Title: **Utilization of Numerical Simulation Tools for Aiding Decisions about DP Operations**

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Abstract

This paper focus on the real applications of numerical simulation tools for aiding and supporting decisions concerning offshore DP operations.

The time domain simulator TPN (Numerical Offshore Tank) contains mathematical models for multi-vessel dynamics, mooring and risers lines, DP system, propellers and environmental forces. It has been developed in a long-term research project with cooperation between the oil state company Petrobras and University of São Paulo (USP). Several validations of the numerical code have been done by means of model scale experiments and real scale measurements.

The first case is related to a recently DP converted crane-barge, that also operates for pipe-laying. Two complex operations of offshore crane installation of large equipments in moored or fixed platforms have been extensively studied in the numerical simulator. Different environmental conditions, failures and relative positions between the barge and the platform were considered. Operational parameters were evaluated, including crane lines tension, DP power consumption, oscillation of the equipments, and relative motions. The results were used for defining the maximum wave condition for a safe operation, the best relative positioning and the required auxiliary cables for reducing the motion of the equipments.

The second case is related to a DP drilling vessel operating under failure conditions. A real DP failure situation was fully reproduced in the numerical simulator, and similar results observed in the real-scale monitoring could be obtained in the simulator. That incident required the disconnection of the drilling riser, because the heading (among some others causes) was limited by the angle of the auxiliary lines (kill and choke) of the drilling system. After that, the simulator is able to be used for evaluating a more adequate angle for the BOP, considering the typical environmental conditions of the Brazilian offshore oil fields and common variations of wind conditions in those fields.

Finally, the simulator was used as an important tool for defining new DP lay-outs for oil shuttle tankers concerning dynamic behavior, holding capacity after thruster failure and downtime for offloading operations. For the downtime analysis, a procedure for defining a comprehensive set of environmental conditions was established. Some time-domain simulations with automated post-

processing and a complete set of static calculation were then used for defining the allowable conditions and the downtime. The downtime could be used as an important design criteria for DP layout, optimal FPSO heading and definition of operational safety zone.

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