

**INTECSEA**

WorleyParsons Group

# Marine Risers

## Capability & Experience





# Capability Overview

INTECSEA now offers, in a single company, industry leading capability for all marine riser systems including top-tensioned risers (TTRs) for direct vertical wells, steel catenary risers, drilling risers, flexible risers and hybrid riser systems.

With more than 100 SCRs designed and 52 detail designed and installed, INTECSEA is the industry leader by a large margin, assuring customers proactive application of lessons learned and innovative engineering to make cost-effective SCRs viable. These benchmark SCRs include the deepest oil risers and largest and heaviest gas risers.

We have also designed TTRs for direct vertical wells for TLP and SPARS, with 68 risers installed and in operation. Associated system engineering, analysis, material specification, procurement, component design, and testing and installation are incorporated in those riser projects.

Since 1998, INTECSEA has been supporting drilling operations with operators and drilling contractors by providing drilling riser design and analysis, optimizing drilling operability, and selecting and qualifying equipment. Project water depths from 100 ft. to 12,000 ft. are in regions from the Arctic North to the high seas in Western Australia.

INTECSEA is an industry pioneer in hybrid riser tower engineering. Early work started in the late 1980s in relatively shallow water using single leg risers for work over, and recent FEED projects are in over 5000 ft. of water depth for bundled and single leg riser towers. INTECSEA was the EPCM company for a prototype riser tower system installed in the Gulf of Mexico (GoM) and decommissioned during late 2000s and early 2010s.

## Services

- Technical and economic studies
- Preliminary and detailed design
- HP/HT riser engineering
- Wet insulated riser technology
- Riser pipe-in-pipe technology
- Deepwater riser technology
- Repair technology
- Materials and NDT technology
- ECA analysis
- Systems engineering and analysis
- Procurement
- Component design
- Testing and installation
- Maintenance management and operations assistance

## Industry leading capability for all marine riser systems

INTECSEA's capability in Marine Riser Systems has consistently led the industry as functional requirements have expanded with applications in increasing water depths and frontier areas. INTECSEA's industry experience has included design and analysis, beginning with concept selection and development, through fabrication and installation.



# Engineering Services

## Top Tensioned Risers (TTR)

INTECSEA has performed both preliminary and detailed designs for TTRs for floating vessels in the Gulf of Mexico, offshore West Africa, Southeast Asia and Australia. The TTR system was developed to meet the functional requirements for production, water injection and gas lift wells. The engineering work includes single casing or dual casing TTR design. The design experience includes all forms of TTRs with actively controlled tensioners, passive tensioners, as well as risers directly connected to the floating platforms deck.

## Steel Catenary Risers (SCRs)

INTECSEA is a leader in the industry in Steel Catenary Riser (SCR) technology. More than 50 INTECSEA-designed SCRs are in service in various projects in the Gulf of Mexico (GoM), West Africa and Southeast Asia. These include SCRs of various sizes (from six to 24 inches in diameter) hung off from all types of floating platforms (FPSOs, Semisubmersibles, TLPs and Spars) in water depths ranging from 1,500 to 7,150 feet. In addition, FEED engineering has been done for a number of additional projects with SCRs and Lazy Wave Steel Risers in challenging fatigue environments such as Western Australia. Several projects include sour service and the use of clad pipe segments, as well as both types of top terminations (flexible joints and TSJs). INTECSEA's SCR capability covers all aspects of SCR design, manufacture, component specification, procurement, installation engineering and management, and commissioning.

## Flexible Risers

INTECSEA has been responsible for the design of flexible pipe risers and management of flexible riser deliveries for various projects worldwide. INTECSEA designed flexible risers are installed on both fixed and floating production systems in shallow water developments, and with various types (FPSO, FPU, SEMI, TLPs and SPARS) of floating production facilities and as dynamic jumpers on hybrid riser towers in deepwater developments. Complex configurations of the flexible risers, such as steep or lazy wave, or steep or lazy S, double catenary configurations, were designed and analyzed to meet specific operational and environmental conditions. INTECSEA also developed FLEXAS, a highly sophisticated in-house FEA tool package for analyzing global-local-multilayer interactions of flexible risers.

