

Novel Composite Riser Development for Offshore Deep Water Applications & Hydrodynamics

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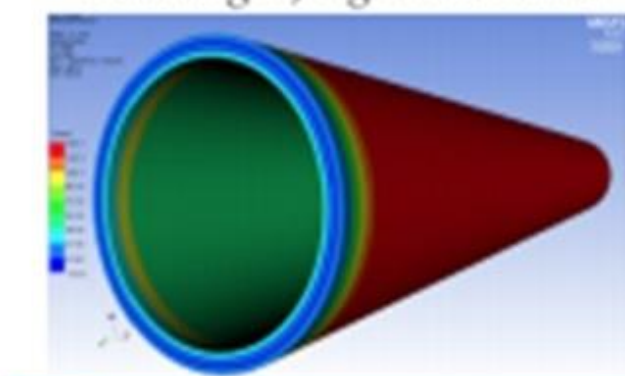
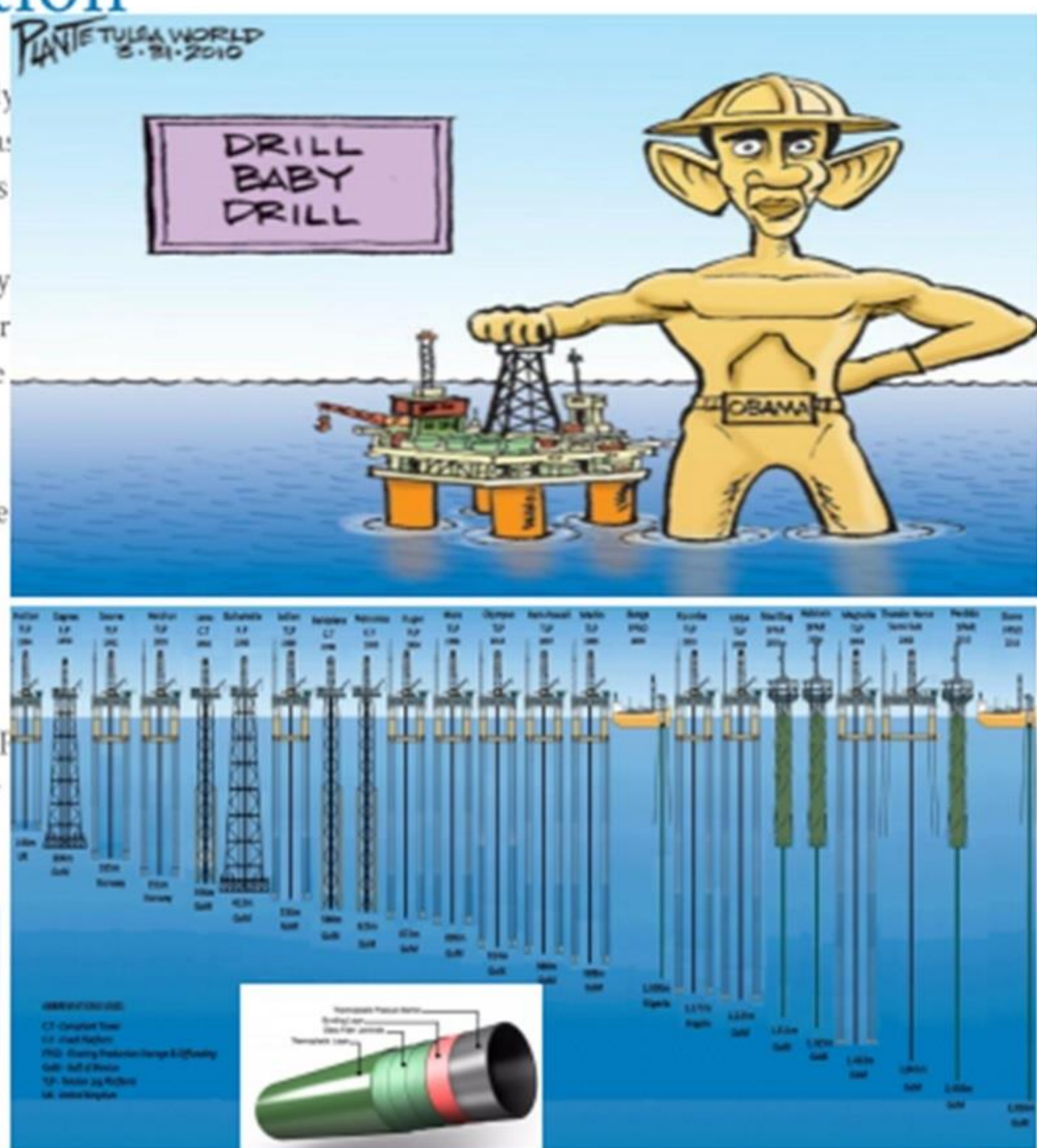
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1 Introduction

The use of pipes in oil explorations dates back to early Chinese using bamboo sticks as conduits to transport oil. Thus the study on Composite Marine riser behaviour is very important. Structures in water behave differently from those structures not in water. Composite materials offer a range of benefits that could be harnessed to improve riser technology. Although composite risers were first deployed in deep waters in 2002 in the UK on Hutton TL platform as a composite riser joint, there are still some challenges, e.g. standards.



