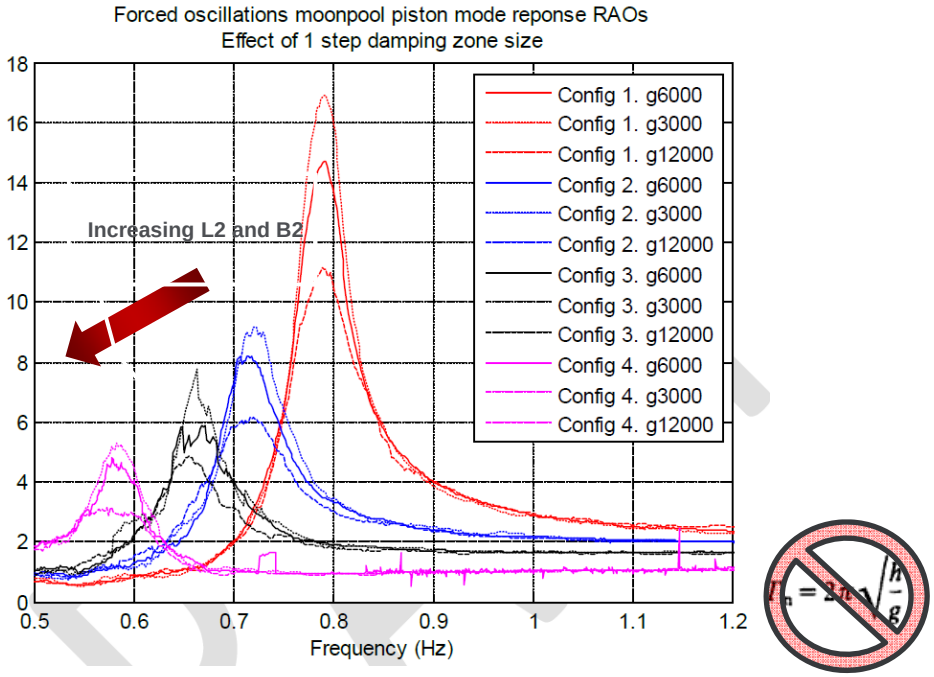

| | |
|---|---|
| Length overall: | 121.8 m |
| Lpp: | 109.3 m |
| Breadth moulded: | 24.0 m |
| Depth to main deck. | 10.5 m |
| Max. draught: | 8.0 m |
| Accommodation: | 90-100 persons |

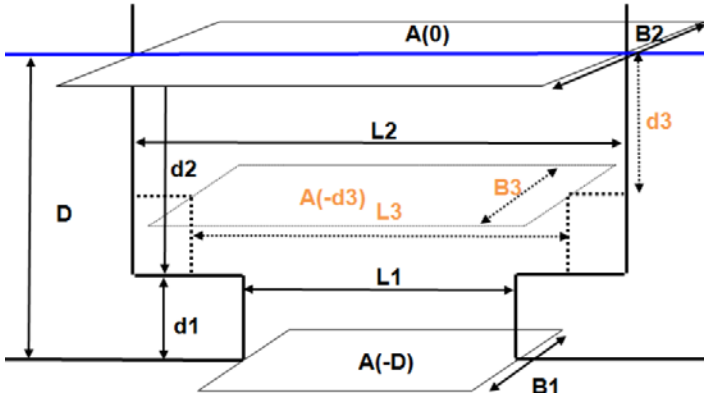
# Moonpool optimization project

- 14 mill. NOK budget, NFR supported
- 3 year duration
- Project partners DOF Management & Marintek
- Litterature study
- Numerical calculations
- 2D & 3D model tests of local moonpool features
- Model tests of vessels with moonpools in waves

# Moonpool damping zone

Changing size and layout of the damping zone influences both response level and the response natural period. Figure shows the effect of changing L2 and B2 with constant L1 and B1.



