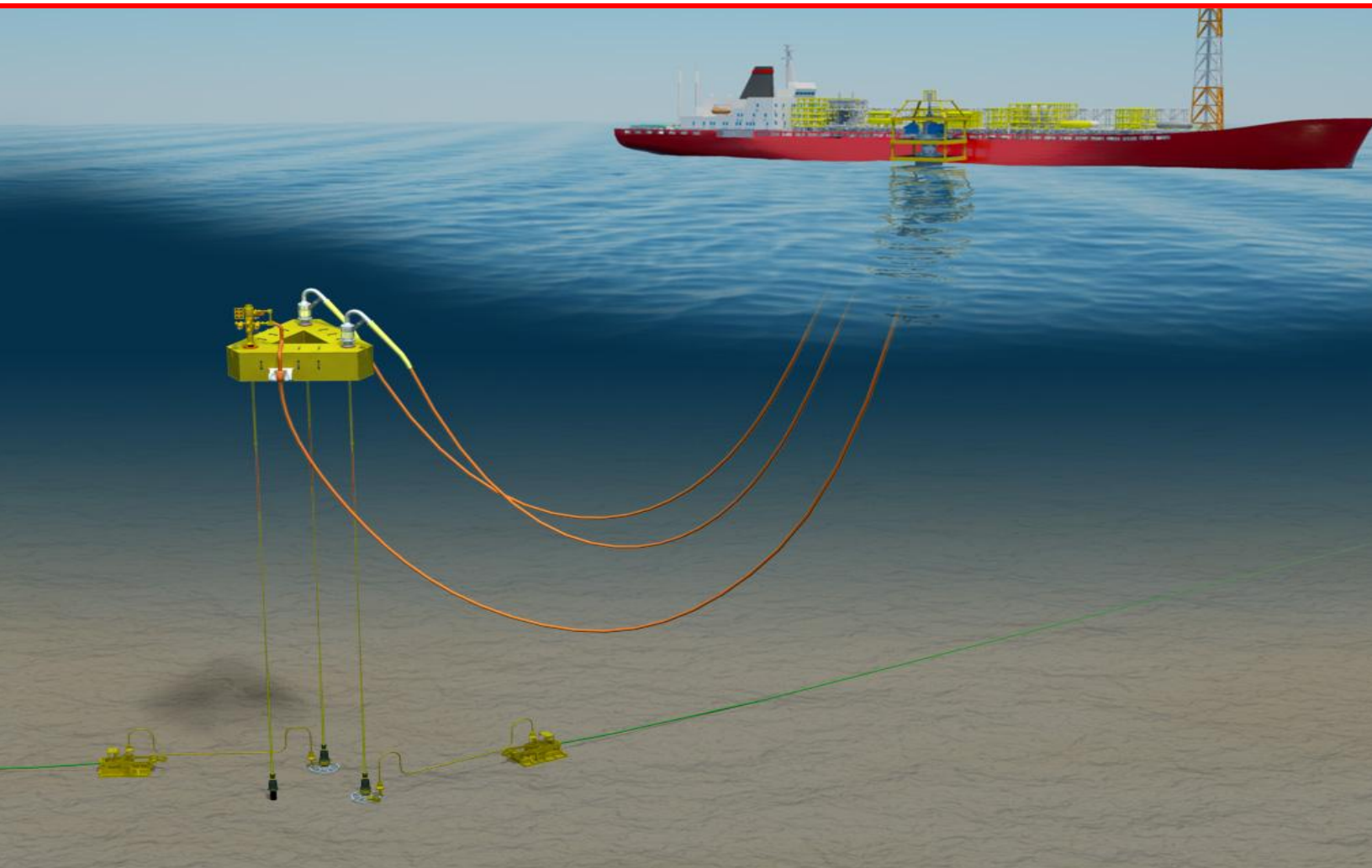
INTECSEA
WorleyParsons Group

# Marine Risers

## Capability and Experience

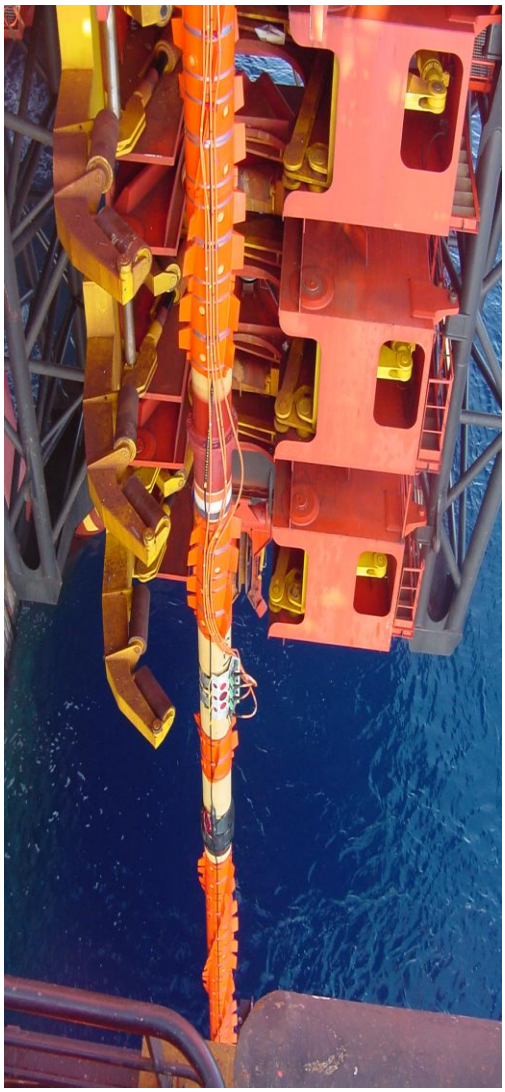


# Capability Overview

INTECSEA offers industry leading capability for all marine production riser systems including direct vertical access risers, steel catenary risers (SCRs), flexible risers and hybrid riser systems.

With over 100 SCRs designed and and installed, INTECSEA is the industry leader by a large margin, thus assuring clients a 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.

INTECSEA has also designed more direct vertical access risers than any other company with 68 risers installed and in operation. Associated system engineering, analysis, material specification, procurement, component design, testing and installation are incorporated in all riser projects.



**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

2,200m

Water depth and beyond

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# Engineering Services

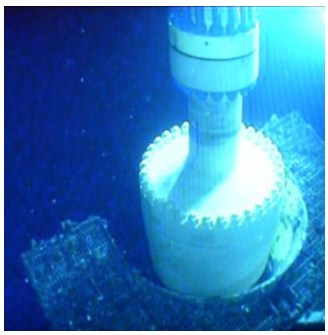
## Conventional Steel Pipe Risers

INTECSEA has performed detailed designs for numerous conventional pipeline riser systems for the Gulf of Mexico and Southeast Asia offshore platform applications. The key consideration for high temperature risers is pipeline expansion at the base of the riser and the resulting bending stresses in the riser. This can be accommodated by various methods, including pipeline expansion loops and offsets, and also by cold springing risers during installation such that the pipeline expansion relieves the cold springing effects.

## Flexible Pipe Riser

INTECSEA has been responsible for the design and installation of flexible pipe risers for various projects worldwide. Flexible risers are used with both fixed and floating production systems in shallow water developments, and with floating production facilities (FPU, SEMI, TLPs and SPARs) in deepwater developments. For shallow water applications, flexible risers may be used in steep or lazy wave or steep or lazy S configurations. For deepwater applications, flexible risers are used primarily in a free hanging catenary configuration.

