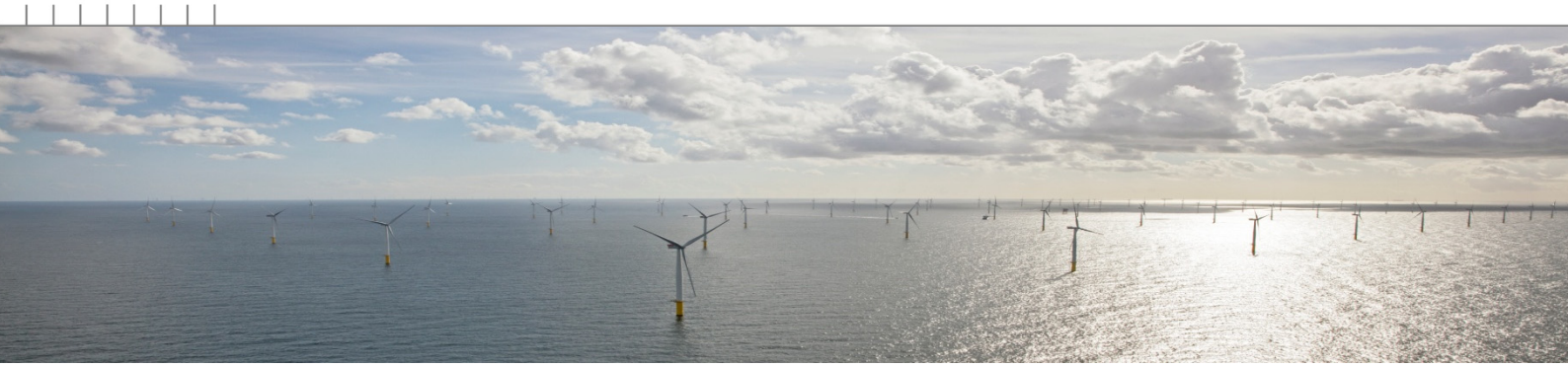
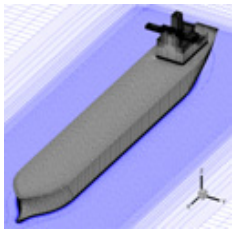
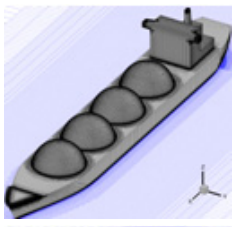


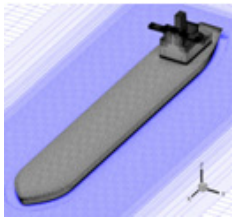
# CoCoS JIP, Coefficients for Concept Studies

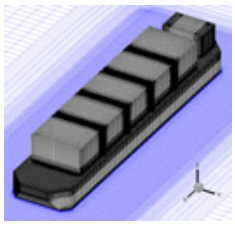
Easy accessible, complete and reliable Wind, Wave and Current Load Coefficients

CoCoS
Coefficients for Concept Studies









## Background

The availability of accurate wind, wave and current coefficients is important in concept studies like dynamic mooring analysis or offloading feasibility. It can be a challenge to find a reliable and complete set of coefficients, especially in an early project stage when much is unknown and budgets are low. On the other hand, the reliability of a concept study is highly dependent on the reliability of the input.

Existing databases are often incomplete, for example offering wind and current loads without wave loads, with coefficients for only one loading condition or lacking a clear description of the geometry and reference areas. Also the availability of modern-day hull shapes is limited.

The oil and gas industry is challenged to save costs when starting up new projects. The present JIP proposal aims to deliver a complete and consistent database for generic hull designs that can be used directly in the conceptual stage. This allows performing reliable hydrodynamic analysis at low starting cost. Furthermore, at the early design stage line plans of vessels are often unavailable or confidential. In that situation this database can serve as a starting point with consistent coefficients and clear reference.

## Objective

The objective of this JIP is to build and deliver a reliable database of wind, wave and current load coefficients for modern day generic ship designs. The database will be documented in a detailed way including the coefficients, hull shape drawings, drafts and reference. A simple tool will be delivered to visualize and compare the database coefficients. Some basic functions like a mean heading analysis and motion RMS based on frequency domain will be added to the tool to give each concept study a head start.

Some results are presented below.

