Subsea 7 provides riser technology best suited to your field characteristics such as extreme water depth, harsh environmental conditions, host specification and hydrocarbon composition, for deepwater and ultra-deepwater installation.

Key benefits:
- Uniquely adaptable, comprehensive suite of riser solutions
- Able to meet a full range of field characteristics
- Preparing for the future with development of high strength steel and composite materials
- Improved fatigue performance
- Enhanced thermal performance.
Riser systems installed on a worldwide basis by Subsea 7 fall into two categories: those coupled directly to the host facility, and uncoupled systems which in most cases are connected by flexible jumpers.

**Coupled Risers**
- Steel Catenary Risers (SCRs)
- Weight-Distributed SCRs
- Steel Lazy-Wave Risers (SLWRs)
- Flexible riser systems

**Un-coupled Risers**
- Single Hybrid Riser (SHR)
- Grouped Single Line Offset Riser (SLOR)
- Hybrid Riser Tower (HRT)
- Tethered Catenary Riser (TCR)
- Catenary Offset Buoyant Riser Assembly (COBRA)
- Buoy-Supported Risers (BSR)

**Steel Catenary Risers (SCRs)** have been adopted for many field developments and can be installed by all three methods of installation offered by Subsea 7 with J-lay, reel-lay and S-lay. Subsea 7’s widespread experience includes the metallurgical-clad riser for the Shell Bonga field by J-lay (six SCRs each 2km in length) and for the Exxon Mobil Erha field (ten SCRs each approximately 3km in length).

Subsea 7 has also installed SCRs by reel-lay in Brazil and the Gulf of Mexico.

One of the main challenges in any SCR design is the fatigue performance of the weld. Through the application of advanced welding technology, Subsea 7 has developed high-quality SCR welding solutions, especially for metallurgical-clad or lined SCRs.

Through extensive in-house research and development, Subsea 7 has further developed the Weight Distributed SCR concept, which enhances the applicability of SCRs to harsher environments. In this concept, ballast elements are attached at certain sections of the SCR to reduce the stresses around the touchdown point and enhance the fatigue performance of the SCR.

Using the reel-lay vessel Seven Oceans, Subsea 7 installed the first Steel Lazy-Wave Riser (SLWR) in the BC-10 field offshore Brazil at a depth of 1,800m for Shell International. The overall BC-10 scope included fabrication and installation of seven steel catenary lazy-wave risers, totalling approximately 21km.

**Grouped SLOR** is for deepwater applications and based on the proven single-riser concept. Grouped SLOR is an ‘open Bundle’ riser solution developed specifically to optimise the riser/vessel interface, production vessel approaches and access for riser inspection and maintenance. It uses a buoyant truss frame to guide the freestanding risers, constraining all risers to move collectively, and thus eliminating the risk of clashing. The Grouped SLOR has great potential for large deepwater developments, which typically have a complex and congested seabed layout immediately adjacent to the production vessel where there are spatial constraints imposed by mooring lines and vessel offsets.

**Hybrid Riser Towers (HRTs)** are recognised to have significant benefits for deepwater riser applications.

Specific characteristics of the Hyperflow® Hybrid Riser Tower include:
- Custom-designed and built for optimum flow performance and adapted to the specific characteristics of each field development
- For ultra-deepwater flow assurance (pressure, temperature and heat transfer characteristics)
- Highly suitable for remote and hostile environments
- Simplifies field layout with no interference between numerous risers
- Low in-situ fatigue damage
- Additional equipment such as gas lift, separator unit and booster pumps can be incorporated in the vicinity of the riser base.

The first HRT application installed by Subsea 7 was Girassol in Angola for Total in 1998. The field, incorporating three HRTs, has been producing for more than ten years to the specified stringent flow assurance requirements.

The latest Subsea 7 HRT technology is currently being applied to Total's CLOV projects where two HRTs were installed in 2013 in 1450m water depth. Subsea 7 has experience in designing and installing Single Hybrid Riser towers in offshore West Africa by the J-lay method, most recently for the Total CLOV development and previously for ExxonMobil AB15 GG, both in Angola.

The Tethered Catenary Riser (TCR) concept consists of a number of Steel Catenary Risers supported by a subsurface buoy which is tethered to the seabed by a single pipe tendon and anchored by a suction pile. The system has all the advantages of de-coupled riser arrangements: flexible jumpers effectively absorb platform motions, and therefore the rigid risers and tendon have reduced dynamic excitation. The riser system is most suitable for one or two drilling centres.
Riser Technology

Un-coupled Risers continued

The Buoy-Supported Riser (BSR) System was developed and installed by Subsea 7 for the Sapinhoá-Lula NE field development in Brazil.

The BSR concept consists of submerged buoys each weighing approximately 2,000 tonnes installed at approximately 250 metres below sea level and anchored to the seabed by eight tethers, two on each corner of the buoy. The buoy supports 27 steel catenary risers of 3.9km which are connected to the FPSO by non-bonded flexible jumpers. This BSR system absorbs the dynamics from the FPSO, resulting in almost no dynamic stresses on the SCRs.

Since there is very little dynamic response for the SCRs, mechanically-lined pipe can be used for the SCR section, thereby providing a cost-effective solution.

Subsea 7 continues to develop further un-coupled riser concepts designed for harsh environments. A recent example is the Catenary Offset Buoyant Riser Assembly (COBRA), which consists of a catenary riser section with a long, slender buoyancy module on top, which is tethered down to the seabed. Similar to the multi-riser BSR, the top of the catenary riser section is connected to the host by a flexible jumper.

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