2 Method & Configurations

Types of Risers

- Flexible Risers
- Rigid Risers
- Hybrid Risers
- Composite Risers

Riser Classification:

- Drilling Risers
- Production Risers

Offshore Hose Classification:

- Floating Hoses
- Submarine Hoses

Description of composite risers

- Oil and gas recovery
- Transport of fluid
- Flow Application

Mooring configuration of paired column semi-submersible platform

Mooring configuration of CALM buoy with submarine hoses

3 Results: Local Design

Free Hanging Catenary

Lazy Wave

Steep Wave

Lazy-S

Steep-S

Chinese-lantern

End-Fittings

Riser Configurations

Some Offshore Structures considered

Buckling results

Fatigue of flexible riser

Optimisation summary

4 Results: Global Design & Experiment

Effect of hose bending moment

Effect of hose tension

Effect of hose curvature

Effect of RAOs

5 Conclusion & Publications

- Strength of submarine hoses in Chinese-lantern configuration from hydrodynamic loads on CALM buoy, *Ocean Engineering*, Volume 171, 1 January 2019, Pages 429–442; Authors: Chiemela Victor Amaechi, Facheng Wang, Xiaonan Hou, Jianqiao Ye <https://doi.org/10.1016/j.oceaneng.2018.11.010>
- Composite risers for deep waters using a numerical modelling approach, *Composite Structures*, Volume 210, 15 February 2019, Pages 486–499; Authors: Chiemela Victor Amaechi, Nathaniel Gillett, Agbomerie Charles Odjie, Xiaonan Hou, Jianqiao Ye <https://doi.org/10.1016/j.compstruct.2018.11.057>
- Microscale intrinsic properties of hybrid unidirectional/woven composite laminates: Part I experimental tests; *Composite Structures*, Volume 262, 15 April 2021, 113369; Authors: Junjie Ye, Heng Cai, Lu Liu, Zhi Zhai, Chiemela Victor Amaechi, Yongkun Wang, Lei Wan Dongmin Yang, Xuefeng Chen, Jianqiao Ye <https://doi.org/10.1016/j.compstruct.2020.113369>
- Sensitivity Studies on Offshore Submarine Hoses on CALM Buoy with Comparisons for Chinese-lantern and Lazy-S Configuration; *Paper OMAE2019-96755*, Authors: Amaechi, C. V., Wang, F., Hou, X. & Ye, J., 10/06/2019 38th International Conference on Ocean, Offshore and Arctic Engineering, ASME OMAE, Glasgow, Scotland, UK
- Economic Aspects of Fiber Reinforced Polymer Composite Recycling; *Encyclopedia of Renewable and Sustainable Materials*, Choudhury, I. & Hashmi, S. (eds.) Elsevier, Vol. 1. p. 377–397 21 p., Authors: Amaechi, C. V., Odjie, A. C., Drok, E. O. & Ye, J., 20/01/2020
- Recycling of Renewable Composite Materials in the Offshore Industry; *Reference Module in Materials Science and Materials Engineering*, Elsevier Authors: Amaechi, C. V., Agbomerie, C. O., Satayo, A., Wang, F., Hou, X. & Ye, J., 1/09/2019
- Local and Global Design of Composite Risers on Truss SPAR Platform in Deep waters. *MECHCOMP2019 5th International Conference on Mechanics of Composites - Instituto Superior Técnico, Lisbon, Portugal, Lisbon, Portugal*; Duration: 1/07/2019 → 4/07/2019 Authors: Amaechi, C. V., Ye, J., Hou, X., Gillett, N., Odjie, A., Wang, F., ...
- A numerical modeling approach of composite risers for deep waters; *ICCS20 20th International Conference on Composite Structures*; Ferreira, A. J. M., Larbi, W., Deu, J.-F., Tomabene, F. & Fantuzzi, N. (eds.) Società Editrice Esculapio, p. 262–263 2 p. (Structural and Computational Mechanics Book Series); Authors: Amaechi, Chiemela Victor & Ye, Jianqiao, 8/09/2017
- Liner wrinkling and mechanical behaviour offshore composite bonded hoses (OBCH) using local design pressure for burst and collapse. Submitted to *Composites Part A*
- Finite element model on the global and local design of offshore composite bonded hoses for operational reeling conditions. Submitted to *Engineering Structures* 2021
- Parametric investigation on marine drilling riser of a Paired Column Semisubmersible considering tensioner stroke analysis, recoil analysis and disconnect in deep water waves. Submitted to *Renewable and Sustainable Energy Reviews* 2021
- Experimental and numerical investigation on the dynamic behaviour of submarine hoses attached to CALM buoy in lazy-S configuration. Submitted to *Ren. Energy*
- Experimental and numerical studies of CALM buoy hydrodynamic responses on the effect of buoy geometries and buoy skirts under wave loadings. *Ocean Engineering*
- A novel coupling model on CALM buoy submarine hoses with sensitivity studies and comparisons for Lazy-S and Chinese-lantern configurations under irregular waves. Submitted to *Renewable and Sustainable Energy Reviews* 2021
- Tailored local design of deep water composite risers under burst, collapse, tension and combined loadings with parametric investigations. *Composites Part B* 2021
- High amplitude flow analysis of marine risers array system and column array of Paired Column Semisubmersible by varying wave angles based on fluid-structure interaction. Submitted to *Renewable Energy Journal*. 2021
- A novel tensioner model applied on global response of marine riser recoil and disconnect. Submitted to *Ocean Engineering Journal*. 2021

Optimisation case 1

Design using different liners

Offshore Hose with Floats

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