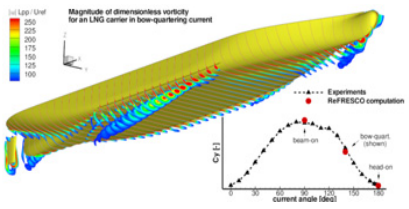



*Figure 1: Current loads on LNG carrier, flow visualization by means of vorticity distribution for 135 degrees current direction and comparison of CFD results to model test results, see [4].*

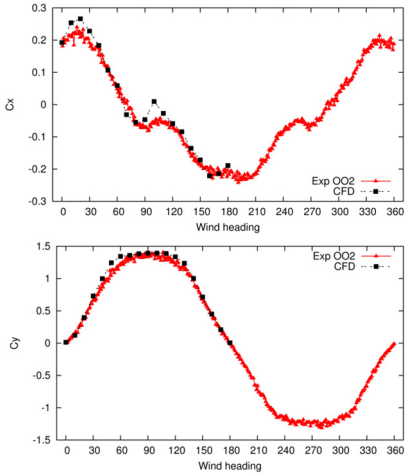



*Figure 2: Resuls for wind loads on shuttle tanker, comparing CFD results to wind tunnel results, see [5].*

**Previous work**

MARIN has been involved in many projects that include the assessment of wind, wave and current loads. With MARIN's CFD code ReFRESCO the wind and current loads have been obtained accurately for a number of cases including:

- Current loads on offshore constructions such as semi-submersibles, TLP's, LNG carriers, shuttle tankers and offshore supply vessels. Recent results include shallow water current loads [4], Side-by-side current loads [6].
- Wind loads shuttle tankers, LNG carriers and offshore supply vessels.

## Method

In recent years the CFD capabilities to determine the wind and current loads have been improved significantly and nowadays CFD is being used as an efficient and accurate design tool. Within the Current Affairs JIP [3] and WindLoad JIP tools and guidelines have been developed to assist in the assessment of these loads in different design stages. CFD and model-scale experiments were compared and good agreement between the two was obtained. Extensive verification and validation procedures are followed as shown in [1] and [2] to give confidence in the CFD results. As a result CFD is a reliable and cost effective source for wind and current coefficients in early design studies in combination with wave loads from standard diffraction analysis.

## Scope of work

The size of the database will be dependent on the number of participants and will grow each time a new participant joins. For example, for *ten* (10) participants a typical scope is given below:

LNGC's

- 135,000 $m^3$ Spherical
- 220,000 $m^3$ Spherical
- 220,000 $m^3$ Membrame
- 267,000 $m^3$ Membrame

Tankers

- VLCC
- Shuttle tanker
- Aframax

Barge shaped hulls

- FLNG Cylindrical bow (L/B = 7)
- FLNG Straight bow (L/B = 7)
- FPSO Cylindrical bow (L/B = 5)
- FPSO Straight bow (L/B = 5)

With each floater loaded and ballasted. The scope will be discussed in the kick-off meeting and depends on the number of participants and their specific wishes.

## Project deliverables

The most important deliverables of this project will be:

- A data base with wind, wave and current load coefficients for various drafts and generic vessel designs.
- A summary report with a clear description of the floaters.
- Guidelines on how to use the database including scaling possibilities.
- A simple visualization tool for the database with added functions as mean heading analysis and motion RMS for a given environment.

## Organisation

The CoCoS JIP will be conducted as a 2-year Joint Industry Project in close co-operation with oil companies, operators, yards and marine system suppliers. MARIN will act as JIP manager and sign participation agreements with all members. All participating companies will be represented in the JIP Steering Group with meetings during the FPSO week every 6 months. Presentations, reports and other relevant info will be posted on the confidential project website.

## Participation fee

The participation fee is 15.000 Euro. A late participation fee of 125% applies for participants joining the JIP after July 1st, 2016. Late participation fees will be used to grow the database.

## References


[1] Koop, A., Bereznitski, A.; "Model-Scale and Full-Scale CFD Calculations for Current Loads on Semi-Submersibles", OMAE2011-49204, Rotterdam, the Netherlands, 2011.

[2] Koop, A., Klaij, C., Vaz, G.; "Viscous-Flow Calculations for Model and Full-Scale Current Loads on Typical Offshore Structures", MARINE 2011, IV International Conference on Computational Methods in Marine Engineering Computational Methods in Applied Sciences Volume 29, 2013, pp 3-29.

[3] Vaz, G., Waals, O., Ottens, H. Fathi, F., LeSouef, T., Kiu, K.; "Current Affairs: Model tests, Semi-Empirical Predictions and CFD Computations for Current Coefficients of Semi-Submersibles", OMAE2009-80216, Hawaii, USA, 2009.

[4] Koop, A.; "Shallow Water Current Loads on a LNG Carrier Using CFD", OMAE 2015-41275, St. John's, Canada, 2015.

[5] Koop, A., Rossin, R., Vaz, G.; "Predicting Wind Loads on Typical Offshore Vessels using CFD", OMAE 2012-83449, Rio de Janeiro, Brazil, 2012.

[6] Koop, A.; "Predicting Side-by-Side Current Loads using CFD for Typical Offshore Vessels", OMAE 2016 (to be published).



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