## Steel Catenary Risers (SCRs)



INTECSEA has performed both preliminary and detailed designs for SCR systems within the Gulf of Mexico, Southeast Asia and offshore West Africa. The use of SCRs is becoming more common for deepwater riser applications. INTECSEA has performed a general study and project detail designs for the use of 6-inch to 24-inch SCRs in water depths ranging from 1,500 ft in harsh environment areas such as North Western Australia to 7,000 ft in GOM. The design experience includes uninsulated, insulated, and pipe-in-pipe SCRs. The major issues to be considered in the design of SCRs are pipeline stresses, buckling under extreme loads at seabed touch down zone, fatigue analyses, and end-fitting designs.

## 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 production, water injection, and gas lifting functional requirements. 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.

## Hybrid Risers

There are many hybrid riser configurations such as compliant vertical access risers, hybrid riser towers, SCRs with submerged buoyant air can support and flexible jumpers to the surface, and tension leg riser systems. The tension leg riser configuration consists of a support buoy tethered to a piled foundation on the seabed with SCRs extending down from the buoy to riser bases on the seabed with flexible pipe jumpers from the near surface support buoy to the floating vessel.

Potential benefits of hybrid riser towers in deepwater projects include; allowance for onshore fabrication and installation of the riser tower, high thermal performance, highly compliant riser system, 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.