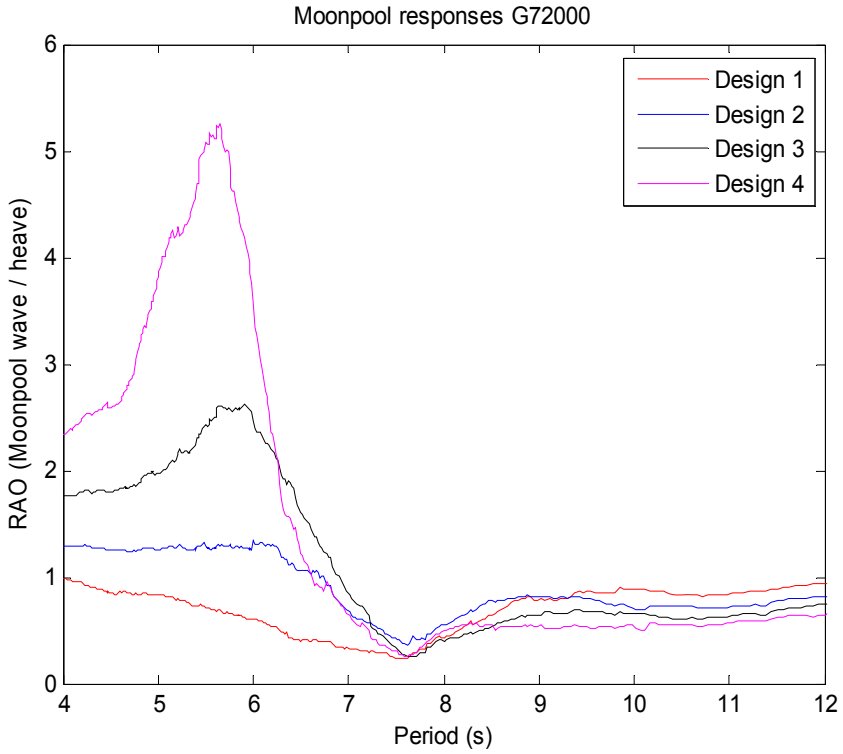



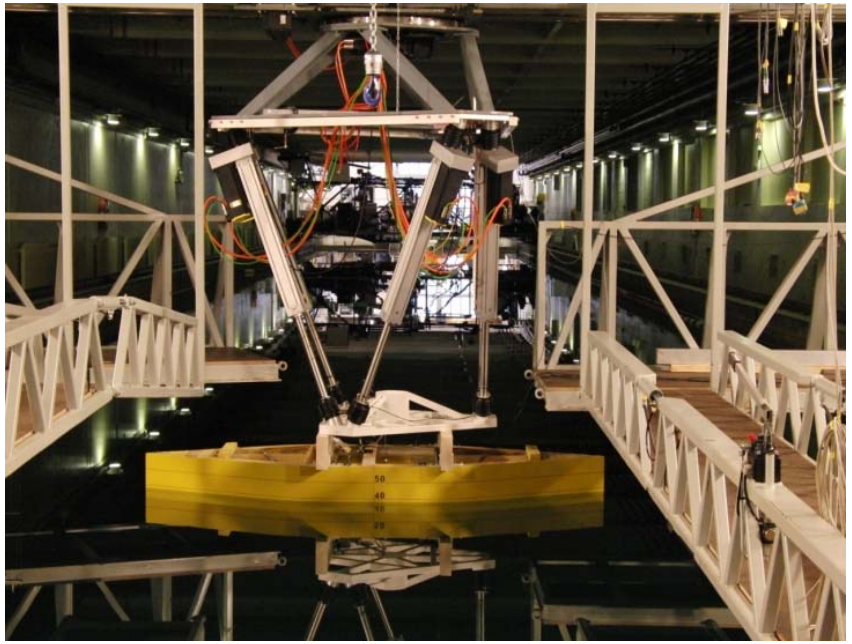

$$T_0 = \frac{2\pi}{\sqrt{g}} \sqrt{\int_{-D}^{0} \frac{A(0)}{A(z)} dz + \frac{A(0)}{A(-D)} \cdot \kappa \sqrt{A(-D)}} \quad [s]$$

By using the formula for natural period of moonpool piston mode response in DNV rp. 103 (formula 3.5.4.6) we got good estimates when including the volume from damping zone / cofferdam and comparing with the measured data.