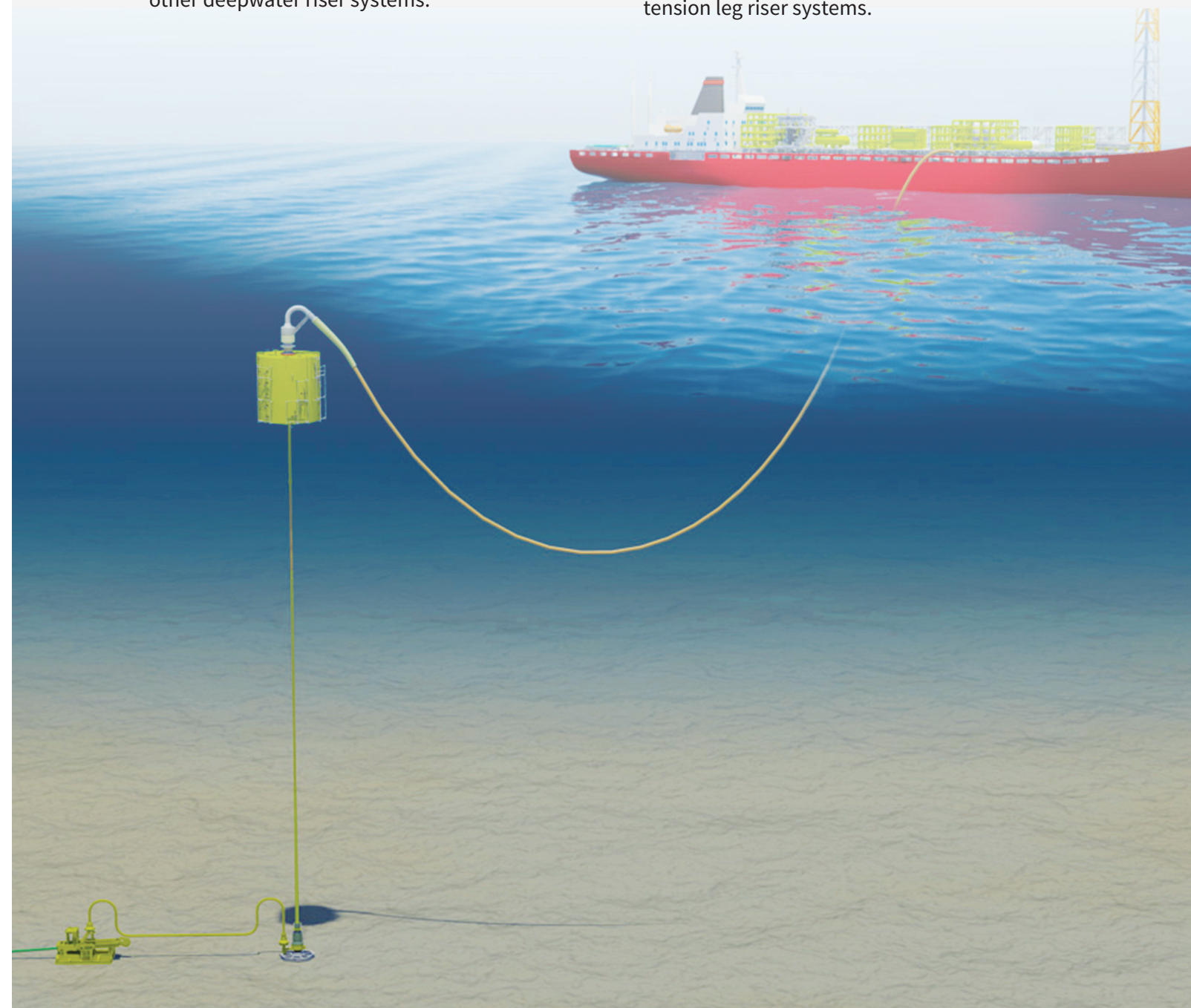
## Drilling Risers

INTECSEA's experience in the area of drilling riser engineering and floating drilling operations for exploratory and development drilling covers a wide range of services for riser design and operability studies, and for riser hardware manufacturing support/management representing the drilling operator. Floating drilling, whether on DP or moored vessels, is fast moving into ultra-deep and Arctic waters to find hydrocarbons. INTECSEA has experience in water depths ranging from 100 ft. to 12,000 ft., having worked on more than 24 drilling riser projects including both conventional subsea BOP and high pressure surface BOP. Our firm commitment to safety in this field is reflected in zero incidents.

## Hybrid Risers

The hybrid riser towers engineered by INTECSEA provide technically feasible and commercially viable solutions for operators in production and well completions. The provided benefits include: allowance for onshore fabrication of riser towers, high thermal performance, highly compliant riser systems, compact riser designs with minimal congestion on the seabed and in the water column, and minimum load transfer through riser porches when compared with other deepwater riser systems.

INTECSEA has performed conceptual design commonly combined with our *Select* functions for the overall field developments, FEED and detail engineering. INTECSEA's riser tower experience covers all types of riser tower installed, such as single leg single pipe riser, single leg pipe-in-pipe riser and bundled riser tower. Furthermore, INTECSEA has been enabling new technologies and adding more functions into other types of riser towers, such as the direct access for drilling and well completion, compliant vertical access risers and tension leg riser systems.





# Project Experience



## Tubular Bells

**CUSTOMER** Hess and Williams  
**LOCATION** Gulf of Mexico, USA

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The Tubular Bells (TB) discovery in the Lauri Basin in the Mississippi Canyon region of the Gulf of Mexico is in about 4,200 ft. of water and lies approximately 150 miles southeast of New Orleans, LA.

INTECSEA provided Pre-FEED, FEED, detail design as well as construction and installation management of high pressure production, water injection and oil and gas export SCR systems for this Spar-based field development. In an earlier phase of the same project, SCR FEED designs were also developed by INTECSEA for a semi-based development.

INTECSEA obtained an in-depth, direct comparison of the two types of host floating platforms for SCR applications. This project has further enhanced INTECSEA's thorough understanding of the SCR design and performance on various types of host floating facilities.