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# Project Experience

**Project:** **Tubular Bells**
**Client:** **Hess**
**Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

**Gulf of Mexico, USA**

Design of production, water injection and oil and gas export

SCR systems.

A discovery in the Lauri Basin in the Mississippi Canyon region of the GOM, ie Tubular Bells (TB), provides the opportunity for development as a third party host option in the DEFINE stage. The TB field is in around 4,800 feet of water and lies approximately 150 miles southeast of New Orleans, LA. Tubular Bells field is located within approximately 30 miles of the Thunder Horse development and closer to Devil's Tower, Ursa and Mars.

INTECSEA is currently doing the detail designs of SCRs in the execute phase for Hess and Williams.

**Project:** **Prince Field Development**
**Client:** **El Paso Energy Partners**
**Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

**Gulf of Mexico, USA**

Overall Project Management, Invitation To Bid Preparation, bid clarification activities, detail engineering, manufacturing, and installation support for TTRs

The El Paso Energy Prince Field Development (formally known as Sunday Silence) is located in Ewing Bank Blocks 958, 959, 1002 and 1003 offshore Louisiana in 1,490 ft water depth. After a six-week bid period, bids were received and evaluated by INTECSEA during June 1999. The recommended surface facility was the MODEC International Moses Mini-TLP. The TLP was intended to support a topsides process facility. A contract was awarded to MODEC International in July 1999 for fabrication of the Moses TLP hull, tendons and production riser. Fabrication began at the AMFELS Fabrication Yard in Brownsville, Texas in September 1999. The installation of the floating facility was completed late 2001 with first oil achieved early 2002.


**Project:** **Marco Polo Export Pipelines and SCRs**
**Client:** **Gulf Terra Energy Partnership**
**Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

**Gulf of Mexico, USA**

Route selection, geophysical/geotechnical survey support, detailed design of SCRs and detail engineering, manufacturing, and installation support for TTRs

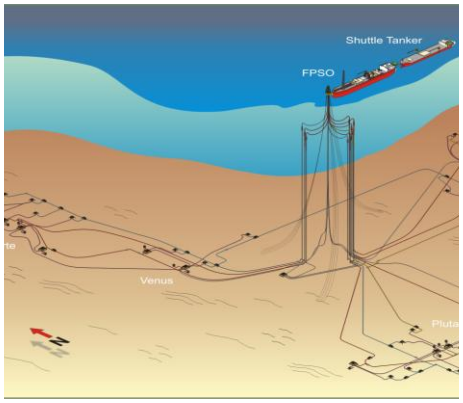
The Marco Polo Oil Export and Gas Export Pipelines and SCRs connect the Marco Polo TLP at Green Canyon Block 608 in approximately 4,300 ft water depth to existing pipeline infrastructure. The 18-/20-inch diameter Gas Export Pipeline is approximately 72 miles long and connects the Marco Polo TLP to a connection point into the Typhoon line at approximately 1,700 ft water depth in Green Canyon Block 236. The 12-/14-inch diameter Oil Export Pipeline is approximately 37 miles long and connects the Marco Polo TLP to a connection point into the Allegheny line at approximately 2,800 ft water depth in Green Canyon Block 164. In-line tees and PLEMs were fabricated by Oil States Industries, pipelines and SCRs were installed by Allseas, tie-in jumper installation as well as SCR hook up was performed by CalDive International. The project was completed by early 2004. The TTR design adopted dual casing concepts. A total of six TTRs are supported by direct action hydra-pneumatic tensioners.

**Project:** **BP Block 31 Hybrid Towers**
**Client:** **Heerema Marine Contractors**
**Phases:** IDENTIFY EVALUATE DEFINE EXECUTE OPERATE

**Angola**

Detailed design of single line hybrid tower

INTECSEA managed third party detailed design of nine single line hybrid tower risers in 2000m water depth offshore Angola. Package engineering responsibility for key components included rotolatch units and tension mooring system.




**Project:** **Mardi Gras Transportation System**
**Client:** **BP**
**Phases:** IDENTIFY EVALUATE DEFINE EXECUTE OPERATE

**Gulf of Mexico, USA**

Select, define and execute phases for oil and gas export SCR systems

INTECSEA did 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-inch to 28-inch with water depths in the range of 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. Provision of technical support to procurement and construction activities.

