DDU Model in the Max Operational Drilling Condition

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Dynamic Positioning:

Drilling for the Future

In the last year, MARIN has been involved in the model testing of several dynamically positioned vessels. In most cases the objective of these tests is to assess the DP capabilities for both intact and failure cases. For some projects it is also important to investigate the relative motions with respect to other floaters that may be in close proximity of the DP vessel. Two major projects for drilling vessels are presented here.

Olaf Waals
Jorrit Jan Serraris
o.waals@marin.nl

In June 2007, Friede & Goldman commissioned MARIN to perform model tests on the drilling vessel "DDU" that will be built and operated by CNOOC. The vessel is a four-column stabilised, semi-submersible and has been designed by Friede & Goldman.

Models of the semi-submersible with eight azimuth thrusters, a pre-laid mooring system and a simplified horizontal mooring were prepared for the hydrodynamic tests. The purpose of the hydrodynamic model tests was to collect information about dynamic characteristics of the semi-submersible unit and its behaviour in real operating conditions. In addition the tests would examine its station-keeping abilities which are vital to ensure safe and effective operations.

In addition to the DP tests, the relative wave motions were measured at five different positions around the platform and a survival storm wave condition was generated to check the available air gap. The platform motion response was checked with regular wave and irregular wave tests and this was in agreement with the results from diffraction analysis.

For the DP control, the computer program RUNSIM was used. This utilises Kalman filtering to determine the low frequency excursions and a PID controller to determine the required feedback forces to be generated by the eight thrusters. The forbidden angles were included in the algorithm and current load, thruster interaction and full environment tests were performed.

The current loads and thruster interaction effects were tested in captive towing tests. In these tests the thrust losses due to the interactions of the thruster wake with the hull are quantified. This allows the designers of the DP system to include forbidden zones for the azimuth angles of the thruster.

Transocean drillship tests

In February 2008, model tests on a deepwater drillship have been performed at MARIN. Ordered by Transocean and constructed by Hyundai Heavy Industries, the drillship's special features are its moonpool and dynamic positioning system, which consists of six azimuth thrusters.

For a drillship two operational profiles are of primary importance: station-keeping in DP mode during drilling operations and sailing in transit condition. These two operational profiles require contradicting thrust characteristics of the propellers. In DP operations maximum thrust has to be delivered by the propellers at low inflow velocities, while in sailing conditions thrust has to be delivered at an inflow velocity equal to the ship's speed.

A typical thrust characteristic of a DP thruster shows a high thrust coefficient at low inflow velocities and a relatively steep decrease of the thrust coefficient for increasing inflow velocity. The thrust characteristic of a propeller designed for sailing conditions on the other hand, shows a less high thrust coefficient at low inflow velocities and a less steep decrease of the thrust coefficient with increasing inflow velocity.

For many ship types, one of the two operation profiles is of primary importance and the thrusters are designed for that specific condition. However, for drillships the two operation profiles are of equal importance and a compromise in thruster design has to be found. A design with an optimum of about six to eight knots results in a balanced performance for both conditions.

MARIN assisted in the thruster design and determined the thruster interaction in a model basin. These tests resulted in the appropriate forbidden zones for the specific thruster configuration in this design.

Overview of the Drilling Vessel Model

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