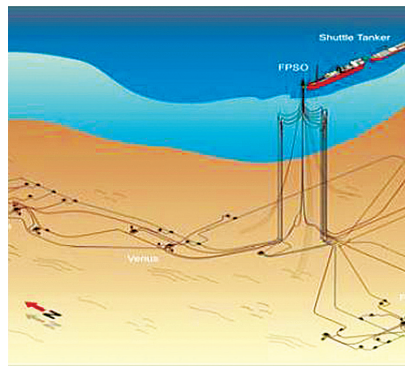
## West Seno Field Development

**CUSTOMER** Chevron  
**LOCATION** Makassar Strait, Indonesia

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West Seno TLP-A is the first application of several design features provided by INTECSEA, including: Fixed (i.e. non-stroking) tensioners for the production risers, a drilling / production riser design in which 90 percent of the length uses threaded and coupled connections, tender-supported drilling operations on a tension-leg platform and titanium stress joint connecting to foundation conductor.

INTECSEA performed the detail engineering of the TLP and was responsible for delivery of the 28 top tensioned well risers. The design of the platform includes dry trees and accommodates tender assisted drilling. The design of riser systems for floating production systems in mild oceanographic and meteorological environments, such as the Makassar Strait, takes advantage of the environment by using innovations such as “fixed” tensioners and threaded and coupled tubular connections. The savings from more conventional designs for more severe environments are significant.



## Hybrid Riser Towers for Various Field Developments

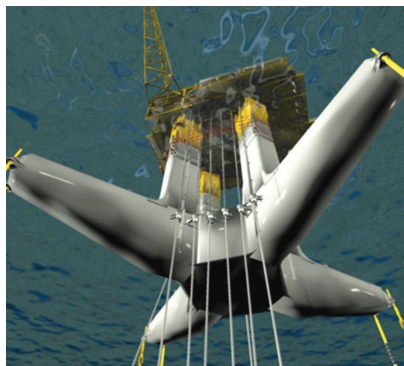
**CUSTOMER** Various Operators and Contractors  
**LOCATION** West Africa and Malaysia

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In the deep waters offshore Angola, INTECSEA managed the third party detailed design of nine single line hybrid tower risers in Block 31 at 6,500 ft. Package engineering responsibility for key components included Rotolatch units and a tension mooring system.

INTECSEA also performed comprehensive pre-EPCI bid engineering services for the four hybrid riser towers used for pipe-in-pipe production and gas lifting, water injection and gas export located offshore Nigeria at a water depth of 5,200 ft. Additionally, INTECSEA performed FEED services for a pipe-in-pipe production riser system planned to be used in a deepwater field offshore Malaysia.

INTECSEA performed comprehensive FEED services for the hybrid riser planned for use in this deepwater field offshore Angola. Both the conventional and innovative designs of the tower structures were developed to maximize the local fabrication content.



## Marco Polo TLP TTRs and SCRs

**CUSTOMER** Anadarko and Gulf Terra Energy Partnership  
**LOCATION** Gulf of Mexico, USA

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The Marco Polo TLP TTRs and SCRs connect the Marco Polo TLP at Green Canyon Block 608 in 4,300 ft. water depth to existing reservoirs below the TLP and pipeline infrastructure. At the time of project, the water depth was the industry record for the TLP and the riser systems.

During the execution stage—as part of the overall engineering for the TLP—INTECSEA designed, analyzed and managed delivery of six (6) dual casing top tensioned risers (TTR) and provided installation support. INTECSEA also performed detail engineering for the 18-/20-inch diameter gas export pipeline and multiple tieback flowline risers.

During the operation stage, INTECSEA provided the TLP and riser life extension engineering to extend TLP service life to 45 years and solutions of converting production TTR to other riser functions.



## Mardi Gras Transportation System

**CUSTOMER** BP  
**LOCATION** Gulf of Mexico, USA

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INTECSEA delivered the *Select*, define and execute phases for oil and gas export SCR systems associated with the Mardi Gras transportation system for Mad Dog, Thunder Horse, Holstein and Atlantis projects.

SCR sizes ranged from 16 to 28 inches with water depths ranging from 4,500 ft. to 7,140 ft. During the *Select* phase, key issues relating to SCR performance—such as dynamic response, VIV motions and fatigue performance—were identified. These design aspects have been successfully engineered during the preliminary and detailed design phases.

INTECSEA also provided support to procurement and construction activities.



## MEPS

**CUSTOMER** Anadarko  
**LOCATION** Gulf of Mexico, USA and Ghana

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The MEPS was developed for marginal field exploration and production. INTECSEA made the operator's idea a reality by providing project services from concept definition, Pre-FEED, FEED, detail engineering, construction management and Installation, support decommissioning and post-commissioning studies on the system components.

The MEPS include direct access riser systems, near surface tree and BOP, off-loading lines, drilling, completion and workover vessels. A prototype MEPS was installed in GoM at a water depth of 3,300 ft. within INTECSEA's EPCM services.

Comprehensive basin model tests were performed according to INTECSEA-prepared specs and the test results were incorporated in the design.

# Success Through Insight