**Project:** **Okume Complex Development**
**Client:** **Amerada Hess Equatorial Guinea**
**Phases:** IDENTIFY EVALUATE DEFINE EXECUTE OPERATE

**Nova Scotia, Canada**

Front End Engineering Design (FEED) for pipelines, risers and subsea facilities, detailed design and engineering of the pipelines, risers and subsea facilities

Amerada Hess Equatorial Guinea is developing hydrocarbon reserves in the Okume Complex field, offshore Equatorial Guinea, West Africa. The development includes two separate mini-TLPs at the Okume/Ebano and Oveng reservoirs and three shallow water wellhead platforms at Elon. A single Central Processing Facility at Elon will handle crude from all four fields. Pipelines in the field will consist of gas lift, water injection, low-pressure gas and produced liquids that vary in diameter from 4.5 to 10.75-inches. Production from the field will be tied back to the existing Sendje Ceiba FPSO via a new 12-inch oil export pipeline system. Flexible risers will be installed at the two mini-TLPs and the FPSO. Tie-in spools will be used to connect the pipelines and the rigid risers on the wellhead platforms. The development also includes a Pipeline End Termination (PLET), a subsea control umbilical and a subsea power cable, and provide 23 TTRs.

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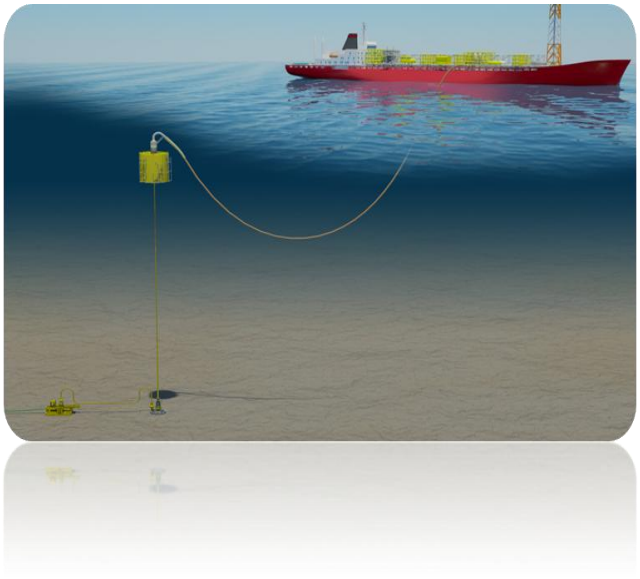
# About INTECSEA

(click here to learn more about INTECSEA)

For more than 25 years, INTECSEA has provided frontier technology leadership for the energy industry's most challenging offshore field development and pipeline projects.

INTECSEA was formed in 1984 and provides design for floating systems, risers, pipelines, and subsea engineering and construction management services within the global WorleyParsons Group. INTECSEA has established operating offices in Houston, Kuala Lumpur, Singapore, Delft, Rio de Janeiro, Jakarta, Angola, Cairo, St. John's, Perth, Melbourne, and London. (see all WorleyParsons' locations)

INTECSEA's major areas of expertise include deepwater subsea and floating production systems, marine pipeline and riser systems, Arctic pipelines, marine terminal systems, and Arctic structures. Additional areas of expertise include flow assurance and operability, marine surveys, marine operations, and offshore equipment design.



***A History of Innovation and Benchmark Achievements…***

SUBSEA

- Deepest Subsea Production
- Longest Oil Tieback
- Longest Gas Tieback
- First Subsea Allocation Flow Meters
- First 15,000 psi Subsea Trees
- First Electrically Heated Pipe-in-Pipe Flowlines
- Deepest Multiphase Subsea Pumps
- First Super Duplex Umbilical
- First Diaphragm Chemical Injection System

**RISERS**

- **First Pipe-in-Pipe Steel Catenary Riser**
- **First Reeled Steel Catenary Riser**
- **The Deepest Steel Catenary Risers**
- **Most Shallow Catenary Riser**
- **Largest Diameter Flexible SCR Joint**
- **First SCRs on an FPSO**
- **Most Direct Vertical Access Risers**
- **First GOM Free-Standing Riser**

FLOATING SYSTEMS

- Largest FPSO
- Deepest TLP at Time of Installation
- Deepest SPAR at Time of Installation
- Most Installed TLPs
- First Deepwater FPU Operated with a Drilling Tender
- Most Types of Floating Systems

MARINE PIPELINES

- Deepest S-lay Pipeline
- Deepest J-lay Pipeline
- Longest Offshore Pipeline
- First Offshore Arctic Pipeline
- First Arctic Pipeline Leak Detection System
- First Piggable Wyes
- First Arctic Pipeline Bundle

(for more capabilities information click here)

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# Global Reach,
# Local Knowledge,
# Global Solutions

For further information about
our global capability, email
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