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TECHNOLOGY BULLETIN

# The FHSB Semi

## An Innovative High Performance Solution for Dry Tree Applications in Harsh Environment

### Customer Benefits

- FHSB Semi is an innovative technology, which enables semisubmersibles to be suitable for dry tree applications in harsh environments
- It allows direct vertical access to wells from semisubmersibles
- It also serves as a cost effective alternative to spars in ultra-deepwater dry tree applications
- It offers larger payload capacity compared to spars
- It offers a larger deck area, which has its safety advantages in operation
- It offers safer and cheaper installation operations compared to spars

## Introduction

Top Tensioned Risers (TTRs) have their advantages in allowing direct vertical access to production wells. However, due to tensioner stroke limitation, the use of TTRs requires a floating system that provides minimal heave response. Both spars and tension leg platforms (TLPs) have been recognized by their favorable response and therefore their suitability to support TTRs.

In water-depths beyond about 1,500m (5,000ft), the TLP tendon design becomes increasingly challenging, leaving spars as the only feasible solution in ultra-deepwater. However, the single column configuration of spars can support limited deck area, and poses restrictions on the maximum payload. Spars also require hull upending and topside integration through heavy lifts offshore. These operations bring their own cost and risk disadvantages.

Conventional semisubmersibles provide significantly larger deck area, are less sensitive to payload and do not require offshore integration. However, due to their large heave response, semisubmersibles are not suitable for dry tree applications.

The FHSB Semi is an innovative technology, which enables semisubmersibles to be suitable for dry tree applications in harsh environments. It maintains the advantages of conventional semisubmersibles, and offers favorable motion characteristics of spars to enable the use of TTRs.

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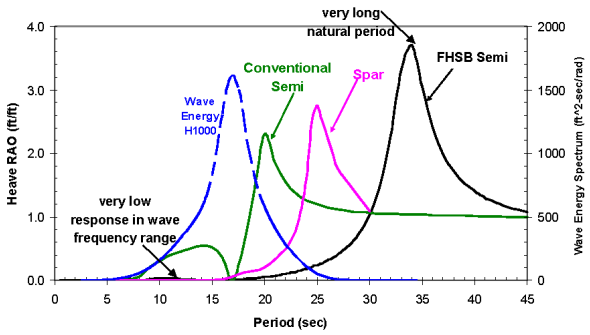
## Enabling Technology

The FHSB Semi hull resembles conventional semisubmersible hull configurations with four columns connected by a ring pontoon at the keel level, but is enhanced with a robust low-tech feature, namely, free-hanging solid ballast tank (SBT). The SBT is connected to the FHSB Semi hull through four groups of chains.

The FHSB Semi provides heave response comparable or better than spar floaters through the added mass on the surface and the in water weight of the SBT.

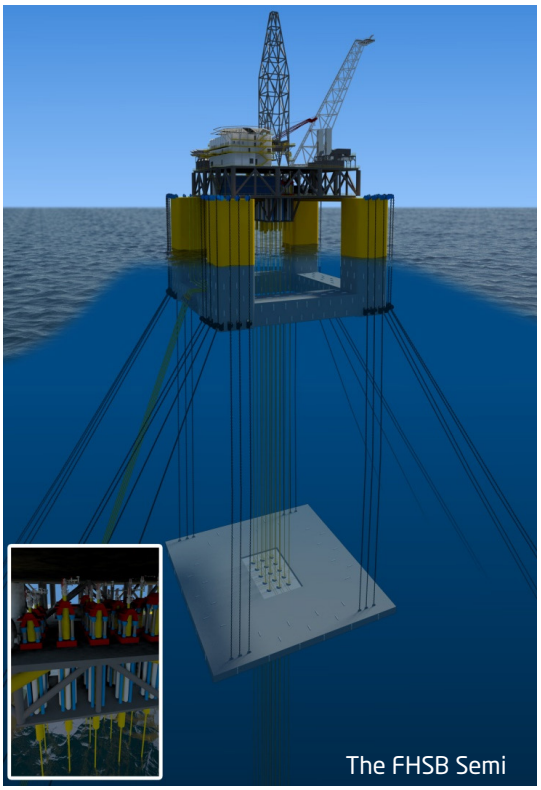
The chain connection between the semi hull and the SBT facilitates transportation and installation, and solves fatigue issues that are often associated with the use of rigid connection.




The FHSB Semi versus other Floaters

| | TLP | Spar | FHSB |
|---|---|---|---|
| Fabrication | ○ | ○ | ○ |
| Quayside Integration | ○ | ● | ○ |
| Transportation vertically | ○ | ● | ○ |
| Available deck area | ○ | ◐ | ○ |
| Heave response for TTR application | ○ | ○ | ○ |
| Tensioner type suitability for harsh environment | ○ | ◐ | ○ |
| Suitability for weak soil | ◐ | ○ | ○ |
| Suitability for ultra-deepwater dry tree application WD > 5000 ft | ● | ○ | ○ |

○ No Major Issues
◐ Major issues that can probably be resolved with additional engineering analysis and cost
● Major issues that may not have a foreseeable solution.


The FHSB Semi

The tensioner stroke for the FHSB Semi in harsh environment is within the design limits for existing RAM-type tensioner technology

A case study was recently conducted, where the FHSB Semi was designed for similar conditions as those in the Holstein Spar (Gulf of Mexico). The comparison indicated that the FHSB Semi provides an equivalent efficiency (payload to hull and deck steel), while providing significantly better heave response. All TTR equipment was also found to be within capacity of the existing equipment used with spars.

### Publications


OMAE 2013-10922: High Performance Semisubmersible Design for Dry Tree Applications in Harsh Environment
Alaa Mansour, Dhiraj Kumar

OMAE 2013-10468: TTR System Design for FHSB Semi
Jim Yu, Alaa Mansour, Alan Yu, Ricardo Zuccolo

OMAE 2009-79303: FHS Semi; A Semisubmersible Design for Dry Tree Applications
Alaa Mansour

DOT Asia/Pacific 2008-175: New Semisubmersible Design for Ultra-Deepwater Dry Tree Application
Alaa Mansour, Chunfa Wu



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