

## Experimental and Numerical Assessment of Mini TLP for Benign Environments

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### ABSTRACT

The response behaviour of a mini TLP under West Africa type of environmental conditions has been investigated numerically and by scale model experiments. The experiments were conducted at two different scales, 1:62 and 1:40, and at two different water depths. The results do not indicate any systematic differences originating from the choice of scale. However, significant statistical variability can be observed, both in experiments and computations. The general agreement between theory and experiments appears to be quite good.

### INTRODUCTION

The paper contains a detailed comparison of experimental and numerical results for the horizontal motion response of a mini TLP under environmental conditions typical for West Africa. Under this type of mild environment, the mini TLP offers many technical advantages, including surface intervention and dry trees. The particular research work reported in the present paper has been carried out as joint venture between Statoil and Offshore Technology Research Center (OTRC). The scale model experiments were conducted at the OTRC Model Basin, while the computations, for the most part, were carried out at Statoil Research Centre.

During the experiments, two different scale models were employed; one at a scale of 1:62, and the second one at a scale of 1:40. The first choice of scale, which appears to be quite adequate, corresponds to a water depth of 1000 m, whereas the 1:40 model has been tested at a water depth of approximately 650 m. Due to the large water depth, testing at a reasonable scale, which is necessary in order to obtain robust results, is generally rather difficult. However, in the present situation the authors

have had the good fortune to be able to test the structure with full length tethers. Correct modelling precludes testing with truncated tethers, unless one wants to engage in complicated feedback systems for controlling the stiffness of the structure. More precisely, with mass, draught and pretension preset to meet given specifications, the horizontal restoring force is determined by geometry alone (the ratio of pretension to tether length), and cannot be adjusted independently.

Model testing of deep water structures in benign environments meets with other particular challenges. Wave action is relatively moderate as compared to wind and current loading. In general, about 50-60% of the offset may be due to current<sup>1</sup>, 30-40% to wind and the remaining 10% to waves. This means that one has to be cautious and meticulously accurate in setting the current, something which for any wave basin is a tedious and difficult task. In practice one has to accept fairly large spatial and temporal fluctuations in the current field due to formation of large vortices. This matter is discussed further in subsequent chapters.

### TLP DATA AND ASSUMPTIONS

The main characteristics of the mini TLP is given below in table 1. To simplify the test set up and to avoid incurring unnecessary costs, the number of tethers were reduced from 8 to 4 (one in each corner), while the 12 risers were replaced by a single "equivalent" riser at the center of the well bay area. The "equivalent" single riser was modelled according to Froude scaling, i.e. added mass is scaled correctly, whereas the drag forces on the risers will be underestimated.

The model basin at OTRC has dimensions 45.7 x 30.5 x 5.8 m<sup>3</sup> (length x width x depth). A 16.7 m deep pit resides in the middle of the basin, facilitating testing of deep water TLPs with

<sup>1</sup>Including current loads on tethers/risers.