INTECSEA
WorleyParsons Group

TECHNOLOGY BULLETIN

Hybrid Cellular Tendon

Hybrid cellular tendons provide a more economical solution for large TLPs, and enable TLPs in ultra-deepwater.

Economical solution

Provides a more economical solution for large TLPs

Large production hub

Enables TLPs for large production hubs with wet and dry trees and drilling capability

Ultra deepwater

Enables TLPs in ultra-deepwater (>5500ft) field development

Increases safety

Increases structural redundancy compared to conventional tendons

Background

The cellular tendon design was introduced to the industry in 2013. The design enables the tension leg platform (TLP) application in ultra-deepwater as well as for large topsides such as production hubs. Cellular tendon was designed for onshore fabrication and assembly of the tendons followed by tendon wet-tow to installation site. This design provides specific advantages for increased local content, more economical offshore installation and reduction in the number of tendons required. However, the design also had some limitations in applicability, such as availability of assembly yard with open water access and reasonable distance of installation site to shore.

In order to accommodate conventional fabrication and installation methods, an alternative design of the cellular tendon has been developed, called the hybrid cellular tendon.

While preserving the advantages of the cellular tendon, the hybrid cellular tendon employs the same transportation and installation methods as conventional tendons with minimal deviation from existing qualified components. The hybrid cellular tendon can be fabricated in any of the existing tendon fabrication yards and installed by any of the current tendon installation vessels. It provides reduced cost for large TLPs by reducing the number of tendons and connectors, and enables TLPs for ultra-deepwaters.

Advantages

Provides a practical tendon solution

- Sufficient axial stiffness, can be increased if required
- Weld-able wall thickness
- In-water weight suitable for Installation
- Similar construction and installation to existing industry practices

Enhances structural redundancy in each tendon

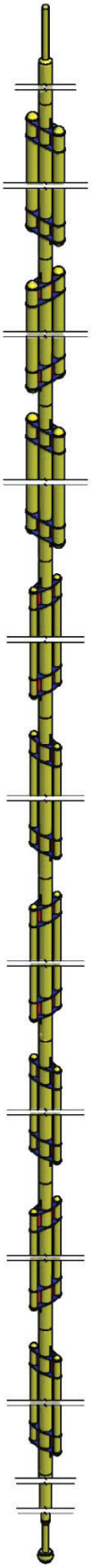
- Damage to a single string in the bundle does not easily propagate to or impair the other strings
- Low dynamic stress in the stiffness controlled section design thus more strength and fatigue margins

Provides potential superior economics comparing to conventional tendon

- Cost saving from reduction of tendon specialty components (connectors, piles, and buoyancy modules, and tendon porches)
- Cost saving from installation time

Achieve ALARP (As Low as Reasonably Possible) risk management

- Identical to conventional tendons in global design, analysis, and installation
- Using mature and field proven tendon components



FPU Major Characteristics	TLP*	SPAR	SEMI
Suitability for ultra-deepwater depth > 1,600 meters	No	Yes	Yes
Suitability for deepwater depth 1000~ 1,600m and large/heavy topside weight > 30,000 Tonne	Limited	No	Yes
Suitability for dry tree	Yes	Yes	No
Suitability for HP and /or Sour service large size SCR	Yes	Limited	Limited

*TLP with conventional tendon

Table 1 Limitations of current non-ship shaped floaters

	Conventional Tendon	Hybrid Cellular Tendon
Tendon Global Design	Top connector, TTS, MBS, TBS, and Bottom connector	Top connector, TTS, MBS, TBS, and Bottom connector
MBS Design	Singe pipe, OD stepped as needed	Multiple parallel pipes in one MBS
Connections Between MBS	Mechanical couplings	Mechanical couplings
Construction	All segments fabricated on-shore	All segments fabricated on-shore
Transportation	On barge to site	On barge to site
Installation	Segments assembled on HLV, and latch to foundation	Segments assembled on HLV, and latch to foundation
Pre-installed stage	Supported by TSB(s)	Supported by TSB(s)

Table 2 Comparison of hybrid cellular tendon and conventional tendon

For more information, contact:
Jim Yu - Department Manager, Tendon & Riser Systems
Jim.Yu@intecsea.com or technology@intecsea.com