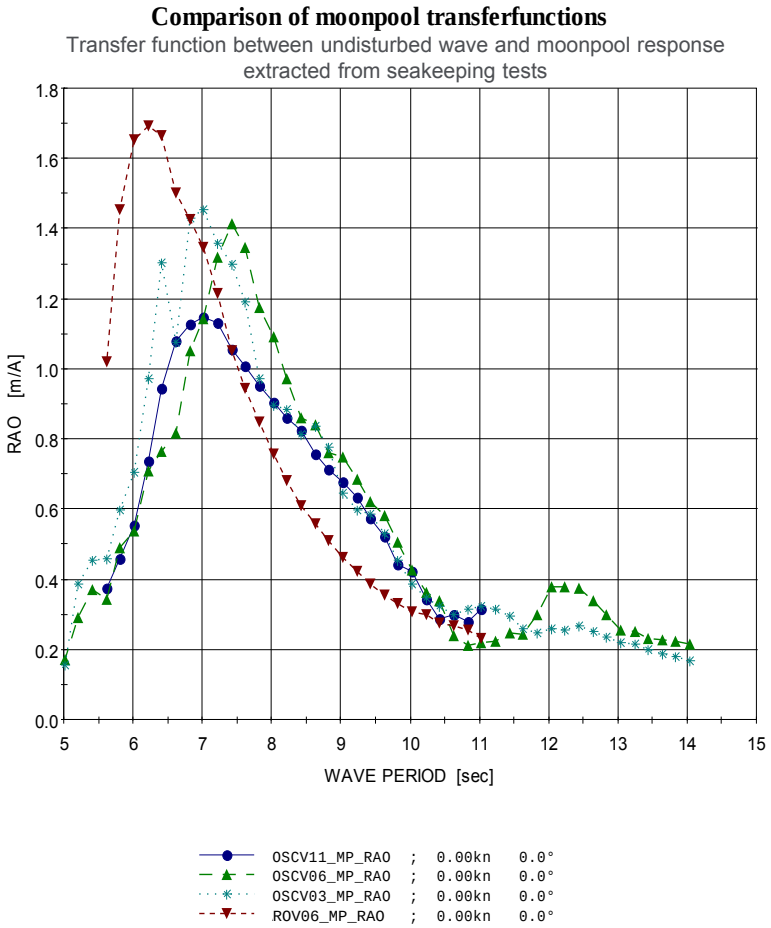
# Moonpool local design

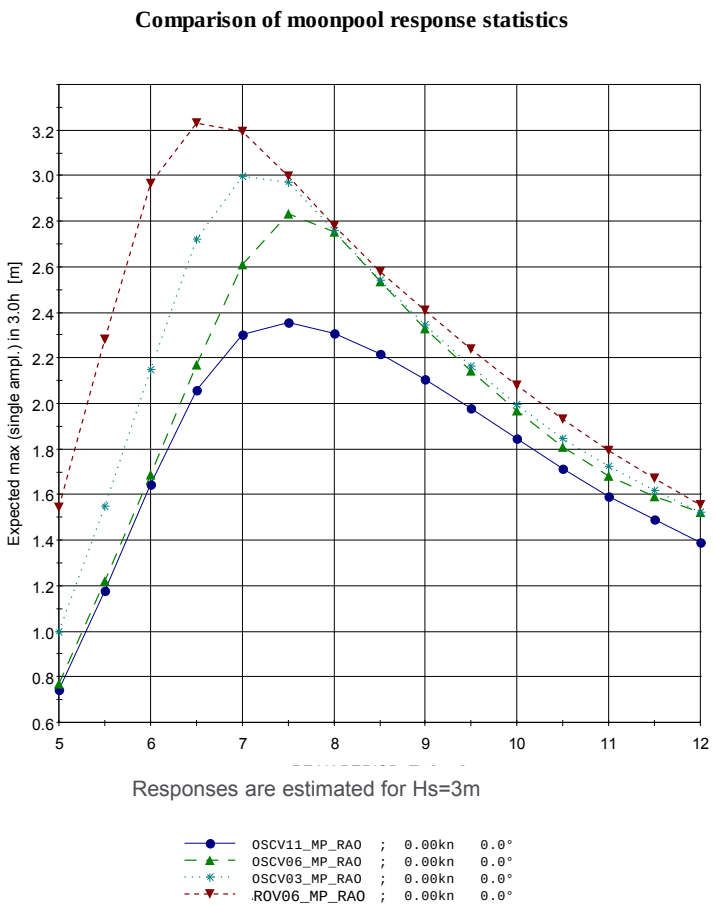
- Broadband heave excitation
- Moonpool response / heave - transferfuntion



# Moonpool response varying with moonpool design




Comparing moonpool piston-mode water responses is forward (ROV) moonpools for similar vessels